GTAA Facilities Systems Engineering Design Standards

Facilities Systems Engineering

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Document Governance
The GTAA reserves the right to amend the content of Engineering Design Standards on a regular basis. When issued, amendments are a valid replacement for any part of this Standard and effective on the date of issue. Refer to the Document Control page for the current version of the document. The current version of the Airport Construction Code is available internally on the GTAA Portal, and externally on corporate website.

Designers, consultants, or engineers relying on information contained in this document must disclose any conflicts, ambiguities, or conflations encountered during use to the GTAA for direction or clarity.

All correspondence concerning or requesting clarification of any information contained in this Code can be directed to the Construction Compliance and Permits Office at constructioncompliance@gtaa.com.

Version History

Version	Date	Changes	Prepared by	Approved by
2.0	2024-03-30	Addition of PMDs, PBBs, APM, Cyber Security Reference, Fueling Systems and Vehicle Charging. Updates throughout.	Various	A. Fallavollita
1.3	2020-03-30	7.1.3.2 – Specified Manufacturers for lighting systems and power distribution equipment	C Parker	F. Chen Naden
1.2	2019-09-25	- page 62 of 115 – 1.3.2.4(3)(e) - MTC phone number noted is outdated … its now 6-work - Diesel generators to be integrated into BMS	C Parker	F. Chen Naden
1.1	2019-09-25		E Lai	F. Chen Naden
1.0	2019-05-06	Final sent to owner to distribute. Published in documentation library	A Schwartz	F. Chen Naden
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0.4	2019-04-17	Recovered B Parmar's changes to Electrical section		F. Chen Naden
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Version	Date	Changes	Prepared by	Approved by
0.1	2019-04-04	Recovered SME changes to Mechanical Section	A Schwartz	F. Chen Naden
0.1	2019-03-25	Added Mechanical document To consolidate 3 documents into 1 document: ▪ GTAA Engineering Design Std Electrical Final v1.0 ▪ GTAA Engineering Design Std Mechanical Final v1.0 ▪ 19-01-31 Engineering Design - Life Safety FINAL JS	A Schwartz	F. Chen Naden

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1. Purpose

The Airport Construction Code is published by the Greater Toronto Airports Authority (GTAA) to provide a comprehensive set of construction compliance requirements in force at Toronto Pearson International Airport (Airport). This code has been prepared to assist GTAA's and Tenants' employees, Consultants, and Contractors with established Airport requirements for planning and constructing Projects involving a variety of Facility types on Airport Lands.

The Construction Compliance and Permits Office (CCPO) represents the principal authority having jurisdiction on behalf of the GTAA and is responsible for regulating compliance by applying this Code for any construction at the Airport. For the purposes of applying this Code, the CCPO is an autonomous entity operating independently of the GTAA. Adherence to this Code and any herein referenced documents is mandatory for all Airport design and Construction initiatives where specific requirements are determined to be relevant to the scope of each Project. Understanding and observing the procedures and requirements outlined in this Code by the initiators will expedite the undertaking of Construction at the Airport.

2. How to use this Standard

This document specifies the compliance requirements to be included and utilized in the designs for the range of Construction Projects encountered at the Airport. This Code also serves as the central information source for other construction related documents originating within the GTAA, and other authorities having jurisdiction which should be applied with the understanding that the latest edition of all documents, codes and standards should be used.

This Code is to be read in conjunction with the National Building Code, National Fire Code, the National Energy Code for buildings, TP312E Aerodrome Standards and Recommended Practices for Airside Areas, and other referenced codes and standards related to specific Project types.

3. Content Summary

3.1 General Information

1. This Design Standard has been developed to establish minimum expectations and requirements for all Mechanical, Life Safety and Electrical Equipment and Systems installed within GTAA Owned, Occupied and Maintained buildings.
2. This Design Standard is based on current Codes and Standards, Industry Best Practices and the GTAA's preferred approach to standardizing design from the perspective of system configuration and performance, operating flexibility and efficiency, maintenance practices and protocols and inventory management.

3.2 Compliance Criteria

1. Full compliance is mandatory on projects involving new construction.
2. Full compliance is mandatory for new installation within projects involving significant renovations.
3. Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of existing infrastructure.
4. Any deviations from the minimum requirements outlined in this Design Standard must be approved by the GTAA Project Manager and GTAA Engineering and Utilities Team.

3.3 Responsibility of the System Designer

1. The System Designer remains responsible for ensuring any proposed design solution is in full compliance with all applicable Codes and Standards in force at the time of the design.
2. Any conflict between applicable Codes and Standards and this Design Standard shall be identified and presented to the GTAA Project Manager, together with proposed measures for addressing the conflict; this exercise shall be completed before the end of the Schematic Design Phase.

3.4 Design Innovation

1. This Design Standard is not intended to preclude or constrain an Innovative Approach to Design. It however remains the responsibility of the Designer to demonstrate that any proposed design innovations are in general compliance with the design intent outlined in this Standard.
2. All proposed Design Innovations shall be tabled for consideration by the GTAA Project Manager GTAA Engineering and Utilities Team before the completion of Schematic Design.

3.5 Reference Documents

- National Building Code
- Ontario Building Code
- Airport Construction Code
- ASHRAE Standards
- American Society of Plumbing Engineers
- Region of Peel By-law for Cross Connection Protection
- LEED Certification – Measurement and Verification.
- GTAA Architectural Design Requirements
- CSA B651-23
- CSA 2651.2-07
- CSA A123.26
- CSA S478
- GTAA Envelope and Roofing Guideline
- GTAA Acoustic and Vibration Standard
- GTAA Lighting Standard

3.6 Acronyms

AHJ	Authority Having Jurisdiction
ATD	Anti-Tampering Device
AWWA	American Water Works Association
BAS	Building Automation Systems. Is the same as BMS
BMS	Building Management System. Is the same as BAS
CACF	Central Alarm and Control Facility
CCPO	Construction Compliance and Permits Office
ESA	Electrical Safety Authority
F and ES or F&ES	GTAA Fire and Emergency Services
FACP	Fire Alarm Control Panel

FCC	Fire Connection Cabinet
FESTI	Fire & Emergency Service Training Institute
FM	Factory Mutual
GTAA	Greater Toronto Airports Authority
IOCC	Integrated Operations Control Centre
ITM	Information Technology Management
LSNMS	Life Safety Network Monitoring System
MTC	Maintenance Technical Centre
MF and ES	Mississauga Fire and Emergency Services
NBC	National Building Code
NFC	National Fire Code
NFPA	National Fire Protection Association
OnyxWorks	Notifier Campus Network Monitoring System
TSLSS	Technical Specialist, Life Safety Systems
ULC	Underwriters Laboratories of Canada

4. Mechanical – Plumbing Systems

4.1 Design Criteria

4.1.1 General

1. The requirements outlined in the following clauses are applicable to all Plumbing Systems; Application Specific requirements are outlined in separate sections with in this document.
2. Potable Water System Design Temperature:
   - Cold Water: 4.4 ^{o}C (40 ^{o}F)
   - Hot Water: 60 ^{o}C (140 ^{o}F).
3. Potable Water System Configurations.

System Configuration	Definition	Typical Applications
Potable Water System	Water Distribution System delivering cold and/or hot water suitable for human consumption	Washrooms, Hand Washing Sinks, Pantry Supplies, Drinking Fountains, Sterilizers, Coffee Machines, Soda/Pop Machines, etc.
Tempered Potable Water System	Water Distribution System delivering tempered potable water suitable for human consumption	Eyewash Stations, Emergency Showers, Sinks, etc.
Non-Potable Water System	A Process Water Distribution System derived from the Potable Water Distribution System but separated from	Lab Sinks and Lab Supplies, Fume Hood Supplies, Process Equipment Supplies, Kitchen Equipment Supplies, Hose

	the same using Cross-Connection (Backflow) Protection Devices. Water delivered through this system is not suitable for human consumption.	Bibb's, Janitor/Slop Sinks, Laundry Supplies,

4. Architectural information can be found in GTAA Architectural Design Requirements reference document.

4.1.2 GTAA Building Hazard Classification

1. This classification is intended to group buildings based on the Activities envisaged within the buildings now and in the future. In each instance the GTAA's own Building (Hazard) Classification is equal to or higher than the Hazard Classification assigned by the Region of Peel Backflow bylaw.
2. Building Hazard Classified as "Light", "Moderate" or "Severe"; classification identified by the GTAA Project Manager and the GTAA Engineering and Utilities Team before the commencement of Schematic Design.
3. Building type descriptions and zones are noted in GTAA Architectural Design Requirements reference document.

4.1.3 Incoming Water Service

1. Incoming water service shall be extended from the GTAA's Water Distribution Main.
2. Premise Protection against Cross-Connection shall be provided in accordance with the Region of Peel Backflow Bylaw for the Building Hazard Classification.
3. A Funnel Floor Drain shall be provided in the immediate vicinity of any Backflow Device, whether installed or provisioned for.

4.1.4 Metering

1. An Electro-Magnetic Water Meter manufactured by Intellimeter or Neptune Trident shall be provided on the incoming water service.
2. Meter shall have a Pulse Output for interface with the GTAA's Centralized Metering System, a BACnet output for interface with the BAS and a Local Reader. All outputs shall allow a reading of an Instantaneous Flow as well as the Totalized Flow over a chosen time-period.
3. Sub-Metering manufactured by Intellimeter shall be provided on all Water Supplies to the Tenant Water Systems.
4. Preference is to install Sub-Meters at an elevation that allows it to be read standing on the Finished Floor. Where a Sub-Meter needs to be installed at a higher elevation, a Remote Reader shall be provided at a level that allows it to be read standing on the Finished Floor.

4.1.4.1 Note to Users

The GTAA is in the midst of redrafting its metering, controls, and energy management standards as of February 2024. The content provided in subsection 4.1.4 is the best available information at the time of document publication; however, Designers, Consultants and Engineers are notified that the content of this section will change dramatically in the near future and reliance is not advised. Anyone who must or should include metering in their designs or deliverables shall contact the Manager of Facilities Systems Engineering for direction and clarification.

4.1.5 Potable Water Distribution Systems

4.1.5.1 Renovation Projects

1. Modify existing Plumbing Systems to suit new Work. Maintain the design criteria followed for the existing installation.
2. Where feasible arrange piping in a loop arrangement with isolation valves to allow sections of the distribution piping system to be taken out of service for maintenance and repairs without affecting an extended zone.

4.1.5.2 Provisions to protect against Cross-Connection

1. Where practical and economically feasible, create a new Non-Potable Water System (Loop) limit the number of new Testable Devices required to protect against Cross-Connection.
2. Options to create a non-potable water loop with an accompanying cost-benefit analysis shall be presented for review by the GTAA Project Manager and the GTAA Engineering and Utilities Team at the Schematic Design Stage.

4.1.5.3.1 Potable Cold-Water Booster Pumping System

1. A Potable Cold-Water Booster Pumping System shall be provided, as necessary, to support the Facility Potable Water Demand (Flow and Terminal Pressure)
2. Sizing supported by Connected Load and Demand Load Calculations.
3. Potable Water Booster Pumping System shall be configured as follows:
    a. A Variable Speed Duplex Pumping System with each Pump sized to satisfy 75% of the Peak Demand.
    b. A Variable Speed Triplex Duplex Pumping System with each Pump sized to satisfy 50% of the Peak Demand. This configuration shall be provided in the case of designated Critical Applications requiring 100% Availability of Potable Water.

4.1.5.3.2 Potable Hot Water System

1. A Potable Water System shall be provided to support the Facility Potable Hot Water Demand.
2. Potable Hot Water for the Non-Potable Water System (where provided) shall be extended from the Potable Hot Water System; cross-connection protection devices shall be provided on the Potable Hot Water Supply and Recirculation piping to protect the Potable Water System.
3. Piping for both the Potable and Non-Potable Hot Water System shall be arranged to ensure that the maximum length of Non-Recirculated piping is limited to 3m (10 feet).
4. Sizing supported by Connected Load and Demand Load Calculations.
5. Potable Hot Water System shall be configured as follows:
6. Electric Storage Tank Type Domestic Hot Water Heaters shall be provided to satisfy the Domestic Hot Water needs. A minimum of two (2) Heaters, each sized to satisfy 75% of the Peak Demand shall be provided.
7. Alternates measures such as Electric Instantaneous Heaters, Gas-fired Instantaneous Heaters or Gas-fired Storage Tank Type Heaters, etc. for Domestic Hot Water Production shall be presented for review by the GTAA Project Manager and the GTAA Engineering and Utilities Team at the Schematic Design Stage.
8. Arrange Piping in a Loop Arrangement complete with Isolation Valves to allow sections of the distribution system to be taken out of service for maintenance and repairs without affecting an extended zone; size and configuration of individual zones to be reviewed and finalized in consultation with the GTAA Project Manager, the GTAA Design Discipline Team Lead and the GTAA Engineering and Utilities Lead before finalization of the Schematic Design.

4.1.6 Mechanical Rooms, Service Rooms, and Roof

4.1.6.1 Mechanical Room

1. One (1) Hand-Washing Sink connected to the Potable Water System shall be provided in each Mechanical Room
2. One (1) Deep Bowl Chemical Service Sink connected to the Non-Potable Water System shall be provided in each Mechanical Room housing Heating and Cooling System or Closed Loop System Recirculation Pumps.
3. At least one (1) Hose Connection connected to the Non-Potable Water System shall be provided in each Mechanical Room

4.1.6.2 Service Rooms

1. One (1) Slop Sink connected to the Non-Potable Water System shall be provided in each Service Room.

4.1.6.3 Housekeeping Room and Closet

1. One (1) Slop Sink connected to the Non-Potable Water System shall be provided in each Housekeeping Closet.
2. One (1) Soap Dispenser compliant with the GTAA's Standard shall be provided within each Housekeeping Closet.
3. No plumbing services or components requiring maintenance access shall be located within or routed through/above this room.

4.1.6.4 Roof Level

1. A minimum of one (1) Non-Freeze Hydrant shall be provided within 10'-0" of Rooftop Mechanical Equipment and Installations.

4.1.7 Drainage and Venting Systems

4.1.7.1 Storm Drainage Systems

1. All Roof Drains shall be of the "Controlled Flow" type.
2. To the extent feasible, storm drainage systems shall be designed for gravity flow.

4.1.7.2 Sump Pump Systems

1. Where required to handle Storm Water Inflow from a Weeper System or Strom Drains that cannot flow to the Storm Sewer under gravity, a Duplex Sump Pump System with Automatic Alternation shall be provided.
2. Each pump shall be capable of supporting 100% of the calculated storm water inflow.
3. Sump Levels shall be monitored with High and High Levels alarmed at the Building Automation System.
4. Power supply to the Sump Pumps shall be extended from the GTAA's Emergency Power System.
5. A Stainless-Steel Guiderail System shall be incorporated into each Sump to facilitate removal of a Pump.
6. Rain Water Leaders shall not be routed along any exterior wall.

4.1.7.3 Sanitary Drainage Systems

1. Floor Drains shall be provided at a minimum in the following locations:
2. A Combination Funnel Floor Drain at each Equipment or a Group of Equipment to serve a point to drain condensate from equipment or a point of drain to serve piping systems. Further requirements stipulated in GTAA Architectural Design Requirements reference document.
3. Floor Drains in each Mechanical Room and Service Room for housekeeping.
4. A Floor Drain at each Eye Wash and Emergency Shower.
5. Automatic Trap Priming System in the form of an Electronic Trap Seal Primer comprising a Timer, a Solenoid Valve and an Air Gap shall be provided for each Floor Drain or a group of Floor Drains; exceptions include:

6. An insertion type Trap-Guard Primer or a Mechanical Pressure Drop Type Primer may be used with the prior approval of the GTAA Project Manager and the GTAA Engineering and Utilities Team. Intent to use such alternate measures shall be identified and presented for approval prior to completion of the Design Development Stage.
7. To the extent feasible, sanitary drainage systems shall be designed for gravity flow.

4.1.7.4 Sump Pump Systems

1. Where required to handle Sanitary Drains that cannot flow to the Sanitary Sewer under gravity, a Duplex Sump Pump System with Automatic Alternation shall be provided.
2. Each pump shall be capable of supporting 100% of the calculated sanitary water inflow.
3. Sump Levels shall be monitored with High and High Levels alarmed at the Building Automation System.
4. Power supply to the Sump Pumps shall be extended from the facility's Emergency Power System.
5. Sump Pit Covers shall be Gasketed to ensure an air-tight seal. Vent piping shall be extended to the outside in accordance with the Plumbing code. Vents shall be terminated away from Air Intakes.
6. A Stainless-Steel Guiderail System shall be incorporated into each Sump to facilitate removal of a Pump.

4.1.7.5 Miscellaneous Requirements

1. Drinking Fountains
2. Shall be Barrier Free, and
3. Of the "Refrigerated Type" and equipped with Bottle-Filler c/w Totalizers.

4.1.7.6 Domestic Water Piping to Water Closets and Urinals

1. In all new construction, domestic water piping to Water Closets and Urinals shall be arranged independent of all other Domestic Water Piping.
2. Further requirements in GTAA Acoustic and Vibration Standard

4.1.8 Piping Material and Jointing Systems

4.1.8.1 Incoming Water Piping (GTAA Mains to Water Meter)

1. Copper Type K shall be used for installations where the pipe size is specified to be less than 65mm (NPS 2½).
2. PVC or Hyprotec-coated ductile iron pipe shall be used for installations where the pipe size is specified to be greater than 75 mm but less than 300mm in diameter.
3. Concrete pressure pipe or Hyprotec-coated ductile iron pipe shall be used for installations where the pipe size is specified to be 300mm or larger in diameter.
4. All Non-metallic Buried Piping shall be installed with Tracing-Wire adhered to the pipe (min 12-gauge stranded copper).
5. Where practicable all bends on Buried Piping shall be secured with mechanical restraint rods rather than with concrete thrust blocks. All Buried Metallic Restraints shall be of Stainless-Steel construction.

4.1.8.2 Domestic Water Distribution Piping

1. Potable and Non-Potable Domestic Water Piping: Copper Type L

4.1.8.3 Drainage Piping – Storm and Sanitary

1. Drainage Piping shall be System XFR in all areas except Fire Rated Service Shafts.
2. Drainage Piping shall be Cast Iron or Copper in Fire Rated Service Shafts.
3. Pumped Storm and Sanitary Drainage Piping shall be Copper Type L or Schedule 40 Galvanized Steel.

4.1.8.4 Jointing System

1. Copper Pipe

a. Flanged or Soldered shall be used in all areas excepted as noted below.
b. Use of Mechanical Grooved Couplings (Victaulic) Joints in Mechanical Rooms is permitted with prior approval from the GTAA Project Manager and the GTAA Maintenance Manager.
c. Use of Pressfit Joints or Shark-bite Fittings is not permitted without prior approval from the GTAA Project Manager and the GTAA Engineering and Utilities Team.

2. Cast Iron Pipe
   a. Mechanical sleeve joints to CSA B602 and ASTM C1540 with neoprene or butyl rubber compression gaskets to ASTM C564, with stainless steel sleeve and not less than four stainless steel drive clamps with stainless steel worms.
3. PVC Pipe.
   a. Fusion Weld or Cement Joint to Pipe Manufacturer's Specifications

4.1.9 Valves

1. All direct-buried valves and fittings shall be wrapped with "Denso" tape. Corrosion protection shall be provided as per the Region of Peel Specification for a Corrosion Control System.
2. Valves shall not be installed under concrete apron areas, but where necessary located within a concrete chamber designed to the GTAA standards.
3. Valves on Potable and Non-Potable Water Distribution System Piping shall be Ball or Globe Type with Stainless Steel Internals or Butterfly Type. Gate Valves are permitted only for Direct Bury Applications.
4. All Ball Valves shall be Full Port Style.
5. All Valves, whether within Mechanical Rooms or in the Ceiling Space, shall be installed in readily accessible locations. Where a Valve within a Mechanical Room is located higher than 8'-0" above Finished Floor Elevation or over Equipment, Chain Operators shall be provided.
6. Fixture Isolation Valves shall be provided at each individual Fixture.

4.1.10 Fixtures and Specialties

1. Refer to GTAA Architectural Design Requirements reference document.

4.1.10.1 Cross-Connection Protection Devices

1. All Cross-Connection Protection Devices shall be manufactured by Conbraco for NPS 2 or less and Zurn or Conbraco for all other sizes.

4.1.10.2 Plumbing Trim

1. All Plumbing Trim shall be sourced from a single manufacturer; identify the preferred manufacturer in consultation with the GTAA Project Manager and GTAA Engineering and Utilities Team before completion of the Design Development phase.

4.1.10.3 Water closets

1. All water closets shall be of the wall mounted type with automatic flush valves.

4.1.10.4 Urinals

1. All urinals shall be of the wall mounted low flow type with automatic flush valves; waterless urinals shall not be installed.

4.1.10.5 Piping Specialties

1. Automatic Air Vents c/w Manual Isolation Valves shall be provided at all High Points in the System.
2. Pressure Relief Valves piped to Drain (c/w an Air Gap) shall be provided in all piping systems operating at pressure more than 50 PSI

4.1.10.6 Water Hammer Arrestors

1. Water Hammer Arrestors shall be provided within the domestic cold and hot water piping distribution system.

4.1.10.7 Plumbing Specialties

1. Grease Interceptors, Oil Interceptors, and other specialties shall be provided as appropriate to protect the drain piping systems.

4.1.11 Equipment Installation

4.1.11.1 Water Meters

1. Water Meters shall be installed with an upstream strainer and upstream and downstream isolation valves.
2. Water Meters shall be installed in a dedicated Service Room or a Mechanical Room.

4.1.11.2 Incoming Water Service Cross-Connection Protection Device

1. Cross-Connection Protection Device on the incoming water service shall be installed between upstream and downstream isolation valves. These isolation valves may be shared with the Water Meter installation. Connections shall be completed using Unions for piping NPS 3 or smaller and Flanges for piping NPS 4 and larger.
2. Discharge from the Cross-Connection Protection Device shall be directed to a Floor Drain located directly underneath or in the immediate vicinity of the Device; drain piping shall be arranged with a fixed Air-Gap.
3. Cross-Connection Protection Device shall be installed in the same Service Room or Mechanical Room as the Water Meter.

4.1.11.3 Cleanouts

1. Cleanouts shall be installed in an accessible location.
2. Cleanouts in Pipe Chases/Service Spaces shall be installed at least 300 mm above the Flood Level of the Fixtures they serve.

4.1.11.4 Gas Piping

1. Material of Construction and Installation of all Buried Gas Piping shall comply with the requirement of the local Utility Company.
2. All above Grade Gas Piping shall be Welded Black Steel, Schedule 40. Use of Threaded Pipe is permitted only for Pipe Size 50 mm (NPS 2) and smaller.
    a. Pipe shall be supported independently of all other Services.
    b. Piping shall be painted Yellow in accordance with Applicable Codes.

4.1.12 Heat Tracing

1. Electric Heat Tracing shall be provided on all Water and Drain Piping installed outdoors or in areas such as Receiving/Loading Docks where “freezing” conditions could exist.
    a. Pipe 100 mm (NPS 4) and Smaller: Single Heat Trace Cable.
    b. Pipe Larger than 125 mm (NPS 5) and Larger: Two Heat Trace Cables.
2. Heat Trace cable shall be the self-regulating type, sized and selected based on an ambient temperature of-30°F (with wind-chill).
3. Heat Trace cable shall be installed in accordance with the Manufacturer’s recommendation. Insulation and jacketing shall be provided over all Heat Traced piping systems.
4. Heat Trace Cable Control System shall provide a BACNet output for remote monitoring of a Cable Fault or an Alarm Condition.
5. Reference GTAA Roofing and Envelope Guideline for additional requirements.

4.1.13 Insulation

1. All Plumbing Equipment and Piping Systems shall be insulated in accordance with ASHRAE 90.1. Horizontal sections of Roof Drain Piping within an unconditioned Ceiling Space shall also be insulated.

2. Insulation on Exposed Piping or Piping within Receiving Areas/Loading Docks and Mechanical/Service Rooms shall be jacketed with PVC. Where physical damage is a possibility, i.e. within 6 feet of the finished floor or adjacent to Working Platforms, Aluminum or Stainless-Steel jacketing shall be used.

4.1.14 Identification

4.1.14.1 Pipe Identification

1. All Piping shall be identified using Flexible Coil Wrap Pipe Markers listing at a minimum the following: Service; Direction of Flow.
2. Identification shall be provided every 20 feet or every change in direction/ and within 3 feet on both sides of a wall/partition.

4.1.14.2 Valve Identification

1. Brass Valve Tags shall be provided at each Valve

4.1.14.3 Equipment Identification

1. in schedules and equipment selection sheets.
2. Laminated Plastic, White Face Black Center; minimum size 90mm x40mm x2.5mm; engraved with 10 mm high lettering.

4.1.15 General Requirements

4.1.15.1 Service and Maintenance Clearance

1. All Equipment whether located in Mechanical Rooms, Ceiling Space or simply suspended from the underside of the building structure, shall be installed with minimum service and maintenance clearances as recommended by the supplier/manufacturer.
2. Identify service and maintenance clearance on the drawings.
3. Equipment located in the Ceiling Space or simply suspended from the underside of the building structure:
    a. Equipment proposed for installation within a Ceiling Space or simply suspended from the underside of the building structure shall be identified as a part of the Schematic Design; such planned installations can proceed only with the approval of the GTAA Project Manager and GTAA Engineering and Utilities Team. It is incumbent on the Designer to demonstrate that there is practical opportunity to install such Equipment on the Ground or on a readily accessible Service Platform/Mezzanine.
    b. For Equipment in Mechanical Rooms, identify path of travel between the Equipment and Door(s) leading into the Room.

4.1.15.2 Equipment Schedule

1. Equipment Schedules listing Performance Criteria shall be included on the Drawings. At minimum, the Schedules shall include the following: Pumps, Hot Water Tanks, Heat Exchangers, Plumbing Fixtures, Expansion Tanks, Floor and Roof Drains, and Plumbing Specialties.

4.1.15.3 Piping Installation

1. Except as permitted below, Water or Drain Piping shall not be routed over or through Electrical Rooms/Closets, IT/COMM Rooms/Closets, Computer Rooms or Other Spaces intended to accommodate Electrical, IT or Communications infrastructure.
    a. Storm Drain Piping extended directly from a Roof Drain above or in the immediate vicinity of the Spaces listed above.
    b. Water or Drain Piping may be routed over or through the Spaces listed above provided there is no other practical alternate path available to route the piping. In such instances:

i. The proposed arrangement shall be presented for the approval of the GTAA Project Manager and the GTAA Engineering and Utilities Team before the finalization of the Design Development Phase, and
ii. Where permitted the Piping shall be installed without any Mechanical Joints or Couplings, i.e. all piping both Water and Drain to be fabricated using Welded or Soldered Connections and protected with an Aluminum Drip Tray c/w Leak Detection extended over the entire run over these Spaces. Leak Detection shall be interfaced with the Building Automation System.

4.1.15.4 Demolition and Removals

1. Plumbing Services to Fixtures and Equipment being removed shall be cut back and capped at the Main Services.
2. Location of Caps to be clearly identified on the As-Built Drawings.

4.1.16 Triturator

This section is intentionally blank. Inquiries should be directed to GTAA Project Manager.

4.1.17 Plumbing and Drainage Specific to Parking Structures

For all matters relating to plumbing and drainage specific to Parking Structures, Designers, Consultants and Engineers are directed to contact the GTAA Project Manager..

4.1.18 HVAC Specific to Parking Structures

For all matters relating to heating, ventilation and air conditioning specific to Parking Structures, Designers, Consultants and Engineers are directed to contact the GTAA Project Manager.

4.2 Hydraulics

4.2.1.1 Gas Fired Boilers

1. Water Tube boilers to be specified where capacity exceeds 4 MMBTU/hr (1170KW)
2. Natural Gas fired hot water type boilers are to be specified when possible.
3. Boilers must be sized with allowance for the use of tube plugs (NBBI compliant) for isolating leaky tubes without compromising hydronic loop capacity.
4. Boilers must be compliant with ASME Section IV; CSA B52-19; CSA B149; and all other applicable gas burning heating boiler codes.
5. Fully condensing boilers are to be installed at all locations with minimum initial efficiency of 95% at/near hydronic system operating temperature.
6. Use of Low NOx burner is required, preferably less than 20 ppm.
7. NOx , CO, and CH4 gas detection systems to be installed in all spaces where boilers are located with alarm notification in GTAA BMS system.
8. NG Boiler must be equipped with Oxygen Sensors for flue gas air/fuel ratio monitoring, and optimum combustion efficiency.
9. Full burner and modulation required for reduced on/off cycling, load tracking and energy consumption. Minimum required turndown is 5:1, and should be accomplished using sensor-driven servos; use of mechanical linkage is not acceptable.
10. NG Boiler system must be supplied with adequate combustion air and room ventilation provisions that are compliant with boiler manufacturer’s and regulatory/code requirements, for supporting proper combustion and equipment and room ventilation.

11. NG Boiler must also be categorized based on ANSI Z21.13 standard and flue gas stack must be fabricated from corrosion resistant materials. Use of category IV boiler is anticipated for fully condensing boilers.
12. Flue gas system must be Listed to standard UL 1738 Special Gas Vent and be installed in accordance with the National Fuel Gas Code (NFPA 54) or ANSI Z21.47/ CSA 2.3
13. Use of insulated vent pipe spacers is required where the Flue Gas vent penetrates combustible roofs and walls.
14. NG Boiler must be configured to collect and discharge condensate according to codes and regulations.

4.2.1.2 Electric Boilers

1. Boiler shall be equipped with redundant installed electric heating element capacity, with additional capacity totaling a minimum 10% of the peak heating demand
2. Boiler must be equipped with flanged Direct Immersion heaters and Tubular elements
3. Heating element bundle shall consist of an integral Thermostat and high limit thermocouple
4. Boiler shall be configured with variable power output, and individual stage toggle switch.
5. Boiler must be equipped with low level switches for minimum water level control

4.2.2 Boilers – General Specification

1. Boiler manufacturer must provide boiler output power data for low and medium temperature operation.
2. All supplied boilers must be compatible with low temperature heating solutions such as ground source heat pumps. Boiler with no limitation on minimum continuous inlet water temperature is preferred.
3. Boiler shall be designed, constructed, and installed in compliance with all applicable ASME and CSA codes, including but not limited to ASME Section IV and Section VIII.
4. Boilers used for indoors installation must be furnished with integrated OEM cover panels, insulation, and designed for quiet operation.
5. BACNet IP capability for integration with GTAA BMS platform is required.
6. Boiler shutdown logic must include override to allow delay in pump shutdown for boiler loop thermal management.
7. All boiler heating water supply and return piping must include emergency use flanged connections and boiler isolation valves, to be used for connecting emergency use external boiler. Flanged connection must be accessible outside building envelope.
8. Flanged boiler inlet and outlet connections must be compliant with ANSI flange standards.
9. Closed loop Boiler piping must be configured with expansion tank and chemical treatment equipment
10. Electrical, mechanical and control peripheral and auxiliary equipment, and components that are essential for boiler commissioning and operation shall be installed along with boilers as a complete package

4.2.3 Glycol Distribution Systems

For all matters relating to glycol distribution systems, Designers, Consultants and Engineers are directed to contact the GTAA Project Manager.

4.3 Localized Heating Systems

4.3.1 Gas Fired Unit Heaters

For all matters relating to localized gas fired unit heaters, Designers, Consultants and Engineers are directed to contact the GTAA Project Manager..

4.3.2 Electric Unit heaters

For all matters relating to localized electric fired unit heaters, Designers, Consultants and Engineers are directed to contact the GTAA Project Manager.

5. Mechanical - Heating Ventilation and Air-conditioning System

5.1 Design Criteria

5.1.1 General

The requirements outlined in the following clauses are applicable to all HVAC Systems; Application Specific requirements are outlined in other sections of this document

5.1.1.1 Outdoor Design Conditions.

Parameter	Winter	Summer
Dry Bulb	- 22 ^{o}C	31 ^{o}C
Wet Bulb		24 ^{o}C

5.1.1.2 Indoor Design Conditions

1. The Indoor Design Conditions tabulated below apply to all air-conditioned spaces within a facility.

Area	Winter	Summer
Concourse/Circulation Areas / Office Spaces	22 ± 1 °C (30-40% RH)	23± 1 °C (55± 10% RH)
Baggage Hall/Lounges	22 ± 1 °C (30-40% RH)	23 ±1 °C (55± 10% RH)
Electrical Rooms/Elevator Machine Room	21 ± 3 °C	23 ± °C (55± 10% RH)
Mechanical Rooms	20 ± 2°C	27 ± 2 °C
IT / COMM Rooms	22 ± 1 °C (30-50% RH, Non-Condensing)	23± 1 °C (30-50% RH, Non-Condensing)
Storage Room*	20 ± 2°C	27 ± 2 °C
* Temperature will depend on Materials being stored. Coordinate requirements with the GTAA Project Manager		

2. Indoor Design Conditions for spaces that are “naturally ventilated” and/or “only heated” shall be determined to suit the application. In such instances the chosen Indoor Design Conditions shall be tabled for consideration by the GTAA Project Manager and the GTAA Engineering and Utilities Team before the completion of Schematic Design.
    a. Considerations shall be given to the provision of pressurized vestibules at the entry from conditioned to unconditioned, naturally ventilated or heated only spaces to guard against infiltration into the conditioned spaces.

b. Heated Air Curtains shall be provided at each entry from the outside to conditioned, naturally ventilated or heated only spaces to guard against infiltration of cold outside air into these spaces.
c. Hydronic Heating shall be utilized unless the location of the Air Curtain makes it impractical or cost prohibitive to extend hydronic heating piping in which case use of Electric Heating is permitted subject to a prior approval from the GTAA Project Manager and GTAA Engineering and Utilities Team.
d. Reference GTAA Acoustic and Vibration Standard for additional requirements.

5.1.2 Energy Performance

1. All HVAC Systems for new Construction shall be designed to provide at a minimum, a 45% cost improvement in the proposed building performance rating when compared to the Model National Energy Code for Buildings (MNECB), or a 36% cost improvement when compared to the baseline building as calculated according to Appendix G of ANSI/ASHRAE/IESNA Standard 90.1(latest edition). Energy performance shall be demonstrated through the preparation of an Energy Model, the same shall be presented to the GTAA Project Manager before the completion of the Design Development Phase.
2. All new HVAC Equipment shall provide a minimum energy performance rating as prescribed under ASHRAE Standard 90.1 and the National Energy Code of Canada for Buildings. The more conservative of the two codes is to be applied for minimum energy performance determination.
3. Carbon Footprint / Greenhouse Gas Emissions associated with a HVAC Solution shall be identified and with supporting calculations/documentation presented to the GTAA Project Manager before the completion of the Design Development Phase.

5.1.3 General Requirements- Ventilation Systems

1. All Air Systems shall be designed as Variable Air Volume Systems.
2. Air Systems shall be designed to ensure Space Noise Criteria as tabulated below:

Area	Noise Criteria (NC Level)*
Offices – Private	30 - 32
Offices – Open Plan	34 - 36
Conference / Board Rooms	30 - 32
Corridors	36 - 38
Public Areas	38 - 40
*Confirm requirements prior to finalization of the Schematic Design in consultation with the GTAA Project Manager and with due consideration given user requirements.	

3. Engineered Silencers shall be provided within the main supply, return and exhaust air ductwork and/or at terminal units to achieve the specified NC Limits; use of internally lined ductwork is not permitted except in the case of Transfer Air Ducts less than 2m in length.
4. HVAC design must be compliant with the Canadian National Building Code, National Energy Code, and National Fire Code. Use of ASHRAE, CSA, NFPA and other acceptable industry codes and best practices must be used for executing HVAC design. Where there is misalignment between the Codes and Standards, use of the more conservative standard is mandatory.

5. Where there is a design change to an occupied space, HVAC services must be re-evaluated and the necessary HVAC work undertaken for achieving/maintaining compliance with all ASHRAE standards including but not limited to ASHRAE 55 Thermal Environmental Conditions for Human Occupancy, and ASHRAE 62.1 Ventilation and Acceptable Indoor Air Quality.
6. Where HVAC design updates/changes are to be incorporated into ventilated spaces, air-supply ventilation equipment that are solely servicing the designed space, and are aged/degraded/obsolete must be replaced within design scope. Examples include but are not limited to dampers, VAV boxes, ecology units, fans & motors etc.

5.1.3.1 Air Handling Equipment

1. The requirements listed below apply to all new Air Handling Equipment, whether installed as a part of a renovation project or in new construction.
2. Arranged with: Outside Air Dampers; 30% Pre-Filters (MERV 8), Carbon Filter Rack (Provision only for future installation of actual Filters); 80% Pleated Final Filters (MERV 14); Hydronic Pre-heating Coil (in case of 100% Outdoor Air Units); Hydronic Heating Coil; Humidification Section; Cooling Coil; Mist Eliminator and Supply Fan Section.
3. Self-Supporting Galvanized Structural Steel Base, minimum 150 mm (6") high.
4. All new damper installations for occupied spaces must be electrically actuated and controlled via BMS
5. VAV units must be pressure independent and equipped with flow sensor.

5.1.3.2 Casing

1. Minimum 100mm thick double walled insulated construction; Insulation Density 48 kg/m3.
2. Outer skin: 1.6 mm (16 ga), galvanized steel, G90, Satin Coated.
3. Inner skin: 0.8 mm (22 ga), galvanized steel, G90.
4. Perforated sheet, 22% open, in mixing plenums, filter sections and fan casings.
5. Solid sheet in sections with cooling coils, humidifiers or condensing heat recovery devices and for at least 900 mm (36 in) downstream of each of these sections.

5.1.3.3 Flooring

1. Reinforced, minimum 3mm (0.125 in) aluminum or 1.9 mm (14 ga) 304 stainless steel checker plate, designed to prevent "oil canning".
2. 50 mm (2 in.) insulation, with 0.8 mm (22 ga) bottom panel caulked and sealed.
3. 40 mm (1 ½ in) watertight collars around inside of perimeter of unit and around floor openings.
4. Integral recessed and sealed floor drains.

5.1.3.4 Supply Fan Section

1. Arranged with a minimum of two Fans each sized at 75% of the Design Air Flow or As a Fan Wall affording a comparable level of redundancy.
2. Provide Spring Isolators or Other Measures to isolate fan vibration from the Unit Casing.

5.1.3.5 Coils

1. Copper or aluminium coils with aluminum fins.
2. Bottom Draining Coil with Air-Blowout Connection.
3. Means to continually circulate supply air drawn from the supply air section through the coil.

5.1.3.6 Drain Pans

1. mm (16 ga) 304 stainless steel, cross broken and double sloped to recessed bottom drain with drain pipe extended from side of floor pan, above top of base rail.
2. 50 mm (2 in.) insulation, with 0.8 mm (22 ga) bottom panel caulked and sealed.
3. Drain size: 32 mm (1¼ in) NPT minimum size, FPT connection.

4. Locations: at fresh air intakes, in mixed air plenums, and as shown.

5.1.3.7 Cooling Coil Drain Pans

1. As above for drain pans and 75mm (3 in) sump, located above base rail
2. Located under cooling coil rack and extending 100 mm (4 in) upstream of coil entering side and minimum 100 mm (4 in) downstream of coil on leaving air side, and not less than 100 mm (4 in) from face of eliminators on leaving air side.
3. Locations: at cooling coils, condensing heat recovery units, and in humidification sections.
4. Intermediate cooling coil drain pans:
5. Fitted under upper coils in a bank where coils are stacked,
6. Equipped with vertical stainless-steel drain piping at each side of coil, discharging directly to bottom drain pan.
7. Extended at least 50 mm (2 in) upstream of coils on entering air side, 100 mm (4 in) downstream of coils on leaving air side, and not less than 100 mm (4 in) from face of eliminators on leaving air side.

5.1.3.8 Energy Recovery

1. Integral Energy Recovery Section for 100% Fresh Air Systems. A Cost-Benefit Analysis comparing each of the listed Energy Recovery measures shall be presented for review by the GTAA Project Manager and Design Discipline Team Lead before finalizing the Schematic Design.
    a. Total Enthalpy Wheel.
    b. Heat Pipe.
    c. Glycol Run-around Loop.

5.1.3.9 Access Doors

1. Double wall construction, as described for wall panel but with solid inner liner, fabricated with:
    a. mm (16 ga) formed channel trim with welded corners,
    b. Mounted in matching 1.6 mm (16 ga) welded casing channel frame with continuous angle stop
    c. 250 mm (10 in) round or 250x250 mm (10x10 in) square, wired or tempered glass window, double glazed in sections subject to temperatures below 4.5 C (40 F).
    d. Two Ventlok latches installed with handles on inside and outside of door.
    e. Continuous stainless-steel piano hinge or two butt hinges, welded to door and casing frame.
    f. Continuous 13 mm closed cell hollow gasket with metal encapsulated, reinforced backing, mechanically fastened to door opening perimeter.
2. Doors to open against pressure differential.
3. Door height to be smaller of 1500 mm (60 in) or 200 mm (8 in.) less than inside height of unit.
4. Door, and removable panels within ceilings and walls to provide 800 mm x 800 mm e cleaer service access to valves, pull boxes, dampers, control devices, etc., and shall be designed at all locations except in the Fan Section where the Door width shall be adequate for the purposes of removing a fan.

5.1.3.10 Marine Lights

1. Installed In each section of unit provided with access door.
2. Wired to a common Switch on the exterior of the Unit near the Fan Section.

5.1.3.11 Fan Starter

1. Variable Frequency Drive c/w External Across the Line Bypass Starter and a Door Mounted Lockable Disconnect:
    a. Select drive, motor, electrical filters and accessories to match duty specified and installation configuration. Furnish written 3-year extended warranty to cover labour and materials for repair/replacement in case of motor burnout or drive failure.

b. Factory mount variable speed drives in recessed enclosure in fan section, with access door (without window) and ventilating louvres at top and bottom of enclosure.
c. Size enclosure to permit routing of field power wiring around unit.
d. Provide a 50mm (2 in) threaded conduit fitting through wall for field power wiring.

5.1.4 General Requirements – Heating Systems

5.1.4.1 Renovation Projects

1. Modify existing Heating Systems to suit new Work. Maintain the design criteria followed for the existing installation.

5.1.4.2 New Construction Projects

1. High Temperature Hot Water supplied from the Central Utilities Plant (CUP) shall be the primary source of heat to T1, T1 PG and APM unless otherwise noted; the GTAA Project Manager will identify the primary source of heat at the onset of the design process.
    a. Incoming high temperature hot water to be extended from the GTAA High Temperature Hot Water Heating Loop.
    b. Incoming High Temperature Hot Water Supply to be metered; the Meter shall provide an output to the BAS.
    c. Heat Exchangers to decouple the Central Plant High Temperature Hot Water system from the Building Systems.
    d. Supply Pressure from the CUP to Building will be confirmed by project, when and if needed.
    e. Supply Water Temperature and Temperature Differential:
        i. All Equipment and Piping Systems, both the Primary and Secondary Side shall be designed for continuous operation at a Supply Water Temperature of 138 ^{o}C.
        ii. Building Decoupling Heat Exchanger and downstream Equipment and Piping Systems shall be sized based on a Winter Operating Temperature of 110^{o}C.
2. Heating within the Building including its Air Systems shall be based on the use of Hydronic Distribution Systems.
    a. Separate and dedicated Heating Distribution Systems to service:
        i. 100% Outdoor Air Systems (Air Handling Units) or areas susceptible to freezing
        ii. Perimeter Heating Systems and Heating Coils within Recirculation Type Air Handling Systems.
        iii. Terminal Reheat Systems.
3. Heating Systems serving 100% Outdoor Air Systems and Energy Recovery Loops to utilize 40% Propylene Glycol.

5.1.4.3 Heat Exchangers

1. Heat Exchangers shall be sized and arranged such that each Heat Exchanger can support at least 75% of the peak heating demand.
2. Considerations shall be given to combining the Heat Exchangers serving Perimeter Heating Systems and Terminal Reheat Systems, with the stipulated system operating temperatures realized using Pumps and Mixing Valves in the distribution piping. A Cost-Benefit Analysis comparing separate heat exchangers versus combined heat exchangers shall be presented for review by the GTAA Project Manager and the GTAA Engineering and Utilities Team.
3. Heat Exchangers shall be of the Plate and Frame Type and designed to operate without leaks, controlled or otherwise at all temperatures from Room Temperature to 138^{o}C. Some specialized applications such as steam boilers may require the use of Shell & Tube Heat Exchangers and exceptions can be made with GTAA engineering input and industry best practices.
4. Reference GTAA Acoustic & Vibration Standards for additional requirements.

5.1.4.4 Heating Distribution Pumps

1. Pumps shall be sized and arranged such that each Pump can support at least 75% of the peak heating demand.
2. Pumps shall the Vertical-in-Line Type, Split-Coupled for Motors larger than 10 HP.
3. Pumps shall incorporate Variable Frequency Drives
    a. Pump Speed Control shall be based on an Input Signal from a remotely mounted Pressure or Differential Pressure Sensor.
    b. Sensorless Drives are not permitted.

5.1.4.5 Special Requirements

1. Review with the GTAA Project Manager at the onset of a project a need to provide a Back-up Heating Source in the form of Electric Heating Boilers located within an individual Building.

5.1.5 General Requirements – Cooling Systems

5.1.5.1 Renovation Projects

1. Modify existing Cooling Systems to suit new Work. Maintain the design criteria followed for the existing installation.

5.1.5.2 New Construction Projects

1. Chilled Water supplied from the Central Utilities Plant (CUP) shall be the primary source of Cooling to the Building unless otherwise noted; the GTAA Project Manager will identify the primary source of cooling at the onset of the design process.
2. Incoming chilled water supply to be extended from the GTAA Chilled Water Loop.
3. Incoming Chilled Water Supply to be metered; the Meter shall provide an output to the BAS.
4. Supply Pressure from the CUP to Building: Design xxx PSI / Operating xxx PSI.
5. Supply Water Temperature and Temperature Differential:
    a. All Equipment and Piping within the Chilled Water System shall be designed for continuous operation at a Supply Water Temperature of 7^{o}C / Delta T: 9.4 ^{o}C
    b. All Equipment and Piping within the Chilled Water System shall be sized based on a Supply Water Temperature of 9^{o}C.

5.1.5.3 Cooling Distribution Pumps

1. Where provided, Pumps shall be sized and arranged such that each Pump can support at least 75% of the peak cooling demand.
2. Pumps shall the Vertical-in-Line Type, Split-Coupled for Motors larger than 10 HP.
3. Pumps shall incorporate Variable Frequency Drives
4. Pump Speed Control shall be based on an Input Signal from a remotely mounted Pressure or Differential Pressure Sensor.
5. Sensorless Drives are not permitted.
6. Dedicated Point-of Use Cooling Systems shall be provided only as detailed below and:
    a. Use of DX Cooling Systems including Split Ductless Units is permitted only in buildings without a chilled water supply from the Central Utility Plant or where it deemed uneconomical to extend chilled water piping to provide point-of-use cooling. In each of these instances comply with the following:
        i. A choice to use DX Cooling Systems or Split Ductless Units is to be tabled for consideration and approval by the GTAA Project Manager and Design Discipline Team Lead, and
        ii. The Capacity of the DX Cooling Systems or Split Ductless Units Specs for Split Ductless Units is no more than 5 Tons.

b. Use of DX Cooling Systems is mandated for Computer Room Cooling and Other Critical Applications as identified by the GTAA. In such instances the DX Cooling Equipment shall incorporate the following features:
    i. A Chilled Water Coil in Series with the DX Cooling Coil; Motorized Chilled Water Supply Isolation Valve external to the Cooling Unit
    ii. A Free-Cooling Economizer using Liquid Refrigerant or Glycol
    iii. On-Board Leak Detection to Switch from Chilled Water Cooling to DX Cooling and Close the Chilled Water Supply Isolation Valve in the event of a Leak
    iv. Electric Reheat c/w SCR Controls
    v. Electric Infra-red Humidification System
    vii. Refer to GTAA Acoustic and Ventillation Standard for additional requirements.

7. Halocarbon Tags
    a. Complete and update all relevant Halocarbon tags in accordance with SOR/2003-289.
    b. Include within the Contractor's Scope of Work to complete and update all GTAA Halocarbon tags, forms and service logs as per SOR/2003-289 for the decommissioning of any existing DX Equipment called to be removed and installation and commissioning of the new DX Equipment.
    c. Obtain from the GTAA Project Manager the contact information for GTAA's Representative tasked with managing the Halocarbon Tag Database for the Airport.

5.1.5.4 Fans

1. Supply Air Fans within Air Handling Units shall be arranged as outlined under Section 4.6.3 Air Handling Units.
2. Fans to be designed to provide 10% Excess Capacity on Flow and 10% Spare Capacity on External Static Pressure relative to Peak Design requirements.
3. Submit Airflow and Pressure Drop Calculations as a part of the Schematic Design.
4. Loose Return Air Fans shall be sized to match the installed Supply Fan Capacity.
5. Return Air Fans shall incorporate Variable Frequency Drives.

5.1.5.5 Washroom and General Exhaust Fans

1. Sized and Arranged to afford 100% Redundancy
2. Floor Mounted Fans shall be mounted on Spring Isolators
3. Ceiling Hung or Duct Mounted Fans shall be suspended using Spring Hangers.
4. Acceptable Fan Types: Inline centrifugal, Plug, Base Mounted Centrifugal (SWSI or DWDI), Axial Flow Fans, Cabinet Fans
    a. Select Fan Type to provide most efficient performance under Design Conditions.
    b. Fans to be designed to provide 10% Excess Capacity on Flow and 10% Spare Capacity on External Static Pressure relative to Peak Design requirements.
5. Submit Airflow and Pressure Drop Calculations as a part of the Schematic Design.

5.1.5.6 Kitchen Exhaust

1. Where a Kitchen Exhaust Hood is required for Tenant Operations, the Hood shall be hooked up to a Tenant Supplied Ecology Unit. Discharge of the Ecology unit shall be connected to a Base Building Kitchen Exhaust Duct.
2. Base Building Kitchen Exhaust Ducts and Fans shall be designed and installed in compliance with NFPA 96.

5.1.5.7 Fans Sized and Arranged to afford a 100% Redundancy.

1. Acceptable Fan Types: Base Mounted Centrifugal (SWSI or DWDI).
    a. Fans to be designed to provide 10% Excess Capacity on Flow and 10% Spare Capacity on External Static Pressure relative to Peak Design requirements.

b. Submit Airflow and Pressure Drop Calculations as a part of the Schematic Design.

5.1.6 Air Distribution System – Ductwork

5.1.6.1 Materials

1. Galvanized Steel, G90 for Supply Air Systems
2. Stainless Steel, SS 316 for Shower Exhaust System (first 50 Feet)
3. Aluminum for Washroom Exhaust Systems (first 25 feet)
4. Fire Rated Ductwork in accordance with NFPA 96 for Kitchen Exhaust Systems

5.1.6.2 Jointing System

1. Designed in accordance with SMACNA Standards to withstand the intended system operating pressure and application.

5.1.6.3 Balancing Dampers

1. Shall be provided at every on every main, sub-main, branch-main and branch ducts (definitions as per ASHRAE systems hand book) and at locations required to perform testing, adjusting and balancing.

5.1.6.4 Relief Dampers

1. Shall be provided at every on every return/exhaust system sized at 4500 L/S or higher and located within or near the return/exhaust fan inlet ductwork.
2. Locate fan units to be easily accessible for routine maintenance.

5.1.6.5 Security Provisions

1. Ductwork crossing the Airport Prime Security Line shall include provisions of the GTAA Engineering, Architectural Design Requirements.

5.1.7 Supply Air Systems

1. Fabricated from Galvanized Steel, G90, and Gauge as per SMACNA for the Size, Service Class and Application.
2. Air Distribution System arranged with Terminal Units c/w Attenuators:
   a. Dedicated Terminal Unit for each Executive Office, Board Room or Meeting Room.
   b. No more than three (3) Private Offices on a Single Terminal Unit Zone.
   c. Maximum Area of Coverage for a Single Terminal Unit Zone: 1500 sq. ft.
   d. No Supply Air Diffuser/Grille in Public Washrooms.

5.1.8 Washroom Exhaust Systems

1. Fabricated from Aluminum for the first 25 Feet or up to the first Vertical Riser (whichever is less) and Galvanized Steel thereafter; Gauge as per SMACNA for the Size, Service Class and Application.
2. Exhaust Air Grilles arranged in a Linear Fashion across the entire length of a Washroom Bank:
   a. Grilles to be Aluminum Construction and positioned over Water Closets and Urinals.
   b. One Grille directly at the Entry to the Washroom.

5.1.9 Shower Exhaust Systems

1. Fabricated from Stainless Steel for the first 50 Feet or up to the first Vertical Riser (whichever is less) and Galvanized Steel thereafter; Gauge as per SMACNA for the Size, Service Class and Application.
2. Exhaust Grilles to be Stainless Steel Construction.

5.1.10 Special Exhaust Systems

1. Provide General Exhaust Grille(s) sized for a minimum exhaust airflow of 150 CFM over Photocopiers and Printers.
2. All exhaust systems shall be serviceable for annual cleaning and clearing of debris.

3. Kitchen exhaust systems shall have sufficient fire alarm and suppression systems as per code.
4. Kitchen exhaust systems shall be powered to ensure that sufficient exhaust is maintained throughout the ducting and at exit of system.
5. Kitchen exhausts shall have platforms and tie off points to all for maintenance workers to access ducts, fans, and bends with tools and cleaning supplies.

5.1.11 Intake and Exhaust Louvers

1. Intake and Exhaust Louvers shall be arranged in accordance with NFPA 415 and to assure no cross-circulation from the Exhaust to the Intake.

5.1.12 Hydronic Piping Systems

1. Materials Black Steel, Schedule 40 or copper
2. Black Steel Jointing Systems
    a. Screwed or Welded Connections: NPS 2 and under
    b. Welded Connections: NPS 2½ and larger.
    c. Flanged Connections NPS 2½ and larger (Mechanical Rooms and Equipment Connections only)
    d. Grooved Joint System (Victaulic) – only within Mechanical Rooms and with prior approval of the GTAA Project Manager and GTAA Engineering and Utility Team.
    e. Use of Pressfit Joints is not permitted.

5.1.13 Copper Pipe Jointing System

1. Soldered or brazed.
2. Grooved Joint System (Victaulic) – only within Mechanical Rooms and with prior approval of the GTAA Project Manager and GTAA Engineering and Utility Team.
3. Use of Pressfit Joints is not permitted.

5.1.14 Valves

1. Manual valves shall be provided at a minimum at the following locations:
    a. At individual equipment for isolation
    b. On every branch pipe serving more than three (3) individual equipment or having a length more than 20m.
    c. Upstream of all control valves.
2. Valves shall be Ball, Globe or Butterfly Type- Stainless Steel Ball and Trim
3. High Performance Butterfly Valves for Isolating Incoming High Temperature Hot Water and Chilled Water extended from the GTAA High Temperature Hot Water and Chilled Water Distribution Mains.
4. All Valves, whether within Mechanical Rooms or in the Ceiling Space, shall be installed in readily accessible locations. Where a Valve within a Mechanical Room is located higher than 8’-0” above Finished Floor Elevation or over Equipment, Chain Operators shall be provided.

5.1.15 Humidification System

5.1.15.1 Renovation Projects

1. Maintain the design criteria followed for the existing installation.

5.1.15.2 New Construction Projects

1. Humidification Systems shall be designed around the use of Ultrasonic Humidifiers or High-Pressure Water Injection Humidifiers using Softened or RO Water as the source of humidification water.

Provide a Cost-Benefit Analysis for each of the above listed options to the GTAA Project Manager and GTAA Engineering and Utility Team for review and approval at the Schematic Design Stage.

5.1.16 Heat Tracing

1. Electric Heat Tracing shall be provided on all Water and Drain Piping installed outdoors or in areas such as Receiving/Loading Docks where "freezing" conditions could exist. Heat Tracing is not required on Water Piping filled with a Glycol Mix.
2. Pipe 100 mm (NPS 4) and Smaller: Single Heat Trace Cable.
3. Pipe Larger than 125 mm (NPS 5) and Larger: Two Heat Trace Cables.
4. Heat Trace cable shall be the self-regulating type, sized and selected based on an ambient temperature of-30°F (with wind-chill).
5. Heat Trace cable shall be installed in accordance with the Manufacturer's recommendation. Insulation and jacketing shall be provided over all Heat Traced piping systems.
6. Heat Trace Cable Control System shall provide a BACNet output for remote monitoring of a Cable Fault or an Alarm Condition.
7. For sofit requirements refer to GTAA Roofing and Envelope Guideline

5.1.17 Insulation

1. All HVAC Equipment and Piping Systems shall be insulated in accordance with ASHRAE 90.1.
2. Insulation Thickness for all piping installed outdoors and exposed to the elements shall be 50% greater than the values recommended by ASHRAE for the corresponding operating temperature.
3. Insulation on Exposed Piping or Piping within Receiving Areas/Loading Docks and Mechanical / Service Rooms shall be jacketed with PVC. Where physical damage is a possibility, i.e. within 6 feet of the finished floor or adjacent to Working Platforms or outdoors near the Passenger Boarding Bridge, Aluminum or Stainless-Steel jacketing shall be used.

5.1.18 Identification

5.1.18.1 Pipe Identification

1. All Piping shall be identified using Flexible Coil Wrap Pipe Markers listing at a minimum the following: Service; Direction of Flow.
2. Identification shall be provided every 50 feet or every change in direction and within 3 feet on both sides of any Wall or partition.

5.1.18.2 Duct Identification

1. All Ductwork shall be identified using Adhesive Labels or Stenciled Letters listing at a minimum the following: Fan Number; Service – Supply/Return/ Exhaust; Direction of Airflow.
2. Identification shall be provided every 50 feet or every change in direction/

5.1.18.3 Valve Identification

1. Brass Valve Tags shall be provided at each Valve

5.1.18.4 Equipment Identification

1. Identification plates shall be provided for each equipment identified with number designations in schedules and equipment selection sheets.
2. Laminated Plastic, White Face Black Center; minimum size 90mm x40mm x2.5mm; engraved with 10 mm high lettering.

5.1.19 Air and Water Balancing

1. All Air and Water Balancing shall be performed by National Environmental Balancing Bureau (NEBB) Certified Contractors holding a current and valid license to provide the required services.

5.1.20 Motors

1. All motors used in the Baggage System are not applicable to this design standard. Designers, Consultants and Engineers shall reference Baggage Specifications.
2. All Motors 5 HP (3.73 kW) and Larger shall be Premium Efficiency rated for Invertor Duty. Motors under 5 HP (3.73 kW) shall be High Efficiency.
3. Invertor Duty Rated Cables shall be used for wiring between a Variable Frequency Drive and the corresponding Motor.
4. Reference GTAA Acoustic and Vibration standard for additional requirements.

5.1.21 Variable Frequency Drives For Indoor Applications

1. VFD's shall be CSA listed, mounted in CSA Standard C22.1 Type 2 enclosure and incorporate at a minimum the following:
    a. Door mounted disconnect and by-pass switch handles
    b. Input Harmonic Filters to limit total harmonic distortion (THD) measured at filter input terminals to values set out in IEEE 519; voltage distortion to be 3% as set out in Table 10.2 of IEEE 519; AND total current demand distortion to be as set out in Table 10.3 of IEEE 519 for ratio of available short circuit current to VFD demand load current (Isc/Iline) at a value defined by the Designer for the specific installation.
    c. RFI filter, input transient protection, 5% impedance input line reactor and output LC load reactor.
    d. I/O external interface- Input:
        - external dry contact closure for start/stop,
        - external dry contact for remote fault reset,
        - external dry contact for fireman's bypass,
        - 4-20 mA or 0-10 VDC input for speed setting from BAS or standalone instrumentation.
2. I/O external interface- Output:
        - 4-20 mA or 0-10 VDC speed current value,
        - dry contact for drive-run status.
3. Bypass Starter:
        - Combination across-the-line magnetic starter ahead of VFD.
        - By-pass switch to Off and Bypass position; simultaneously disconnect input and output of VFD and provide total isolation of VFD in off and by-pass positions.
4. Test and Bypass: disconnect VFD output contacts, and run motor on bypass, to permit diagnostic testing of VFD. In bypass position motor will be controlled from external dry run contact in magnetic starter control circuit and protected from current overload by conventional relaying in combination magnetic starter.

5.1.22 Building Automation Systems (BAS)

1. The GTAA Campus operates on the Johnson Controls Metasys Direct Digital Control BAS platform; all new BAS work shall be designed and arranged to operate on this platform.
2. All new Controls Work including supply and installation of Sensors, Devices and BAS Infrastructure shall be by Johnson Controls (JCI); use of Standalone Factory Installed Controllers is not permitted.
3. Where new Control Panels are installed, provide a minimum of 25% Spare I/O's in each new Control Panel for future use.
4. All BAS Control Panels shall incorporate a UPS Supply to ensure Controllers remain online in the event of a Power interruption.

5.1.23 General Requirements

5.1.23.1 Service and Maintenance Clearance

1. All Equipment whether located in Mechanical Rooms, Ceiling Space or simply suspended from the underside of the building structure, shall be installed with minimum service and maintenance clearances as recommended by the supplier/manufacturer.
    a. Identify service and maintenance clearance on the drawings.
    b. For Equipment located in the Ceiling Space or simply suspended from the underside of the building structure, demonstrate that the Equipment can be readily accessed for service, maintenance and replacement.
    c. For Equipment in Mechanical Rooms, identify path of travel between the Equipment and Door(s) leading into the Room.

5.1.23.2 Equipment Schedule

1. Equipment Schedules listing Performance Criteria shall be included on the Drawings. At the minimum the Schedules shall include the following: Air Handling Units, Fans, Coils, Pumps, Boilers, Chillers, Heat Exchangers, Expansion Tanks, Pressure Regulating Devices, Fan-coil Units, Humidifiers, Silencers, Terminal Units, Diffusers and Grilles, and HVAC Specialties.

5.1.24.3 Piping Installation

1. Except as permitted below, Water or Gravity Condensate Drain Piping shall not be routed over or through Electrical Rooms/Closets, IT/COMM Rooms/Closets, Computer Rooms or Other Spaces intended to accommodate Electrical, IT or Communications infrastructure.
    a. Gravity Condensate Drain Piping extended directly from a HVAC Equipment within the Space, in the Space directly above or a Space in the immediate vicinity of the Spaces listed above.
    b. Water or Gravity Condensate Drain Piping may be routed over or through the Spaces listed above provided there is no other practical alternate path available to route the piping. In such instances:
        i. The proposed arrangement shall be presented for the approval of the GTAA Project Manager and the GTAA Engineering and Utilities Team before the finalization of the Design Development Phase, and
        ii. Where permitted the Piping shall be installed without any Mechanical Joints or Couplings, i.e. all piping both Water and the Gravity Condensate Drain Piping to be fabricated using Welded or Soldered Connections and protected with an Aluminum Drip Tray c/w Leak Detection extended over the entire run over these Spaces. Leak Detection shall be interfaced with the Building Automation System.

5.1.23.4 Demolition and Removals

1. Piping Services to Equipment being removed shall be cut back and capped at the Main Services.
2. Ductwork associated with Equipment being removed shall be cut back and capped Main Trunk Ductwork on the Upstream side and removed in its entirety if not being reused on the Downstream side.
3. Location of Piping Caps to be clearly identified on the As-Built Drawings.

6. Mechanical - Combustion Systems

6.1 Generators

For all matters relating to diesel or gas fired generators, Designers, Consultants and Engineers are directed to contact the GTAA Project Manager.

6.2 FESTI ARFF Systems

For all matters relating to ARFF, Designers, Consultants and Engineers are directed to contact the GTAA Project Manager.

7. Mechanical - Fueling Systems

7.1 Natural Gas Distribution

For all matters relating Natural Gas distribution, Designers, Consultants and Engineers are directed to contact the Manager, Facilities Systems Engineering.

7.3 Aviation Fuel Distribution and Storage

For all matters relating to aviation fuel distribution and storage, Designers, Consultants and Engineers are directed to contact the Manager, Facilities Systems Engineering.

7.4 Aviation Fuel Measurement

For all matters relating to aviation fuel measurement, Designers, Consultants and Engineers are directed to contact the Manager, Facilities Systems Engineering.

8. Fire Alarm and Monitoring Systems

8.1 Responsibility for Emergency Response on Airport Lands

1. GTAA Fire & Emergency Services (F&ES) has full responsibility for first response to structural fires for all buildings and facilities on the airport contiguous lands.
2. Mississauga Fire & Emergency Services (MF&ES) role is as back-up to GTAA F&ES as and when requested by the GTAA.

8.2 Airport Campus Fire Alarm Monitoring

1. The GTAA campus Life Safety Network Monitoring System (LSNMS) consists of the OnyxWorks Monitoring System which is linked to the monitored buildings via the GTAA campus fiber and copper communications network.
2. The primary user of the LSNMS is the Integrated Operations Control Center (IOCC) whom are responsible for carrying out the campus emergency call response and dispatch functions i.e. airport emergency 911 functions.
3. Upon receiving a signal via the LSNMS or receiving a phone call on the airport emergency line (416-776-3033) from any facility on airport lands, the IOCC is responsible for the emergency callouts to the GTAA Response Teams, GTAA Fire & Emergency Services (F&ES), Police, and Ambulance.

8.3 GTAA Fire Alarm System Monitoring

8.3.1 Fire Alarm System Monitoring Classification

1. The following building classifications within airport lands shall be monitored by the GTAA Life Safety Network Monitoring System (LSNMS):
    a. GTAA owned, occupied and maintained buildings.
    b. Airport Terminal Facilities.
    c. Nav Canada owned and operated buildings.
    d. Airfield Service Buildings

e. Miscellaneous buildings as determined by the GTAA.

2. All work related for the LSNMS interface shall be by an authorized Notifier Fire Alarm Systems Integrator (LSNMS Contractor) with all associated equipment and installation costs carried by the project fire alarm contractor. All work must be approved by and coordinated with the GTAA Life Safety Engineer and the Technical Specialist, Life Safety Systems (TSLSS).
3. There are two levels of monitoring that can be incorporated for new fire alarm systems that are being interfaced to the LSNMS. The level of fire alarm system monitoring will be determined by the GTAA.
    a. Point-by-Point System Monitoring:
        i. Each possible alarm, supervisory, and trouble condition, or any other event that can be generated by the local Fire Alarm Control Panel (FACP), shall be uniquely transmitted into the LSNMS.
        ii. Each event shall automatically call up an electronic floor plan on the LSNMS and indicate the location of the event on the floor plan by means of a flashing icon.
        iii. The FACP shall accept remote commands from the LSNMS for the Acknowledge function if required by the GTAA (usually required for Terminal Buildings only).
    b. General System Monitoring:
        i. Only a general system alarm and trouble condition are transmitted into the LSNMS.
        ii. Each event shall automatically call up that building's general site plan on the LSNMS that indicates the locations of the fire alarm panel, annunciator fire alarm panels, suppression systems control valves, fire department pumper connections, gas shut-off, fire hydrants and building entry points.

8.3.2 Monitoring Tie-in of New Fire Alarm Systems to the LSNMS

1. The Fire Alarm Contractor (FA Contractor) shall supply and install:
    a. A ULC listed Network Input Output Node (NION) complete with a ULC listed power supply. The NION shall be installed next to the FACP complete with all necessary connections between the NION and the FACP.
    b. A by-pass function, key-switch or soft key, to bypass network monitoring to the IOCC.
        i. The fire alarm panel and IOCC monitoring will be in trouble conditions while the by-pass function is in use.

c. A conduit and all required conductors, from the NION to the building's communications room.

2. GTAA will be responsible for the copper/fiber media between the building's communications room and the IOCC. The FA Contractor shall advise the owner exactly the quantity and type of conductors required. The FA Contractor shall be responsible for the final connections between the GTAA supplied media, and the NION.
3. The building owner/owner's representative will provide a digital copy of the floor plans and/or site plan which will be turned over to the LSNMS Contractor to add to the existing LSNMS database. No costs associated with changes to the floor plans before Substantial Performance will be allowed.
4. The FA Contractor shall provide accurate fire alarm Record Drawings to the LSNMS Contractor. The Record Drawings shall indicate the device location with the device address and description of each device connected to the fire alarm system.
5. The LSNMS contractor shall supply all equipment and labour required for the installation at IOCC. The LSNMS Contractor shall update the existing LSNMS database to include the data for the new building. The LSNMS Contractor shall co-ordinate the creation of the floor plans and device layout with IOCC staff.
6. The final connections between the LSNMS and the local FACP shall not be made until the LSNMS contractor has completed updating the LSNMS database. Also, the final connection shall not be

made until the Verification of the building fire alarm system has been completed. The contractors shall not initiate “nuisance” event transmissions to the LSNMS as this creates disruption at IOCC.

7. Once the LSNMS database has been updated and the building fire alarm system is connected to the LSNMS, a full test shall be performed. The intent of this test is to ensure the location of the devices’ input on the LSNMS database matches the actual device locations in the building.
8. The FA Contractor shall include a printout of the LSNMS floor plans and site plan in the Maintenance Manual.

8.3.3 LSNMS Graphic Modifications

1. Modifications to floor plan layouts must be updated and submitted to the LSNMS contractor to update the LSNMS graphic screens including all architectural and fire alarm device changes.

8.4 Non-GTAA Fire Alarm System Monitoring

8.4.1 Central Station Fire Alarm System Monitoring

1. Fire alarm systems for facilities on airport lands that are not monitored by the GTAA and the LSNMS must be remotely monitored by a ULC Listed Fire Alarm Monitoring Company which has been listed in accordance with CAN/ULC- S561 – Standard for the Installation and Services for Fire Signal Receiving Centres and Systems.
2. Final system testing must be witnessed by GTAA Fire Prevention and a copy of the monitoring system printout of the final testing results must be provided upon completion of the testing.
    a. The monitoring station shall provide a company letter indicating their ULC compliance of the station and the monitoring services for the building.
3. Upon commissioning of the facility, the building owner or his representative is responsible for establishing a response protocol between the ULC Listed Monitoring Company and GTAA’s Integrated Operations Control Centre (IOCC) who are responsible for the emergency response callouts (i.e. perform the airport emergency 911 functions) to all facilities and buildings on airport lands. Note that all emergency situations must be reported via the airport emergency line (416-776-3033) and that calls to 911 may cause delays in response to emergency situations.

8.5 Fire Alarm Ancillary Systems and Equipment

8.5.1 Electromagnetic Locking Devices (Maglocks)

1. All electromagnetic locking device installations shall comply with the requirements of the National Building Code.
2. The locking device and all similar locking devices on all intervening doors within the egress path to the exit door must release upon actuation of the fire alarm system in compliance with the fire alarm door release sequence of operations.
3. Final inspection and testing must be witnessed by GTAA Fire Prevention with all required documentation submitted prior to testing and must include:
    a. Fire alarm system manual station verification report, and
    b. Electrical Safety Authority inspection report.

Note: Maglocks are not to be activated and put into service until completion of final inspection & testing which must be witnessed by GTAA Fire & Emergency Services.

8.5.2 Passive & Active Graphics

1. Facilities with fire alarm systems with no computer graphic interface, an active or passive graphic must be provided adjacent to the fire alarm system annunciator for fire fighter's reference when responding to alarm activations.
2. The passive graphic must be reviewed by GTAA Fire & Emergency Services and must include:
    a. The entire building layout clearly labelled with all areas, fire alarm and sprinkler zones that correspond to those indicated on the annunciator.
    b. Locations of all supervised valves.
    c. Locations of all major service and equipment rooms, gas shutoff, etc.
    d. "You Are Here" indication and locations of all building entry/exit points.

8.5.3 Graphic Modifications

1. Alterations to architectural layouts or system components shall be modified on the computer, passive or active graphic display and all changes must be reviewed by GTAA Fire & Emergency Services.

8.5.4 Automatic External Defibrillators (AED)

1. As part of GTAA's commitment to the health and welfare of all members of the airport community, a public access Defibrillation Program has been implemented and is being coordinated by GTAA Fire & Emergency Services EMS Instructor (F&ES) who oversees maintenance, new installations and assures implementation of the training program.
2. The Public Access Defibrillator Program requires the maximum travel distance to an AED shall not exceed 75m / 250 ft. with all walls, doors and furniture installed.
    a. Secure doors shall be considered as a wall for the purpose of maximum travel distance to an AED.
    b. Primary Security Line is considered a wall and shall not be breached to access an AED.
    c. New installations must be reviewed with and approved by F&ES prior to installation.
3. The AED devices shall be model AED 3 manufactured by Zoll or equivalent as approved by GTAA F&ES.
4. Defibrillator cabinets shall be stainless steel SPL AED Recessed Cabinet Assembly (14" x 22" x 8" Tub I.D.) with glass/acrylic windows. The base of the cabinet shall be 1200mm above finished floor.
    a. A pressure plate switch shall be provided and monitored by the fire alarm system to activate a fire alarm system supervisory condition when the AED is removed from the cabinet.
    b. The location of the AED will be clearly identified and indicated on the fire alarm graphic display.
    c. A key switch shall be installed to by-pass fire alarm system activation during maintenance procedures.
        i. The fire alarm system will indicate a trouble condition when the key switch is not in the normal position.
        ii. The key can only be removed when the switch is in the normal position.
    d. The fire alarm supervisory event shall be non-latching, placement of the AED on the pressure switch will restore the supervisory event.
5. Each cabinet will be provided with a Stop the Bleed Kit placed in the upper section of the cabinet following commissioning by GTAA F&ES.
6. The Public Access Defibrillator Program has placed defibrillators in all public areas based on the maximum travel distance indicated above.
    a. New installations must be reviewed with and approved by F&ES prior to installation.

b. GTAA standardized AED identification signage shall be installed 300 mm to 380 mm maximum above the top of the cabinet. Refer to the GTAA Signage Manual for sign specifications.
c. GTAA standardized AED blade signage shall also be installed to match other blade signage within the building. Refer to the GTAA Signage Manual for sign specifications.
d. Every AED cabinet shall be assigned a unique location/identification code which must be used in the programming of the device into the base building fire alarm systems.
e. Location and Identification code shall be provided by F&ES.

7. Surface mounted AED cabinets shall be installed in compliance with barrier free design requirements, specifically Section 3.4- Protruding Objects, of CAN/CSA-B651-95.
8. Once installation is completed, the cabinet functions must be fully demonstrated to F&ES including the indication to the IOCC to ensure the proper location/identification description as assigned properly annunciates.
9. Once the cabinet is fully tested and found to be properly functioning, the defibrillator unit will then be installed into the cabinet by F&ES thus putting the AED station into service.

8.5.5 Baggage System Fire Shutters (BFS)

1. Provide motorized shutter at each baggage conveyor opening through a fire separation.
   a. The shutter shall be smoke, and fire rated equivalent to the fire separation rating.
2. Provide smoke detection on both sides of the baggage conveyor opening.
3. Provide fire alarm system relay to close the shutter upon activation of a Second Stage fire alarm condition in the area of the shutter.
4. Refer to detail BFS.

8.5.6 Fire Alarm System Modifications

1. Fire alarm system modifications shall be compliant with the NBC and applicable ULC-S524 Fire Alarm Installation Standard.
2. The GTAA has provided base building fire alarm coverage within all Tenant areas in accordance with the National Building Code and applicable CAN/ULC Standards. The fire alarm and monitoring equipment includes:
   a. For Terminal 1 – Simplex 4100ES Fire Alarm Network with TrueSite Fire Alarm Monitoring Graphic Workstations. The T1 Fire Alarm System is integrated with the building IED Paging System to utilize the PA amplifiers & speakers for delivery of the fire alarm tones & voice messages throughout the Terminal 1 Building. Remote emergency voice communication capability has also been provided from the ADMIN-IOCC & T1-IOCC remote monitoring locations.
   b. For Terminal 3, T3 Satellite & T3 Parking Garage – Simplex 4100U & 4100ES Fire Alarm Networks with TrueSite Fire Alarm Monitoring Graphic Workstations. The Terminal 3 FA System is integrated with the building IED Paging System which utilizes the FA amplifiers & speakers for delivering the PA functions throughout the Terminal 3 Facilities. Remote emergency voice communication capability has also been provided from the ADMIN-IOCC & T1-IOCC remote monitoring locations.
   c. For All Other Facilities on Airport Lands – Notifier Fire Alarm Panels monitored by the Campus ONYXWorks Fire Alarm Monitoring Network & Graphic Workstations. The T1 Parking Garage, Viscount Parking Garage, APM Stations and the Infield Hold Terminal have been provided with local emergency voice communication capability within each building and remote emergency voice communication capability from the ADMIN-IOCC & T1-IOCC remote monitoring locations.

3. All new equipment shall be compatible with the GTAA LSNMS (OnyxWorks or TrueSite) and connected to the monitoring network.
4. All Class A or Class B circuits shall be maintained.
5. All new fire alarm devices shall be addressable except for cold or damp areas where conventional devices shall be used with remote addressable monitor modules in warm and dry areas.
6. Exterior Manual Stations subject to outdoor weather conditions shall be installed to prevent weather from damaging the device.
7. Conduit shall enter the manual station back box from below and be provided with a water trap.
8. A back plate shall be provided behind the manual station to accommodate a weather proof cover.
9. All new fire alarm raceway shall be "red" in colour.
10. All areas subject to moisture such as sprinkler rooms shall have all fire alarm cable within liquid-tite raceways and connectors with liquid-tite junction boxes.
11. Sprinkler and standpipe system air compressors shall be supervised by the fire alarm system for power loss conditions.
12. All fire alarm circuit junctions shall be provided with labelled terminal strips, twist-on wire connectors shall not be permitted.
13. T-Tapping of any circuit is not permitted.
14. All fire alarm junction boxes shall be permanently identified indicating fire alarm circuit and identify source(s) and destination(s).
15. All field devices shall be visible and documented on floor plans and all reports.
16. Floor plan device layouts shall be updated on all the local workstation graphics and monitoring system graphics including modification to all static graphic displays.
17. Fire Alarm as-built / record drawings shall include:
    a. Fire alarm device type and system address.
    b. Indicate all raceways, wiring and junctions.
    c. Indicate quantity and size of conductors within raceway.
    d. Include junction box details and legend.
18. All new or relocated devices shall be tested and verified in compliance with the applicable ULC-S537.
19. All verification reports shall include signal circuit (speaker, horn, strobe, and bell) load reports for all fire alarm and integrated paging systems.
20. All fire alarm modifications shall be subject to Commissioning and Close Out requirements as indicated in this document.
21. In instances where a fire alarm control unit (CPU) is replaced, a complete CAN/ULC S537 verification shall be performed. A program comparison prior to any modifications shall be deemed equivalent to the S537 verification.

8.6 Fire Suppression Systems & Equipment

8.6.1 General

1. All new equipment shall be in service for a minimum of (5) five years with proven serviceability ratings.
2. All identification labels shall be compliant with GTAA label standards.

8.6.2 Fire Main and Hydrant Systems

8.6.2.1 Classification of Hydrants

1. Hydrants should be classified in accordance with their rated capacities (at 1.4 bar residual pressure or other designated value) as follows:

a. Class AA- Rated capacity of 5,680 L/min or greater.
b. Class A- Rated capacity of 3785-5,675 L/min.
c. Class B- Rated capacity of 1,900- 3,780 L/min.
d. Class C- Rated capacity of less than 1,900 L/min.

2. Fire Hydrants shall be colour coded in compliance with NFPA 291.

8.2.2 Airport Fire Main and Hydrant Design

1. All design, installations and/or alterations to the Airport fire main and hydrant system shall comply with the applicable codes and standards for such construction and shall be prepared and reviewed by a Professional Engineer.
2. Drawings, specifications, calculations and shop drawings for the system shall be signed and sealed by a Professional Engineer and submitted to the Construction Control Office for review. Refer to the Airport Construction Code Section 3.3 – Facility Alteration Permit (FAP) for submission requirements. All shop drawings shall be reviewed before commencing the installation.
3. The Hydrants shall be manufactured in accordance with AWWA Standard C-502, shall be listed with ULC and FM, and be provided with the following:
   a. 2 only 63.5mm Hose Nozzles with CSA Standard thread, 5TPI, 73.4mm OD, Mueller code 12B,
   b. 1 only 100mm Storz Pumper Connection as per ULC S-520,
   c. Hydrant open counter clockwise (open left), 31.75mm nuts.
4. Fire hydrants shall be located and placed in accordance with the National Building Code, and Schedule "A" of City of Mississauga By-Law 1036-81. Hydrants that may be subject to vehicle damage shall be protected with 100mm diameter, concrete-filled, steel pipe bollards.

8.6.2.3 GTAA Hydrant Classification, Installation and Finish Requirements

1. The Construction Control Office shall inspect all stages of underground installations and witness testing procedures before backfilling commences and before final commissioning of the system.
2. The tops and nozzle caps of all hydrants on airport lands are to be classified and colour coded with the following capacity-indicating colour scheme:
   a. Class AA- Light blue (R93, G212, B217, C1, M99, Y95, K0)
   b. Class A – Green (R93, G200, B61, C59, M0, Y98, K0)
   c. Class B – Orange (R218, G135, B63, C5, M50, Y85, K0)
   d. Class C – Red (R217, G46, B33, C1, M99, Y95, K0).
3. All GTAA hydrant barrels are to be painted GTAA standard yellow (R247, G198, B0, C0, M20, Y100, K0). Recommended product: ICI Devflex #4208 waterborne acrylic gloss enamel; colour – “Slicker” (39YY 66/183).
4. All tenant hydrant barrels on airport lands are to be painted GTAA standard red (R217, G46, B33, C1, M99, Y95, K0).
5. All GTAA hydrant protection bollards shall be installed to GTAA standards and painted GTAA standard red (R217, G46, B33, C1, M99, Y95, K0).
6. For hydrant general installation and identification requirements, refer to the Detail HYD-1 & Detail HYD-2 (See Standard Details).

8.6.2.4 Fire Hydrant Anti-Tampering Devices (ATD’s)

1. To deter unauthorized use or tampering and to provide an indication for the fire fighters the hydrant is in good operating condition, all GTAA owned fire hydrants (yellow barrels) must be provided with an ATD.
2. Anti-tampering devices which are labeled “For Authorized Use Contact 416-776-3055” may be obtained through GTAA’s Utilities Department.
3. Once sized to fit the specified fire hydrant, the ATD should be installed as follows:

a. The ATD should be installed to sit on the top operating nut with the side band notches snuggly fitting over the nuts of each side port.
b. Steel banding is strapped through each side port on the ATD band and around the hydrant barrel. Metal clips are then installed and crimped to hold the steel banding together.
c. ATD devices are to be installed only after all flow testing and commissioning is completed which must be witnessed by GTAA Fire Prevention and/or GTAA Life Safety Engineer.
d. Upon completion of the hydrant flow testing, copies of the flow test results are to be distributed to the following via e-mail or hardcopy:
    i. GTAA Life Safety Engineer
    ii. GTAA Fire Prevention
    iii. GTAA Construction Compliance & Permit Office
    iv. GTAA Senior Representative – Corporate Risk.

4. Once hydrants are commissioned and turned over to the GTAA, any subsequent used of the hydrants requires a Life Safety Systems Shutdown Request which must be arranged through the GTAA MTC (6-work (9675)).

8.6.3 Sprinkler and Standpipe Systems

8.6.3.1 Welded Piping

1. Fire and Emergency Services Fire Prevention Division shall be contacted to inspect welded piping prior to installation.
    a. All Hot Permit requests shall be issued by the prime contractor and the CCPO and Fire Prevention will perform random site audits.
    b. Contractors can refer to the CCPO website.

8.6.3.2 Dry Sprinkler Systems

1. Dry sprinkler piping and couplings shall be galvanized.
2. Dry sprinkler pipe shall be minimum Schedule 40 unless protected by ice plug prevention system where Schedule 10 may be used. See 8.6.5 for details.

8.6.3.3 Control Valves & Supervision

1. All isolation valves shall be installed below 1.5m AFF and clear of all electrical sources.
    a. Valves shall be located within service rooms or in a locked cabinet.
    b. Valves shall be located on the same floor as the protected area.
2. Sprinkler / Standpipe valves shall not be gear driven.
3. All sprinkler and standpipe system control valves including outside Post indicator valves (PIV) must be electrically supervised and monitored by the adjacent building fire alarm system.

8.6.3.4 Test and Drain Assemblies

1. All sprinkler systems shall be provided with sufficient isolation valves and individual check valves for each building module and system zone to achieve localized shut-downs for system drain-downs and re-filling when required for maintenance and alterations.
2. All drains, inclusive of drum drips and low point drains, shall be placed in locations that are easily accessible for maintenance staff.

8.6.3.5 Fire Connection Cabinets

1. Appropriate signage must be installed on the FCC door to indicate the fire protection equipment within the FCC is for authorized personnel use only.
2. Fire hose cabinets installed outside or within garage areas shall be PVC plastic cabinets with break glass front and plastic hammer.

8.6.3.6 Standpipe and Fire Extinguisher Cabinets

1. Where new 65 mm fire department hose connections and fire extinguishers are provided, they shall be installed within a combined cabinet Model C-975E manufactured by National Fire or similar as approved by F&ES.
2. Standpipe and Fire Extinguisher cabinets installed outside or within garage areas shall be PVC plastic cabinets with break glass front and plastic hammer.

8.6.3.7 Standpipe Valves

1. Standpipe control valves within stairwells (Class I) shall be provided with tamper proof covers.

8.3.3.8 Sprinkler and Standpipe Modifications

1. Modifications to sprinkler and standpipe systems shall include revisions to the protected area indicated on the as-built / record drawing set.
2. The fire alarm graphic display within the LSNMS will be modified to indicate the new / revised protected area(s).
3. The fire alarm active or static graphic display will be modified to indicate the new / revised protected area(s).
4. Modifications to sprinkler and standpipe systems shall include revised / new sprinkler calculation placard(s) at the system riser(s).
5. Sprinkler / Standpipe as-built / record drawings shall indicate all distribution piping, pipe sizes, control valves, etc.
6. Control valves shall be supervised by the fire alarm system and be identified with the fire alarm system device address.
7. Sprinkler / Standpipe modifications shall include removal of all redundant / unused pipe back to supply source.
8. Sprinkler / Standpipe decommissioning shall include remove all redundant / unused pipe back to supervised supply valve.
9. Removal of any sprinkler supervisory devices shall include removal of fire alarm system devices, programming and graphic modifications to reflect all deletions from the system(s).
10. Sprinkler system modifications shall include new sprinkler head shop drawings, 10% spare heads and two manufacturer service wrenches.

8.6.4 Fire Pumps

1. Consideration shall be given to future expansion of any facility where an increase in fire pump capacity may be a concern. New construction/installations only.
2. All new and modified fire pumps shall be provided with a permanent posting including all Fire Pump Calculations. The posting shall be:
    - Laminated or a permanent Lamicoid.
    - Minimum size shall be 8.5” x 11”.
    - All documentation shall be original print version, no copies.
    - The posting shall be secured to an adjacent wall or on the fire pump controller.

8.6.5Ice Plug Prevention Systems

1. Dry sprinkler systems shall be provided with methods of ice plug/freezing protection.
    a. Newly installed systems may use either an UL/FM approved Nitrogen generator or an air compressor equipped with a twin-tower desiccant air dryer. The freeze protection method shall be sized according to both:
        - The largest system by volume for each sprinkler header
        - The total volume of all dry systems for each sprinkler header

b. Modifications to existing systems shall use a UL/FM approved air compressor equipped with a twin-tower desiccant air dryer. The compressor/air dryer combination shall be sized according to both:
- The largest system by volume for each sprinkler header
- The total volume of all dry systems for each sprinkler header

2. Where a wet sprinkler serves areas that may be susceptible to freezing (such as a vestibule), a UL/FM approved dry sprinkler shall be utilized.

8.6.6 Excess Pressure Pumps

1. Excess pressure pumps for wet sprinkler systems shall be minimum ¾ hp.

8.6.7 Air Compressors

1. Tank mounted air compressors for dry sprinkler or standpipe systems shall be minimum 5 hp.
2. The capacity of each air compressor shall take into consideration:
   a) The largest system by volume at each sprinkler header
   b) The total volume of every dry system at each sprinkler header
3. An air pressure maintenance device shall be installed on each dry system airline.
4. The fire alarm system shall monitor for power loss of all sprinkler and standpipe system air compressors.

8.6.8 Siamese Connections

1. Fire Department / Siamese connections shall be chrome plated brass with chrome plated plastic caps and identification signage.

8.6.9 Kitchen Fire Suppression Systems

1. Kitchen fire suppression system testing shall include balloon test.

a. Provide photographic records of all tests.

2. Provide easily accessible kitchen exhaust duct work with engineered safe access methods as required for inspection and cleaning.

8.6.10 Ecologizer Systems

1. Every kitchen exhaust hood system shall be provided with an Ecologizer system.
2. Provide easily accessible exhaust duct work with engineered safe access methods as required for inspection and cleaning.

8.6.11 Clean Agent Fire Suppression Systems

1. Clean agent fire suppression system shall utilize an appropriate inerting agent.
2. Where equipment above 480V must remain energized through the discharge of gas, the Engineer of Record shall provide their analysis in determining the minimum design concentration.

8.6.12 Foam Fire Suppression Systems

1. Foam fire suppression systems shall utilize a PFAS-free high expansion foam as the suppression agent.
2. System design shall include the equipment and documented method required to test the accuracy of the foam agent proportioner (inductor / educator) without discharging the system into the pipe distribution network.
3. Initial test of the foam fire suppression system may utilize an approved test agent.

8.6.13 Fire Extinguishers

1. Portable Fire Extinguishers for Buildings & Facilities.
    a. Where required by code or under direction of Fire and Emergency Services Fire Prevention Division, fire extinguisher(s) shall be provided and installed and shall be ULC Listed having a minimum rating of 6A-80BC.
    b. As-built drawings indicating the location, size and type of each fire extinguisher shall be provide to GTAA Fire Prevention for review.
2. Portable Fire Extinguishers on Aircraft Servicing Ramps or Aprons
3. For all existing and future new terminal construction/expansion, there will be one at least one ULC Listed wheeled fire extinguisher having a rating of not less than 80BC with a minimum capacity of 55 kg (125 lbs.) of agent per Emergency Fuel Shutoff.

4. The prominent and strategic positioning of wheeled fire extinguishers where the maximum distance between extinguishers does not exceed 60 m (200 ft.). Final positioning must be reviewed with and approved by Fire and Emergency Services Fire Prevention.
5. Temporary Aircraft Parking (Hard Stand) will be provided with a wheeled fire extinguisher for each aircraft.
6. All wheeled extinguishers provided will be owned & maintained by GTAA.

8.6.14 Special Application Extinguishers

6.6.14.1 Kitchen

1. Each kitchen area/room shall be provided with a new Class K fire extinguisher located adjacent to the entrance to the kitchen in compliance with NFPA 10.

6.6.14.2 Clean Agent

1. Each telecommunication or data equipment area/room shall be provided with a new Clean Agent fire extinguisher located adjacent to the entrance to the room in compliance with NFPA 10.

6.6.14.3 Class D

1. Each flammable metal area shall be provided with a new Class D fire extinguisher located adjacent to the entrance to the area in compliance with NFPA 10.

6.6.14.4 Foam

1. Each flammable liquid storage area shall be provided with a new AFFF foam fire extinguisher located adjacent to the entrance to the area in compliance with NFPA 10.

8.7 Fire Department Access & Emergency Planning

8.7.1 Fire Routes

8.7.1.1 Fire Route Designation

1. Site plan drawings showing all designated fire routes must be provided to and reviewed with Fire Prevention.
2. Fire routes must be in compliance with Mississauga BYLAW 1036-81.

8.7.1.2 Fire Route Requirements

1. Fire routes must be in compliance with Mississauga BYLAW 1036-81.

8.7.1.3 Posted Fire Route Signs

1. Fire routes must be in compliance with Mississauga BYLAW 1036-81.
2. All signs shall be bilingual.

8.7.1.4 Fire Route Modifications

1. Fire routes must be maintained in compliance with Mississauga BYLAW 1036-81.

8.7.2 Fire & Emergency Services Lock Box Key Program

8.7.2.1 F&ES Key Lock Boxes

1. GTAA Key Lock Boxes will be provided by Fire Prevention to be installed flush where possible by the contractor at location(s) as determined by Fire Prevention.
2. Keys will be provided and inserted into key box by GTAA Fire Prevention.

8.7.2.2 Elevator F&ES Key Lock Boxes

1. GTAA Key Lock boxes will be provided by Fire Prevention to be installed flush, where possible, by the contractor at 5'AFF adjacent to the elevator fire fighter operations key station normally located on the primary recall level.

8.7.3 Fire Safety Plans

8.7.3.1 Fire Safety Plan

1. GTAA will prepare Fire Safety Plan in compliance with Section 2.8 of the National Fire Code.
    a. The contractor shall provide the site / project information required to complete the Fire Safety Plan.
2. Two printed copies of the plan or one digital copy must be submitted to Fire Prevention for review and approval.
    a. One copy of the final approved Fire Safety Plan must be placed within the Fire Safety Plan Box.
3. GTAA Fire Safety Plan Box will be provided by Fire Prevention to be installed by the contractor by the fire response point(s) adjacent to the fire alarm annunciator panel(s) or at another appropriate location as determined by Fire Prevention.

6.7.3.2 Fire Safety Plan Review & Modifications

1. GTAA will review and modify the Fire Safety Plan as required.

8.8 Close-Out Testing Requirements

8.8.1 General Guidelines

1. The Work shall be the sole responsibility and be under the care, custody and control of the Contractor until the Construction Compliance & Permits Office (CCPO) has issued a Certificate of Acceptance.
2. The Contractor acknowledges that, before any Persons may occupy a building or part thereof, certain elements and life safety systems as defined in the Airport Construction Code must be tested, verified, and demonstrated to the Authority Having Jurisdiction (CCPO, Fire Prevention, LMDG, and/or designated representatives) to be fully operational.
3. The Contractor shall be solely responsible for arranging testing, scheduling, shutdowns, security and fire watch necessary for official demonstrations.
4. The Contractor and its Subcontractors shall supply all measurement devices and testing equipment as may be necessary.
5. All testing shall be performed by the Contractor as required by applicable codes and standards, to be witnessed by the AHJ.
6. All signals from GTAA monitored facilities shall register and record with the GTAA Integrated Operations Control Centre (IOCC).
    a. The Contractor shall have a fire alarm technician present at the IOCC to acknowledge all testing related trouble and alarm signals.

7. All testing of life safety systems shall be coordinated by the Contractor through the Maintenance Technical Centre (MTC), with a minimum of five (5) business days' notice from the Contractor prior to the actual testing.
8. The Contractor acknowledges that, within occupied buildings that are monitored by the IOCC, system testing is dependent on the extent of any operational impact, and accordingly system testing shall be scheduled for off-periods i.e. between 23:00 – 05:00 hours unless the GTAA provides its written consent otherwise.
9. Within other buildings or facilities, testing shall be arranged so as to be conducted during normal working hours.

8.8.2 Close-Out Testing and Acceptance Process

1. The Work shall be the sole responsibility and be under the care, custody and control of the Contractor until the CCPO has issued a Certificate of Acceptance.
2. The Contractor acknowledges the GTAA close-out testing and acceptance process has a number of stages the Contractor shall complete in their entirety to the satisfaction of the AHJ. These stages are as follows:
    a. Contractors' and Subcontractors' close-out testing prior to application for Substantial Performance of the Work
    b. GTAA demonstrations:
        i. Deficiency corrections,
        ii. Substantial Performance of the Work application,
        iii. Demonstration to the Authorities Having Jurisdiction,
        iv. GTAA Training.

8.8.3 Tests and Inspection Items

8.8.3.1 Architectural, Mechanical & Electrical Systems

1. Part A: The following documents shall be submitted to the CCPO upon the successful completion (include submission date for each):
    a. Letters of assurance confirming construction compliance with NBC, Airport Construction Code and all other applicable codes and standards from prime Consultant and all major sub-consultants.
    b. Verification certificates.
2. Part B: The following items shall be inspected and shown to be completed in accordance with the Contract at various stages of the performance of the Work in order to achieve Substantial Performance of the Work:
    - Life Safety Systems
    - Barrier Free Facilities
    - Fire Exits
    - Fire Routes
    - Security Systems.
3. Part C: The following items shall be inspected and shown to be completed in accordance with the Contract at various stages of the performance of the Work in order to achieve Substantial Performance of the Work, and Total Performance of the Work:
    - Plumbing Systems
    - HVAC Systems
    - Electrical Systems.

8.8.3.2 Fire Alarm & Emergency Voice Communication Systems

1. Part A: The following digital documents shall be submitted by the contractor to the CCPO prior to the scheduling of Part B or C (include submission date for each):
    a. Manufacturers current system certificate complete with fire alarm verification report.
    b. Electrical Safety Authority (ESA) inspection certificate referencing fire alarm inspection.
    c. Electrical consultant letter of assurance stating compliance with NBC, NFPA, CAN/ULC-S524-M and tested as per CAN/ULC-S537-M Standard.
2. Part B: The following items required for the inspection and testing of GTAA Monitored Systems shall be the sole responsibility of the contractor:
    a. The contractor shall prepare and provide to the AHJ for review a test script that fully demonstrates all functions of the system.
    b. Confirm the IOCC has been notified of testing and the monitoring system print-out will be available, provided that, depending on the extent of the system testing and duration, the IOCC may require a fire alarm technician to be stationed at the IOCC to acknowledge all testing related system alarms and troubles.
    c. Confirm the fire alarm panel is clear of all alarm, supervisory or trouble indicators or related issues.
    i. Some by-pass functions may remain as directed by the AHJ.
    d. Perform system testing as per test scripts reviewed by the Authority Having Jurisdiction (AHJ) to fully demonstrate the fire alarm system functions including ancillary and auxiliary systems; provided the Contractor acknowledges the AHJ may also test other random devices or system functions.
    e. Once all testing has been completed, confirm all testing devices have been restored to normal condition and the fire alarm panel is clear of all alarm, supervisory or trouble indicators or related issues.
    f. Notify the IOCC that testing has been completed and the system has been restored and put back into normal working service.
3. Part C: The following items required for the inspection and testing of Non GTAA Monitored Systems shall be the sole responsibility of the contractor:
    a. The contractor shall prepare and provide to the AHJ for review a test script that fully demonstrates all functions of the system.
    b. Confirm the monitoring agency has been notified of testing, provided the Contractor acknowledges that normal third-party monitoring agencies monitor for a common system trouble and a common system alarm and thus would not be able to provide a detailed print-out of the system testing.
    c. Confirm the fire alarm panel is clear of all alarm, supervisory or trouble indicators or related issues.
    d. Perform system testing as per test scripts reviewed by the Authority Having Jurisdiction (AHJ) to fully demonstrate the fire alarm system functions; provided the Contractor acknowledges the AHJ may also test other random devices or system functions.
    e. Once all testing has been completed, confirm that all tested devices have been restored to normal and the fire alarm panel is clear of all alarm, supervisory or trouble indicators or related issues.
    f. Notify the monitoring agency that testing has been completed and the system has been restored and put back into normal working service.

8.8.3.4 Automated External Defibrillator

1. Part A: The following documents shall be submitted by the contractor to the CCPO prior to the scheduling of Part B or C (include submission date for each):

a. Obtain AED device unit number and location nomenclature from GTAA F&ES.
b. Submit Product Data Sheet for new AED unit(s)
c. Deliver AED unit(s) to GTAA F&ES to store until cabinet installation is commissioned.
d. Provide Fire Alarm Verification Report for the monitoring of each new AED Unit.

2. Part B: The following items required for the inspection and testing of the new AED shall be the sole responsibility of the contractor:
   a. The contractor shall prepare and provide to the AHJ for review a test script that fully demonstrates each unit.
3. Part C: The following items required for the inspection and testing of AED units shall be the sole responsibility of the contractor:
   a. The contractor shall execute the AHJ approved test script that fully demonstrates each unit.
   b. Confirm the IOCC has been notified of testing and the monitoring system print-out will be available, provided that, depending on the extent of the system testing and duration, the IOCC may require a fire alarm technician to be stationed at the IOCC to acknowledge all testing related system alarms and troubles, unless the GTAA agrees otherwise.
   c. Confirm the fire alarm panel is clear of all alarm, supervisory or trouble indicators or related issues.
   d. Confirm that all AED Cabinets are normal working service.
   e. Perform AED Cabinet tests as per test scripts approved by the Authority Having Jurisdiction (AHJ) to fully demonstrate the AED Cabinet monitoring system performance; provided the Contractor acknowledges that such testing will include random or all systems solely at the discretion of the Authority Having Jurisdiction.
   f. Once all testing has been completed, confirm that all tested AED Cabinets have been restored, and the fire alarm panel is clear of all alarm, supervisory or trouble indicators or related issues.
   g. Notify the IOCC that testing has been completed and that all tested systems have been restored and put back into normal working service.
   h. Upon approval of installation, GTAA F&ES will place the stored AED unit within the cabinet.

8.8.3.5 Sprinkler, Standpipe & Hose Systems

1. Part A: The following documents shall be submitted by the contractor to the CCPO prior to the scheduling of Part B or C (include submission date for each):
   a. Confirmation that welded piping was inspected by Fire Prevention prior to its installation.
   b. Copy of the underground piping Contractor's Material and Test Certificate (Peel Region and/or site service contractor).
   c. Copy of the Contractor's Material and Test Certificate for above ground piping.
   d. Sprinkler engineer's general review letter of assurance stating compliance with the approved drawings, NBC and NFPA 13.
2. Part B: The following items required for the inspection and testing of GTAA Monitored Systems shall be the sole responsibility of the contractor:
   a. The contractor shall prepare and provide to the AHJ for review a test script that fully demonstrates each system.
   b. Confirm the IOCC has been notified of testing and the monitoring system print-out will be available, provided that, depending on the extent of the system testing and duration, the IOCC may require a fire alarm technician to be stationed at the IOCC to acknowledge all testing related system alarms and troubles, unless the GTAA agrees otherwise.
   c. Confirm the fire alarm panel is clear of all alarm, supervisory or trouble indicators or related issues.

d. Confirm that all sprinkler and standpipe systems are pressurized and in normal working service.
e. Perform system testing as per test scripts reviewed by the Authority Having Jurisdiction (AHJ) to fully demonstrate the sprinkler and/or standpipe system performance; provided the Contractor acknowledges that such testing will include random or all systems solely at the discretion of the Authority Having Jurisdiction.
f. Once all testing has been completed, confirm that all tested systems have been drained and/or pressurized, and the fire alarm panel is clear of all alarm, supervisory or trouble indicators or related issues.
g. Notify the IOCC that testing has been completed and that all tested systems have been restored and put back into normal working service.

3. Part C: The following items required for the inspection and testing of Non GTAA Monitored Systems shall be the sole responsibility of the contractor:
   a. The contractor shall prepare and provide to the AHJ for review a test script that fully demonstrates each system.
   b. Confirm the monitoring agency has been notified of testing, provided the Contractor acknowledges that normal third-party monitoring agencies monitor for a common system trouble and a common system alarm and thus would not be able to provide a detailed print-out of the system testing.
   c. Confirm the fire alarm panel is clear of all alarm, supervisory or trouble indicators or related issues.
   d. Confirm that all sprinkler and standpipe systems are pressurized and in normal working service.
   e. Perform system testing as per test scripts reviewed by the Authority Having Jurisdiction (AHJ) to fully demonstrate the sprinkler and/or standpipe system performance; provided the Contractor acknowledges that such testing will include random or all systems solely at the discretion of the Authority Having Jurisdiction.
   f. Once all testing has been completed, confirm that all tested systems have been drained and/or pressurized, and the fire alarm panel is clear of all alarm, supervisory or trouble indicators or related issues.
   g. Notify the monitoring agency that all tested systems have been restored and put into normal working service.

8.8.3.6 Exit and Emergency Lighting Systems

1. Part A: The following documents shall be submitted by the contractor to the CCPO prior to the scheduling of Part B (include submission date for each):
   a. Electrical engineer's general review letter of assurance stating compliance with NBC, and CSA-C22.2. No.141 "Unit equipment for emergency lighting".
   b. Verification certificates.
2. Part B: The following items required for the inspection and testing of the Emergency Lighting Systems shall be the sole responsibility of the contractor:
   a. The Contractor shall shut off regular power to the area and confirm:
      i. Operation of the emergency lighting, including lighting levels (average lighting levels 10 lux, minimum 1 lux),
      ii. Maximum 5% voltage drop, and
      iii. Exit lighting operation and locations.

8.8.3.7 Electromagnetic Locking Devices

1. Part A: The following documents shall be submitted by the contractor to the CCPO prior to the scheduling of Part B (include submission date for each):
    a. Copy of the Electrical Safety Authority inspection report and certificate referencing the specific security doors.
    b. Fire alarm test verification report for the door fire alarm devices, including the adjacent manual station and connection to fire alarm panel.
    2. Part B: The following items required for the inspection and testing (Part of the fire alarm testing – additional ITM requirements not detailed here) of the Electromagnetic Locking Devices shall be the sole responsibility of the contractor:
    a. The Contractor shall prepare and provide to the AHJ for review a test script that fully demonstrates each door.
    b. The Contractor shall confirm that the IOCC has been notified of testing and that the monitoring print-out will be available, provided that the Contractor acknowledges that, depending on the extent of the system testing and duration, the Contractor shall station a fire alarm technician at the IOCC to acknowledge all testing related system alarms and troubles unless the GTAA agrees otherwise.
    c. The Contractor shall confirm the fire alarm panel is clear of all alarm, supervisory and trouble indicators or related issues.
    d. The Contractor shall perform door testing so as to fully verify door functions on all doors.
    e. Inspection and testing by the Contractor shall include:
        i. Confirmation of adequate emergency lighting at doors.
        ii. Confirmation the equipment installed is ULC, cUL or WHI labelled.
        iii. Confirmation that a legible sign is permanently mounted on the exit door to indicate that the locking device will release within 15 seconds of applying pressure to the door-opening hardware.
        iv. Demonstration that the locking device releases upon actuation of a fire alarm activation.
        v. Confirmation of re-set by manual switch.
        vi. Demonstration that a force of not more than 90N applied to the door-opening hardware initiates an irreversible process that will release the locking devices within fifteen (15) seconds with no re-locking until the fire alarm and security systems have been restored.
        vii. Demonstrate the locking device releases immediately on loss of power.
        viii. Demonstrate the locking device releases immediately upon a fault detected between the fire alarm system and the maglock controller.
        ix. Demonstration the locking device releases immediately upon the activation of the global door release key located at a building primary or alternate CACF.
    f. Once all testing has been completed, the Contractor shall confirm that all tested systems have been restored and the fire alarm panel is clear of all alarm, supervisory and trouble indicators or related issues.
    g. The Contractor shall notify the IOCC that testing has been completed and that all systems have been restored and put back into normal working service.
    h. Reference GTAA Architectural Design Requirements for additional requirements.
3. Note: Maglocks are not to be activated and put into service until completion of final inspection & testing which must be witnessed by GTAA Fire Prevention.

8.8.3.8 Elevators

1. Part A: The following documents shall be submitted by the contractor to the CCPO prior to the scheduling of Part B (include submission date for each):
    a. Acceptance and licensing by TSSA.
2. Part B: The following items required for the inspection and testing (Part of the fire alarm testing) of the Elevators shall be the sole responsibility of the contractor.
    b. The Contractor shall make all arrangements to test and demonstrate the function of each elevator to the AHJ:
        i. Test recall functions,
        ii. Fire fighter operations, and
        iii. Key-switch operations.

8.8.3.9 Emergency Power Systems

1. Part A: The following documents shall be submitted by the contractor to the CCPO prior to the scheduling of Part B (include submission date for each):
    a. Technician's test report which includes:
        i. Start-up of the diesel or natural gas engine, load bank test complete with working papers.
        ii. Electrical engineer's general review letter stating compliance with NBC and CSA C282 "Emergency Electric Supply for Buildings".

8.8.3.10 Fire Pumps

1. Part A: The following documents shall be submitted by the contractor to the CCPO prior to the scheduling of Part B (include submission date for each):
    a. Design engineer's general review letter stating compliance with NBC and NFPA 20.
    b. Pump manufacturer's certified pump curves.
    c. Installing contractor's site tested pump curves.
2. Part B: The following items required for the inspection and testing of the fire pumps shall be the sole responsibility of the contractor:
    a. The contractor shall prepare and provide to the AHJ for review a test script that fully demonstrates each fire pump.
    b. Confirm the IOCC has been notified and that the monitoring system print-out will be available, provided that the Contractor acknowledges that, depending on the extent of the system testing and the duration, the Contractor shall station a fire alarm technician at the IOCC to acknowledge all testing related system alarms and troubles unless the GTAA agrees otherwise.
    c. Confirm fire alarm panel is clear of all alarm, supervisory or trouble indicators or related issues.
    d. Perform pump testing as per test script reviewed by the AHJ to fully demonstrate the pump performance.
    e. Once all testing has been completed, confirm that all systems have been restored and the fire alarm panel is clear of all alarm, supervisory or trouble indicators or related issues.
    f. Notify the IOCC that testing has been completed and that all tested systems have been restored and put back into normal working service.

8.8.3.11 Fire Hydrants

1. Part A: The following documents shall be submitted by the contractor to the CCPO prior to the scheduling of Part B (include submission date for each):
    a. Design engineer's general review letter of assurance stating compliance with NBC, Regional Standards and other applicable codes.

b. Underground Pipe Contractor's Material and Test Certificates.

2. Part B: The following items required for the inspection and testing of the fire hydrants shall be the sole responsibility of the contractor:
   a. The contractor must flow test each new fire hydrant which must be witnessed by GTAA Fire Prevention and/or GTAA Life Safety Engineer.
   b. Upon successful flow testing, contractor must provide flow test data to GTAA Fire Prevention and GTAA Life Safety Engineer.

8.8.3.12 Fire Routes

1. Part A: The following documents shall be submitted by the contractor to the CCPO prior to the scheduling of Part B (include submission date for each):
   a. Site Plan drawing indicating location and dimensions of all fire routes including the location of all fire route signage.
   b. Indicate the locations of fire hydrants and Siamese connections.
2. Part B: The following items required for the inspection and review of the fire routes shall be the sole responsibility of the contractor:
   a. Site review with GTAA Fire Prevention is required to determine that appropriate signage has been installed to identify required Fire Route to be kept clear at all times.

8.8.3.13 Fire Extinguishers

1. Part A: The following documents shall be submitted by the contractor to the CCPO prior to the scheduling of Part B (include submission date for each):
   a. Drawing(s) showing the location, sizes and types of all fire extinguishers installed under the Contract.
2. Part B: The following items required for the inspection and review of the fire routes shall be the sole responsibility of the contractor:
   a. Site review with GTAA Fire Prevention is required to determine that appropriate fire extinguishers have been installed in accordance with NFC, Part 6.

8.8.3.14 Kitchen Exhaust/Fire Suppression Systems

1. Part A: The following documents shall be submitted by the contractor to the CCPO prior to the scheduling of Part B (include submission date for each):
   a. Installer's certificate for fire suppression system.
   b. Design engineer's general review letter stating compliance with NBC, NFC and NFPA-96.
   c. Fire alarm verification report.
2. Part B: The following items required for the inspection and testing of the kitchen exhaust & suppression systems shall be the sole responsibility of the contractor and shall include:
   a. Confirmation of fire alarm connections.
   b. Review of clearance of ductwork.
   c. Confirmation of automatic gas/power shut-off.
   d. Confirmation of properly located clean-outs.
   e. Conducting of smoke test on duct system.
   f. Testing of the kitchen fixed fire suppression system utilizing a balloon test to be witnessed by Fire Prevention.
   g. Confirmation that the building owner/operator has been provided with a copy of F&ES Kitchen Exhaust System Cleaning Protocol. Note copies can be obtained through Fire Prevention.

8.8.3.15 Lightning Protection Systems

1. A copy of all documentation for newly installed Lightning Protection Systems is to be provided to Fire Prevention. This documentation will in turn be provided to the Fire Prevention Officer (FPO) during their site inspection.

8.8.3.16 AGCO Liquor License Application

1. The Alcohol and Gaming Commission of Ontario (AGCO) Liquor License Application must be submitted to GTAA Fire & Emergency Services. For planning purposes one week's notice should be provided to avoid any delays. Applications must be submitted in writing to:

   Chief Fire Prevention Officer
   Greater Toronto Airports Authority
   BOX 6031 Fire Hall 1
   5450 Flightline Drive
   Toronto AMF, Ontario
   Canada L5P 1B2.

8.8.3.17 Clean Agent Fire Suppression Systems

1. The following documents shall be submitted by the contractor to the CCPO prior to closeouts
   a. Installer's certificate for fire suppression system.
   b. Design engineer's general review letter stating compliance with NBC, NFC and NFPA-2001.
   c. Room Integrity test results
   d Flow calculations stating minimum design concentration, total volume of gas delivered and nozzle orifice size
   d Fire alarm verification report.

8.9 Commissioning

1. Commissioning of all life safety systems shall include operational testing of all interconnected systems as indicated within the NBC and ULC-S1001 Standard for Integrated Systems Testing of Fire Protection and Life Safety Systems. These systems include:
   i. Fire Alarm Systems, to provide hi-resolution digital photo records of graphic screens.
   ii. Sprinkler Systems.
   iii. Standpipe Systems.
   iv. Pre-Action / Special Hazard Systems.
   v. Kitchen Fire Suppression Systems.
   vi. HVAC / Air Handling.
2. Building Management System (BMS) report of any / all air handling system equipment and damper activation or shutdown.
3. Provide hi-resolution digital photo records of BMS screens.
4. Smoke Control Systems.
5. Security / Maglock / Door Hold Open.
6. Fire Do Not Enter Signs
7. Baggage Systems.
8. Elevators / Escalators / People Movers.
9. Paging / IED System.

8.9.1 Commissioning Plan Reports

1. The contractor shall prepare a commissioning plan for review by GTAA.
2. GTAA will witness all commissioning test.

3. The contractor shall prepare a commissioning test report and submit to GTAA with close out documents.

8.10 Predictive / Preventative Maintenance

1. All life safety systems shall be maintained in working order at all times in compliance with the National Fire Code.
2. All new equipment shall be provided with detailed test, inspection and maintenance schedules with predictive maintenance guidelines showing areas where items may wear prematurely.
3. These systems include:
    a. Fire Alarm Systems
    b. Sprinkler Systems
    c. Standpipe Systems
    d. Fire Hydrants
    e. Fire Pumps
    f. Fire Extinguishers
    g. Special Hazard Systems
    h. Smoke Control Systems.
4. Any disruptions to life safety system operations must be reported to GTAA and corrected as soon as possible.
    a. TSLSS – Technical Specialist, Life Safety Systems
    b. MTC – Maintenance Technical Centre.
    5. Where life safety is compromised, fire watch shall be performed.
    6. All testing, inspection and maintenance shall be documented, and digital reports shall be issued to the TSLSS.

8.11 Standard Details

8.11.1 General Comments

1. The following standard details only serve as a general installation guide. Site conditions may require revisions or alterations which must be reviewed and approved by CCPO and/or F&ES prior to implementation of any revisions.
2. Any discrepancies should be reported to Engineering Manager, Professional Services for clarification.

9. Electrical Systems

9.1 Compliance Requirements

1. All design, installations and/or alterations to the Airport electrical systems shall comply with the applicable coder and standards for such construction and shall be prepared and reviewed by a Professional Engineer.
2. All drawings, specifications, calculations and shop drawings for the system shall be signed and sealed by a Professional Engineer and submitted to the GTAA for review. Refer to the Airport Construction Code for submission requirements.
3. The Canadian Electrical Code (CEC) shall be applied to all Airport property with exception to connections to utility services for which compliance with respective utility provider standards and Electrical Safety Authority (ESA) regulations are mandatory.

4. All electrical construction is subject to inspection and approval by the ESA for CEC regulations. Contractors are responsible for arranging, obtaining and paying for any and all necessary permits. Such inspections shall be arranged before installations are covered and concealed.
5. Conform to the latest edition of standards.
6. An ESA inspection certificate is required with a copy submitted to the Construction Compliance and Permit office (CCPO) before use or occupancy of the construction is allowed.
7. All rough-in installations for cables, conduits, boxes, panels and control devices shall be inspected before walls and ceilings are closed in with finishing materials. All covers for electrical devices and equipment shall be open until such inspection is completed.
8. GTAA-Maintained buildings are subject to final commissioning and acceptance requirements and procedures being completed in accordance with the GTAA TCAT Manual.
9. Any proposed changes and/or changes being made to the electrical power distribution system should follow the requirements outlined within the GTAA Electrical Change Management (ECM) program. All correspondence and inquiries can be directed to ECM@gtaa.com.

9.1.1 Access Door and Panels

1. Access doors and removable panels in ceilings and walls shall provide service access to pull boxes, control devices etc. and shall be provided by the Contractor at locations coordinated with the various trades
2. Maintain Fire Ratings where applicable and submit As-built drawings showing accurate locations.

9.1.2 Identification and Labelling

1. Refer to GTAA standard for Identification and Labeling Standard Manual.
2. Equipment and wiring identification labels shall be provided for all new electrical construction in GTAA-Maintained areas. Identify all electrical equipment with a Lamacoid label and secured with self-tapping screws or adhesive for power source types as follows:
    a. Emergency: blue face with white letters
    b. Normal Power: green face with white letters
    c. UPS: yellow face with black letters
    d. Fire Alarm: red face with white letters
3. Information to be included on the labels specific to the type of equipment shall be as follows:
    a. For Motor Control Centers, switchboards and panel boards indicate equipment ID, supply source equipment ID, location of supply source and system voltage.
    b. For transformers indicate primary and secondary voltages, supply source and kVA rating.
    c.For starters and disconnects indicate equipment ID, system voltage and connected equipment
4. Conduits, panels, junction boxes and receptacles shall be identified and colour coded as follows:
    a. For conduit use plastic tape or paint applied at least 25mm wide on both sides where conduit enters/exits walls, floors and ceiling assemblies and at 15m intervals.
    b. For junction boxes apply a 25mm diameter circle of paint and indicate the voltage, panel ID, and enclosed circuits on the cover plate.
    c. For receptacles use orange for isolated ground circuits.
    d. Use the standard colour code:
        i. green for normal power
        ii. blue for emergency power
        iii. yellow for UPS and
        iv. red of fire alarm circuits.
5. All airfield lighting circuits shall have circuit numbers individually identified by means of a Lamacoid tag within all manholes, handwells and pulpits

6. Identify all receptacles with “Dymo-tape” or approved equivalent indicating panel designation and circuit number.
7. Replace panel directories with new reprinted type written directories reflecting changes, whenever alterations are made to the distribution circuits it serves. Submit a copy of the updated panel schedule to ECM as per Section 9.1 Compliance Requirements as part of closeout document.

9.1.3 Material and Equipment

1. All materials and equipment shall be new, and CSA approved and with certification acceptable to the ESA with labels visible and legible except for the following:
   a. That which is specifically designated as existing to remain which are acceptable to ESA.
   b. Those fixtures, devices and equipment identified as being standard for use at the Airport and that are approved by a recognized testing agency on behalf of ESA.

9.1.4 Power Interruptions/Switching Operations

1. No electrical system providing power to the operation of the Airport service shall be interrupted by the contractor without sufficient notice given to the CCPO and Maintenance Technical office and acceptable to the GTAA. All costs associated with causing such interruption will be the responsibility of the contractor.
2. Power interruptions affecting the operation of the airport require a minimum of 2 weeks advance notice to the Construction Control Office that will have to be performed and completed between off-hours period of 0100h and 0400h and as confirmed by the AOCC.
3. Switching operations shall be carried out by Airport electricians or by the contractor under the supervision of an Airport electrician.
4. For additional information, please refer to: https://www.torontopearson.com/en/operators-at-pearson/construction/contractor-activities

9.1.5 Short Circuit Study, Protection Coordination and Arc Flash Study

1. Provide a complete, comprehensive report at the conclusion of the short circuit, equipment evaluation, protection coordination and arch flash study consisting complete schedule of all protective devices, SC values, TCC curves and arc flash schedule etc.
2. Carry out Short Circuit studies where existing short circuit levels are affected due to the Utility services
3. Over-current and ground fault protection devices installed by Tenants as part of their system shall be coordinated with upstream protection devices of the GTAA. The contractor shall submit a coordination study of additional loads to the GTAA for review.
4. Supply and install arc flash and shock hazard warning labels for all new and modified electrical distribution equipment in accordance with latest CSA Z462.
5. The short circuit, equipment evaluation, coordination and flash studies shall be modeled and performed in ETAP software. Submit all ETAP digital files inclusive of any custom libraries.
6. For additional information, please refer to [FM-0290] - The GTAA Power System Study Requirements.

9.1.6 Service Connection

1. Information on electrical services available pertaining to voltages and phases for specific Airport Areas shall be obtained from the Construction Control Office prior to commencing the design of electrical power systems and equipment specifying.

2. Connections to power sources shall comply with the standards and requirements of Alectra Utilities, Mississauga and the Electrical Safety Authority and all related installations shall be subject to their inspection and acceptance.

9.1.7 Service connection for Tenants

1. Prior to any electric service being energized, connection authorization shall be confirmed by the GTAA electrical inspector with the required tests, inspections and certificates submitted by the contractor and verified as complete by the Construction Control Office.
2. The GTAA shall provide the service feeder and a disconnect switch (no fuse) to the lease line in a building space. Associated with this supply, the GTAA will provide and install a revenue grade pulse output electric meter(s) which will be connected via data cable to a remoted sub- metering system. Costs for installations and maintenance of electrical systems within the lease lines shall be the responsibility of the Tenant.
3. Building Space power supply shall be connected to Airport panel boards within Service Space electrical rooms or closets, as approved by the Construction Control Office
4. Land Parcel power supply shall be located at connection points as indicated in the lease agreement with the GTAA or as otherwise determined by the GTAA and the Tenant.
5. For Land Parcels and Building Spaces, one metered service shall be installed for each Tenant. Provisions are defined in the lease agreement with the GTAA for power and metering with the location determined by the GTAA. Different classes of service may require separate metering as defined by the GTAA.

9.1.8 Temporary/ Construction Power

1. The Contractor is responsible for the design, procurement, and installation of all equipment required to extend temporary power to the construction site.
2. Conduct electrical load assessment to ensure sufficient capacity on the proposed temporary connection.
3. Drawings, specifications, calculations for the proposed temporary/construction power shall be signed and sealed by a Professional Engineer and submitted to the GTAA for review.
4. Temporary/construction power shall be connected to non-emergency power only. Use of emergency power is primarily restricted to critical systems such as life safety, security, IT system, etc.
5. The GTAA reserves the right to meter and charge the contractor and Tenant for all power used and shall be paid for at the prevailing Airport rate for the type of service required and/or as stipulated in the Tenant's lease agreement with the GTAA.
6. Temporary services shall be inspected in accordance with the requirements herein including inspection and approval by ESA.
7. Upon construction completion, the Contractor shall remove all temporary connections and equipment, and revert to its original state.

9.2 Cables-27.6 kV –Inside Buildings

9.2.1 Teck Cable

- Conductor- aluminum alloy 1350(EC) stranded.
- Insulation- XLPE ethylene propylene rubber, RW90, 35 kV 100% insulation, 150 kV BIL Strand shield – semi-conducting extrusion.
- Armour – interlocked non-ferrous aluminum.
- Strand shield – semi-conducting extrusion.

- Insulating shield- semi-conducting extrusion.
- Jacket- PVC inner and outer jackets.
- Provide separate ground wire for every circuit.
- Installation- Install on cable trays, uniform separation between cables throughout to be not less than one cable diameter.

9.2.2 Concentric Neutral Cable

- Standard- CAN/CSA C68.3-M97.
- Conductor – aluminum alloy 1350(EC) stranded.
- Insulation- XLPE, polyethylene, RW90, 35 kV 100% insulation, 150 kV BIL.
- Concentric Neutral – helically wound annealed untinned copper wire.
- Jacket – extruded black linear low-density polyethylene (LLDPE).
- Conductor shield and insulation shield- extruded cross-linked polyethylene.
- Cables shall be FT4 rated.
- Installation- cable shall be installed in rigid metallic conduit.

9.2.3 Cable – 27.6 kV Outside in Duct banks

1. Concentric Neutral Cable as above installed in duct banks.
2. Cables shall be tree retardant and resistant to petroleum products.
3. Provide separate ground wire; for 1000MCM use 300MCM copper ground.

9.2.4 5 kV System Cables

1. Aluminum Sheath cables ((1- 5 KV):
   - CSA-C22.2 No. 131-07, Type TECK 90 Cable
   - Conductors: copper.
   - Insulation: cross-linked polyethylene, Type RW90 rated 5 kV
   - Semi-conducting insulation shielding layer
   - Outer covering: extruded PVC.

9.2.5 Concentric Neutral Power Cable (1-5 kV)

1. Must meet these criteria:
   - Single copper conductor, Semi-conducting strand shield.
   - Insulation: cross-linked polyethylene, rated 90 degrees C and 5 kV.
   - Semi-conducting insulation shielding layer.
   - Copper neutral wires applied helically over insulation shield equivalent to 100 % full capacity.
   - Separator mylar tape over neutral wires.
   - Extruded PVC jacket rated minus 40 degrees C.

9.3 Building Wires and Cables(0-1000V)

9.3.1 Cable in Conduit

1. All cable shall be of copper conductor, stranded for AWG #10 and above.
2. Power and lighting use minimum AWG #12 cable.
3. Feeder to panel boards and splitters use minimum AWG #8.
4. Control circuits use minimum AWG #14.
5. 600 V systems with conductor AWG #8 or larger use RW90, XLPE, 1000 V rated insulation.
6. 600 V systems with conductor size less than AWG #8, 600 V insulation is permitted.

7. For 120/208 V systems 600 V rated use RW cable.
8. Type RW 90 is limited to Indoor application only.
9. All outdoor and underground conductor runs shall use type RWU 90 wires.
10. Copper conductor AWG #10 and above shall be stranded.

9.3.2 AC90 (BX) Cable

1. The final feed to light fixtures shall not exceed 1.8 m from an EMT junction box.
2. For feeds to light switches and receptacles fully conceal in wall assemblies extending no more than 2.5 m from an EMT junction box.
3. Daisy chaining of light fixtures is permitted provided only necessary lengths not greater than 2.5 m are used that are neatly placed and secured to the fixture suspension and not left loosely supported on the suspended ceiling assembly.
4. Where extra high ceiling spaces are encountered, a direct drop to each fixture or device from the EMT junction box is permitted provided that only the necessary length is used, and it is secured by a suspension system where appropriate.
5. Flexible metal conduit is permitted for a final feed connection to motors and equipment, and across expansion joints in structures and shall not exceed 900 mm in length for such uses.

9.3.3 Cable – Armoured

1. Permitted for main feeders and branch circuits.
2. TECK- single conductor copper with XLPE RW-90 insulation, 1000 V rated, inner and outer jackets FT4 rated, helically wound and interlocked aluminum strip armour complete with copper ground wire.
3. Install cable on trays with spacing between cables not less than one cable diameter.
4. Use manufacturer approved connectors.

9.4 Conduits and Boxes

9.4.1 Pull Boxes

1. Locate pull boxes at 30m intervals for pulling cables.
2. Tag each individual cable at all pull boxes.

9.4.2 Redundant Cables, Conduit and Building Wires

1. Remove all unused wiring and conduit back to the panel board and identify the corresponding circuit breakers as spare.

9.4.3 Conduit General

1. Approved wiring methods and conduit are given below; for any deviations GTAA written approval is required.
2. Rigid Galvanized Conduit and Electrical Metallic Tubing are permitted for building wiring subject to codes and standards.
3. Conduits passing through concrete shall use Schedule 40 steel sleeves.
4. All conduits shall not be supported by or fastened directly into, metal roof and floor decking. Such assemblies shall be supported by supplemental support systems (such as unistrut system) attached only to structural framing members.
5. Conceal conduits in all areas with the exception of unfinished areas.
6. Install emergency power circuits and emergency lighting circuits in separate conduits.

7. Install back-up feeders to critical or life-safety systems in separate conduits. Keep adequate physical separation between conduits.
8. Keep adequate separation between communication and power systems conduit runs.
9. Power and lighting systems shall be installed in separate conduits.
10. Run adequate spare conduits from recessed panel boards to ceiling space; terminate in junction boxes in ceiling space.
11. Remove redundant conduits and wiring back to the source of origin; identify source breaker as spare.
12. Metallic conduits shall not be used below grade or embedded in concrete.
13. Colour code conduits.

9.4.4 EMT

1. All wiring in buildings concealed in ceiling spaces or surface run shall be installed parallel and perpendicular to the building grid in a neat and orderly arrangement in consideration of grouping runs, compact hanging methods, headroom clearances and interference with other installations and equipment, to afford maintenance within the space.
2. EMT shall be concealed for all installations with the exception of unfinished areas where it shall not extend lower than 2.4 m above the floor in locations subject to mechanical injury.
3. EMT shall have steel set screw type couplings- T&B Series 5000 or equivalent with the minimum size permitted at 19.5 mm diameter.
4. Flexible metal conduit is permitted to extend 1.8 m from the end of EMT using set screw type couplings without the use of a junction box as the final feed to light fixtures to avoid access to ceiling spaces.
5. All conduits shall not be supported by or fastened directly into, metal roof and floor decking. Such assemblies shall be supported by supplemental support systems (such as unistrut system) attached only to structural framing members.

9.4.5 Rigid Galvanized Conduit

1. Use rigid galvanized conduit in areas subject to physical damage.
2. Use rigid galvanized conduit up to 2.3M above floor level.

9.4.6 Rigid PVC Conduit

1. Conduit are not permitted for use below grade under floor slab
2. Rigid PVC conduit, EB1 is permitted for use in concrete encased duct banks.
3. Rigid PVC conduit shall not be surface mounted in interior or exterior work, concealed or exposed unless approved by the GTAA.

9.4.7 FRE Conduit

1. FRE conduit is acceptable, as a substitute to PVC conduit and in some applications may be the preferred option. Designers and Engineers are to obtain authorization for use from the GTAA Facilities Systems Engineering Department.

9.5 Cable Trays

1. Provide adequate spare capacity in cable trays for future cables. Discuss with GTAA to determine required spare capacity.
2. Cable trays must be easily accessible for maintenance and for future cable installations.
3. Redundant (or back-up) power supplies to life-safety, critical or essential equipment must be run on separate cable trays with adequate separation between circuits.

4. Install cable trays away from mechanical equipment such as pipelines, conveyors etc.

9.6 Electrical Room/ Closet

1. In new construction allow minimum 25% space for future additions
2. Provide a separate room with a separate entrance from outside building for HV rooms.
3. Where main electrical rooms are sprinklered , a pre-action sprinkler system must be installed.
4. Connect 30% of lighting to emergency lighting circuits.
5. Connect receptacles to emergency power.
6. Provide battery packs for all electrical rooms including the generator room in addition to emergency lighting.
7. Electrical rooms and closets shall not be located underneath building floor areas that contain services including supply and drainage systems or activities involving fluids of any kind.

9.7 Grounding Primary

1. To CSA C22.3 No.2, General Grounding Requirements and Grounding Requirements for Electrical Supply Stations, CSA C22. 1 Electrical Safety Code, ANSI/IEEE 837, Qualifying Permanent Connections Used in Substation Grounding, and ANSI/IEEE 80.
2. Provide GPR design as per bulletin 36-10 and stamped by Professional Engineer.
3. LDC/ Utility requires ground grid design level for each point in the system been identified.
4. GPR designed to meet the minimum levels as per CEC (unless deviation as per Rule 2-030, or the LDC/Utility design level:" Must design to the highest of the two requirements".
5. Design continuous grounding system including, electrodes, conductors, connectors and accessories in accordance with CSA C22.3 No.2, ANSI/IEEE Standards 80 and 142, and requirements of local authority having jurisdiction.
6. Conductors: bare, stranded, soft annealed tinned copper wire, size as required for ground bus, electrode interconnections, metal structures, gradient control mats, transformers, switchgear, motors, ground connections.
7. Buried grounding conductors, bare stranded copper, tinned, soft annealed.
8. Gradient control mat.
9. Accessories: non-corroding, necessary for complete grounding system.

9.8 Grounding Secondary

1. Grounding and Bonding shall be designed and installed in accordance with OESC, CSA C22. 1 Electrical Safety Code.
2. Design complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Provide bond wire in all conduit systems
3. Communications system grounding in accordance with ANSI/EIA/TIA 607, 568A, 569 standards
4. Provide 3m long copper-clad steel ground rods and bare copper No. 4/0 AWG ground conductor loop around the building perimeter. Building steel work shall be bonded to the building underground perimeter ground loop.
5. Ground well box complete with cover to house each ground rod connection, in location accessible for inspection. Ground well boxes located in rooms shall be of non- vehicular type with screw-lockable covers. Ground well boxes located outside of building shall be heavy duty type with cast iron covers and identified for Ground.
6. Ground resistance shall be less than 5 ohm or less.
7. Provide perimeter ground bus, Copper 6 mm x 50 mm mounted 150 mm above floor on insulated spacers 600 mm on center. for:

a. Electrical rooms
b. MCC's rooms
c. UPS room
d. Generator room
e. Communication rooms including LAN and telephone rooms' and battery room.

8. All underground conductor to be tin plated copper. All underground connections to conductive water main, electrodes, using copper welding by thermite process.
9. Ground all the structural column of the structural steel.
10. Bare copper grounding conductors in a grid pattern on four-foot centers in each direction of the raised floor grid.

9.9 Lightning Protection System

1. Conduct Lightning Risk Assessment as per CAN/CSA-B72 and NPFA 780 to determine the requirement for lightning protection on all permanent and temporary buildings and structures. Submit detailed assessment report to GTAA.
2. Lightning protection system shall be supplied and installed in accordance with latest version of CAN/CSA-B72- Installation Code for Lightning Protection Systems, NFPA 780 - Standard for the Installation of Lightning Protection Systems, and the Ontario Lightning Rods Act.
3. System to consist of metallic air terminals, lightning conductors connecting air terminals to ground and interconnected ground electrodes, and/or ground cables.
4. Provide report and calculations.

9.10 Lighting General

1. Lighting circuits shall not be in common with power circuits.
2. Illumination levels shall exceed or be in accordance with the latest IES, IDA, and other applicable standards and City By-Laws and Ministry of Transportation regulations.
3. Submit photometric plan and photometric analysis report for all lighting designs, including computerized photometric "lux level grid", target design criteria, photometric calculation summary table with avg/max/min luminance, uniformity ratio, etc.
4. Contractor shall carry out lighting level measurements during testing and commissioning stage. Contractor to submit report with recorded measurements to Consultant and GTAA for review against designed lighting levels.
5. Submit lighting layout with panel identification, circuit identification, and switch number for each individual fixture, luminaire schedule, lighting control strategy, reflected ceiling plan, etc.
6. Reference GTAA Lighting Standard for additional requirements

9.11 Lighting Control

1. The GTAA has implemented centralized lighting control system platform across all Terminal buildings and some other facilities.
2. The current lighting control system include:
   a. For Terminal 1 (Central Processor unsecured side) & Infield Concourse – Acuity Brand
   b. For Terminal 1 (all secured side) – Douglas Lighting (legacy)
   c. For Terminal 3 – GE Lighting
   d. For other buildings – Douglas Lighting (legacy)
3. All new lighting design shall be integrated with the current respective lighting control system platform within the same location coverage.

4. To ensure consistency and facilitate central management, the lighting integration into the existing unified lighting control platform shall be mandatory for all other facilities. Consult with the GTAA before finalization of the lighting design.
5. The lighting control shall be in accordance with latest ASHRAE Std. 90.1 and the latest and OBC supplementary standard SB-10 requirements.
6. Provide a complete programmable centralized lighting control system with daylight harvesting, task tuning, occupancy sensing, dimming, scheduling, etc.
7. Line voltage switching is not acceptable. Check with GTAA for Line voltage switching is required.
8. LV switching, remote switching, or switching through occupancy sensors is allowed
9. All lighting control systems shall annunciate at the Building Management System (BMS) Office.

9.12 Lighting Fixture

1. All base building lighting fixtures shall be of native 347V.
2. Use for high quality energy efficient LED lighting fixtures with proven track record for illumination for Interior and exterior of buildings and parking lots.
3. Use LED for street lighting, Interior and exterior spaces.
4. LED fixtures must be individually fused. A plug-in type easily removable Controller assembly is preferred for ease of maintenance.
5. Use LED lighting fixture in high canopies, high ceilings etc.
6. Use Energy efficient interior illumination.
7. Site lighting shall meet the average maintained illumination level, uniformity, Colour rendering index (CRI) and glare control recommendation outlined in IESNA.
8. The color temperature of LED lighting fixtures shall be in the range of 4000k to 4500K and shall be consistent.
9. RP-20-14 for Parking Facilities & RP-33-99 Lighting for exterior Environments.
10. All LED drivers shall be high efficiency, high power-factor type.
11. Recessed lighting fixtures installed in suspended ceilings shall be supported directly from the building structure by safety chains
12. All fixtures must be easily accessible for maintenance. Provide a safe method to access all fixtures located greater than 3 meters.
13. In outdoor areas that require supplementary lighting, provide infrared sources to enhance outdoor closed-circuit television camera operations in darkness.
14. Reference GTAA Lighting Standard for additional requirements.

9.13 Maintenance Factors/ Maintainability

1. Location and installation conditions of components, equipment, fixtures and devices for any electrical system shall consider the ease of maintaining them as a factor of the design
2. Provide adequate redundancy in systems for maintenance purposes. Consider providing dual feeders, dual transformers and switchboards with two incoming breakers and tie-breaker for essential systems; to enable equipment isolation during planned shutdowns without impacting operations.
3. All breakers with the high-risk arc flash category shall be equipped with arc flash reduction maintenance switch.

9.14 Photo luminescent (PLM) Exit Sign

Photo luminescent (PLM) exit sign to CAN/ULC-S572, ABS plastic, aluminum or steel recyclable, non-toxic, ULC listed for indoor, outdoor locations, complete with mounting bracket, single, double face, thin, low profile design, or explosion proof.

Must meet these criteria:

a. Interior visibility: 15.24m
b. Letters: size to be in accordance with CAN/ULC-S572.
c. Colour: red on visibility green.
d. Directional chevrons: 1 or 2 per side.
e. Running person: to CAN/ULC-S572.
f. Directional indicator: arrows1 or 2 per side.
g. Mounting: ABS plastic, surface, flag, ceiling, conduit assembly kit.
h. Frame: ABS plastic, aluminum housing, as required by architect, frameless ABS plastic or steel.
i. Charging: minimum 54 lux of light on faces of sign at all times during building occupation.

9.15 Exit Sign

1. Exit lights to CSA C22.2 No.141 and CSA C860.
2. Housing: cold rolled steel minimum 1.0 mm thick, satin aluminum enamel finish, cast anodized extruded aluminum housing, or brush aluminum finish.
3. LED lamps designed for 50,000 hours continuously.
4. Letters as per building codes.

9.16 Self-Powered Units

Must meet these criteria:

a. Exit lights: to CSA C22.2 No.141 and CSA C860.
b. Housing: cold rolled steel minimum 1.0 mm thick, satin aluminum enamel finish, cast anodized extruded aluminum housing, or brush aluminum finish.
c. LED lamps designed for 50,000 hours continuously
d. Operating time 60 minutes minimum.
e. Battery: sealed, maintenance free
f. Charger: solid state, voltage/current regulated, inverse temperature compensated, short circuit protected, with regulated output of plus or minus 0.01 V for plus or minus 10% V input variation.
g. Solid state transfer circuit, signal light
h. Illuminated exit signs in the buildings have generator/ battery backup for the project including the tenant spaces.

9.17 Motors

1. Use premium efficiency motors above 5hp with minimum 90% efficiency and above, high power-factor above 90% for large motors 100hp and above
2. Use of Variable Speed Drives and harmonic filters for improving energy efficiency where wide load variations and harmonics are experienced. Refer to the HVAC Design Guideline for application criteria and minimum performance requirements for Variable Frequency Drives.

9.18 Motor Control Centre

1. Provide short circuit protection for the motor circuits with moulded case circuit breakers thermal /magnetic type coordinated with the thermal relay and contactors.

2. Adjustable magnetic protection shall range from 6 to 12 times the nominal current rating.
3. Tinplated electrolytic hard drawn high conductivity copper of 99.9% purity.
4. Provide fully withdrawable starters.
5. Pushbuttons and indicating lights mounted on door front.
6. Provision for three padlocks to lock operating handle in OFF position and lock door closed.
7. Provide all starter units with control terminal blocks for Type 'B' wiring.
8. Provide non-defeat able interlock to prevent installing or removing plug-on unit unless disconnect in "OFF" position. Provide means to padlock unit in partially withdrawn position with tabs free of vertical bus.
9. Provide with shunt trip and 3 auxiliary contacts for BAS.
10. Interface with fire alarm system as required.

9.19 Motors Starters

1. Heavy in-rush starting currents and voltage dips causing lighting flicker or impacting other systems such as computers and electronic equipment are unacceptable.
2. As a general rule reduced voltage starting is recommended for motors above 75HP
3. Solid state soft starters may be used on higher HP motors so that they operate at optimum efficiency. Over-sized or under-sized motors are unacceptable.

9.20 Electrical Cabinet and Enclosures

1. Provide enclosures suitable for the area in which they are located.
2. Type 1 enclosure complete with sprinkler proof for indoor, dry, unclassified areas.
3. Type 4 enclosure for damp, wet locations.
4. Type 4X for External and corrosive environments.
5. Hazardous enclosures for Hazardous area as per classification.
6. All outdoor Panel boards, switchboards, distribution boards and enclosure to be Stainless steel.
7. All outdoor enclosures for transformers, switchgear, distribution boards, Lighting and power panel boards, control panels and disconnect switches external to the building shall be Type 4X stainless.

9.21 Emergency Power

1. Provide building emergency power in accordance with the NBC and NFC.
2. Depending on the size of the installation a diesel generator, a DC battery system, paralleling switchgear, a UPS system or battery packs may be used for emergency power subject to GTAA approval.
3. Provide 4 pole transfer switches for 3 phase 4 wire systems and 2 pole transfer switches for 1 phase 2 wire systems.
4. Provide breaker type transfer switches with facility for closed transition switching where required by the GTAA.
5. Provide remote monitoring at the AOCC for diesel generators through the BAS including generator status, generator trouble, low battery, low fuel oil, failure to start and safety alarms. Additionally, alarms and notices shall be generated in the BMS in order to allow for remote monitoring of this system by maintenance staff. Monitoring points to be included in BMS integration include fuel level, high temperature, generator running, generator auto selection, and any other fault conditions available.
6. GTAA security and access control systems shall be installed using a separate circuit(s) will no other devices and equipment attached for other systems.

7. Emergency Power (power and lighting) shall be provided to support the operation of the following areas and systems:
    a. emergency lighting
    b. electrical rooms
    c. service rooms
    d. public washrooms in Terminal Buildings
    e. exit and directional signage
    f. fire alarm system
    g. equipment and devices supporting fire protection systems
    h. voice communication system
    i. telecommunication system
    j. security and access control systems
    k. CCTV and associated lighting
    l. fire, sump, sewage and heating pumps
    m. selected elevator(s)
    n. selected baggage handling systems
    o. loading bridges
    p. traffic signals
    q. selected street lighting
    r. obstruction lighting.
8. Provide battery packs for electrical rooms, mechanical rooms, stairs, and elevators and to the diesel generator room in addition to diesel generator power.
9. Emergency lighting battery packs connected to a power receptacle shall be provided in all exit stairs, corridors and along paths of travel to exits where the provision of any of the above is not possible
10. Emergency power shall not be run in the same raceways as normal power.

9.22 UPS Power

1. Provide Uninterruptible Power Supply (UPS) system to supply continuous, regulated AC power to critical loads under normal and abnormal conditions, including loss of utility AC power.
2. UPS system shall comprise of isolation transformers, rectifier/ charger with input filter, inverter , static transfer switch, and maintenance bypass switch, integral cooling, housed in a single free-standing type 1 enclosure with drip hood. UPS system shall be modular. N+1 requirement to be discussed with GTAA.
3. UPS system design performance requirements: CSA C22.1, C22.2 No. 107.1, and NEMA PE-1
4. Power factor: Minimum 0.9 to 0.95 lagging at nominal input voltage & full rated output load
5. Provide remote monitoring at both centralized UPS monitoring system (via SNMP protocol) and BAS/BMS system (via dry auxiliary contacts) for all UPS systems including UPS status (on battery, on generator or normal) trouble conditions and battery condition.
6. UPS power shall be not run on the same raceways as normal or interruptible emergency power circuits.
7. The UPS shall be connected to the following critical GTAA computer-controlled systems which are essential to be continuously operating without interruption and have time clock sensors and digital activation functions:
    a. Security systems
    b. Building Automation System
    c. operator computer work stations
    d. primary network communication equipment

e. control rooms
f. communication signal amplifiers
g. secondary power distribution to digital control panels
h. government agencies systems

8. UPS unit shall be with water drip protection

9.23 Generator Quick Connect

1. Provide a free standing, dead front type low voltage quick-connect connection panel utilizing main circuit protective device, generator lugs and cam type receptacle assembly for connection of generator phases, neutral and grounding conductor.
2. Provide key interlock between Generator quick connect breaker main and normal source breaker to prevent inadvertent interconnection and utility feedback or paralleling of unsynchronized sources.
   a. NEMA 12 enclosure for indoor application.
   b. NEMA 3RX enclosure minimum with stainless steel for outdoor application.
   c. The space heater shall be provided.
   d. Doors to have provision for pad locking.
   e. Ventilations opening shall be provided complete with replaceable fiber glass.

9.24 Power Quality

1. Comply with the requirements set out in IEEE 519 “Standard for Harmonic Control in Electric Power Systems”. Verify compliance once the system is in operation by carrying out power quality and harmonic analysis. Submit study details to GTAA for review.2. Any power characteristics or activity in the installed electrical load which impairs the distribution system by harmonics, spikes, transients, heavy in rush currents, etc. are not permitted and may result in disconnection of service if any already exist.
3. Transients – Provide transient voltage surge suppressors at switchboards and at equipment for protection against transients.
4. Lightning and Switching Surges – Provide metal oxide arrestors where required to protect equipment against lightning and switching surges.
5. All medium voltage transformers, medium voltage motors, medium voltage distribution cables, and telephone and computer equipment shall be protected by properly sized surge protectors.
6. Ensure that operation of cranes, welding or any other heavy equipment in construction or otherwise does not impact power systems in other areas.
7. Electrical loads, and distribution systems shall be designed so as not to cause interference to the other users of the Airport distribution system by causing violent fluctuations, radio noise, other signals or voltage and current harmonics. Review and acceptance of power loads by the Construction Control Office is required.
8. Install passive and/or active filters for harmonic mitigations.

9.25 Power Factor Correction System

1. Power factor to CSA C22.2 No.190-14, Capacitor for correction.
2. Provide automatically controlled power factor correction factor.
3. Capacity rating to be determined during design and shall be sized to maintain power factor between Unity and .95.
4. Discharge device to 50V in one minute.
5. Provide harmonic –suppression inductor to avoid countering the effects of resonance.

6. Equipment shall be monitored by and integrated to the EPMS as per Section9.41 Electrical Power Management System (EPMS).

9.26 Power correction in the Tenant spaces.

1. Tenants having connected loads of 25kW and over shall maintain the load power-factor between unity and 0.9 lagging. Install power-factor capacitors as required.
2. Carry out harmonic surveys where required.
3. Make sure that capacitors are not affected by non-linear loads.
4. Make sure that capacitors do not enter into resonant conditions with the system. Submit study for GTAA review.

9.27 Requirements for Public Spaces

1. All power receptacles in public spaces shall be tamper-resistant and of commercial grade.
2. All floor receptacle monuments shall be NOCOM Multiconnect product.
3. All controls and motors installed in non-secure building floor areas shall have devices and guards provided to prevent tampering.
4. Wherever practicable power shall be routed through ceiling spaces and down to supply points of building floor areas to minimize coring and cutting of floor assemblies and patching of floor finishes when altering construction.
5. Pipe chases shall be equipped with an 110V power receptacle and light.

9.28 Automatic Transfer Switch

1. Contactor Type Transfer Equipment with maintenance bypass switch.
2. Contact Type Transfer Equipment: to CSA C22.2 No.178.1 complete with Double by pass switches for maintenance and operation.
3. Two 3 pole contactors mounted on common frame, in double throw arrangement, mechanically and electrically interlocked, open type with CSA enclosure.
4. Rated: Rated: 600 V, 60Hz, 3 phase 4 wire, solid neutral amperes.
5. Main contacts: silver surfaced, protected by arc disruption means.
6. Switch and relay contacts, coils, spring and control elements accessible for inspection and maintenance from front of panel without removal of switch panel or disconnection of drive linkages and power conductors.
7. Equipment shall be monitored by and integrated to the EPMS as per Section9.41 Electrical Power Management System (EPMS).

9.29 Controls

1. Selector switch 4 position Test, Auto, Manual, Engine start
2. Control transformers: dry type with 120 V secondary to isolate control circuits. Normal power supply & Emergency power supply
3. Relays: Continuous duty, industrial control type, with wiping action contacts rated 10 A minimum:
4. Voltage sensing: 3-phase for normal power and on one phase only for emergency, solid state type, adjustable drop out and pick up, close differential, 2 V minimum under voltage and over voltage protection.
5. Time delay: normal power to standby, adjustable solid state, 5 to 180 seconds.
6. Time delay on engine starting to override momentary power outages or dips, adjustable solid state, 0 to 60 seconds delay.
7. Time delay on retransfer from standby to normal power, adjustable 5 to 180 seconds.

8. Time delay for engine cool-off to permit standby set to run unloaded after retransfer to normal power, adjustable solid state, 5 seconds intervals to 180 seconds.
9. Time delay during transfer to stop transfer action in neutral position to prevent fast transfer, adjustable, 5 seconds intervals to 180 seconds.
10. Frequency sensing, to prevent transfer from normal power supply until frequency of standby unit reaches preset adjustable values.
11. Neutral [disconnected] position delay: allow time for motors to delay between live sources, adjustable, 0 to 5 seconds.

9.30 Accessories

1. Ensure pilot lights indicate power availability normal and standby, switch position, green for normal, red for standby, mounted in panel and remote.
2. Plant exerciser: 168 hours timer to start standby unit once each week for selected interval [but does not transfer load from normal supply] [transfers load to emergency supply and retransfers to normal supply on standby unit shutdown]. Timer adjustable 0-168 hours in 15-minute intervals.
3. Auxiliary relay to provide 3 N.O. and 3 N.C. contacts for remote alarms.
4. Instruments:
    a. Digital true RMS, indicating type [2] % accuracy, flush panel mounting Voltmeter Ammeter, Frequency meter, Voltmeter selector switch: rotary, maintained contacts, panel mounting type, round notched handle, four position, labelled "OFF-Phase A-Phase B-Phase C, Potential transformers, Current transformers.
    b. Positive action automatic short- circuiting device in secondary terminals.

9.31 Circuit Breaker Type Transfer Equipment

1. Circuit Breaker Type Transfer Equipment: to CSA C22.2 No.5. , complete with Double by pass arrangement for operation and maintenance
2. Rated: Rated: 600 V, 60Hz, 3 phase 4 wire, solid neutral amperes
3. One 3 pole Power Circuit breaker with LSI 800 A or above or moulded case circuit breaker with thermal magnetic breaker below 800A, motor operator in double throw arrangement and, mechanically and electrically interlocked, open type with CSA enclosure.
4. One emergency 3 pole power circuit breaker with LSI or moulded-case circuit breaker with thermal magnetic trip, motor operated, and interlocked.
5. Two 3 pole Power Circuit breaker with LSI or Moulded case circuit breaker with thermal magnetic breaker, motor operator in double throw arrangement and, mechanically and electrically interlocked, open type with CSA enclosure. complete with Double by pass switches
6. Circuit breakers:
    a. Trip free in closed position.
    b. Interrupting rating: kA symmetrical per design
7. Dead front construction with access to relays and controls for inspection and maintenance, and manual operating lever for transfer switch.
8. Auxiliary contact: to initiate emergency generator start-up on failure of normal power.
9. Main contacts: silver surfaced, protected by arc disruption means. Switch and relay contacts, coils, spring and control elements accessible for inspection and maintenance from front of panel without removal of switch panel or disconnection of drive linkages and power conductors.

9.32 Controls

1. Selector switch 4 position Test, Auto, Manual, Engine start
2. Control transformers: dry type with 120 V secondary to isolate control circuits. Normal power supply & Emergency power supply
3. Relays: Continuous duty, industrial control type, with wiping action contacts rated 10 A minimum
4. Voltage sensing: 3-phase for normal power and on one phase only for emergency, solid state type, adjustable drop out and pick up, close differential, 2 V minimum under voltage and over voltage protection.
5. Time delay: normal power to standby, adjustable solid state, 5 to 180s.
6. Time delay on engine starting to override momentary power outages or dips, adjustable solid state, 0 to 60 s delay.
7. Time delay on retransfer from standby to normal power, adjustable 5 to 180 s.
8. Time delay for engine cool-off to permit standby set to run unloaded after retransfer to normal power, adjustable solid state, 5 s intervals to 180 s.
9. Time delay during transfer to stop transfer action in neutral position to prevent fast transfer, adjustable, 5 s intervals to 180 s.
10. Frequency sensing, to prevent transfer from normal power supply until frequency of standby unit reaches pre-set adjustable values.
11. Neutral [disconnected] position delay: allow time for motors to delay between live sources, adjustable, 0 to 5 seconds.

9.33 Accessories

1. Ensure pilot lights indicate power availability normal and standby, switch position, green for normal, red for standby, mounted in panel and remote.
2. Plant exerciser: 168 hours timer to start standby unit once each week for selected interval [but does not transfer load from normal supply] [transfers load to emergency supply and retransfers to normal supply on standby unit shutdown]. Timer adjustable 0-168 hours in 15-minute intervals.
3. Auxiliary relay to provide 3 N.O. and 3 N.C. contacts for remote alarms.
4. Instruments:
    a. Digital true RMS, indicating type [2] % accuracy, flush panel mounting Voltmeter Ammeter, Frequency meter, Voltmeter selector switch: rotary, maintained contacts, panel mounting type, round notched handle, four position, labelled "OFF-Phase A-Phase B-Phase C, Potential transformers, Current transformers
    b. Positive action automatic short- circuiting device in secondary terminals.
    c. Equipment Identification as per GTAA standard
5. Control panel:
    a. For selector switch and manual switch: size 4 nameplates.
    b. For meters, indicating lights, minor controls: use size 2 nameplates.

9.34 Power Distributions

9.34.1 General

1. The electrical Power system shall be designed with the minimum following criteria:
    a. Reliability
    b. Minimization of outage time in the event of service interruption
    c. Minimal disruption during scheduled maintenance
    d. Minimal disruption to operations
    e. Fault level with stand capacities
    f. Product of one manufacturer.

2. As a general rule, power supplies to most critical facilities are dual-source (dual feeder, dual transformer system) to obtain full redundancy; (if one supply is out the other shall have capacity to keep the connected load in operation).
3. Conduct load assessment to ensure sufficient capacity for the base building system to accommodate the anticipated electrical demand of the proposed design. Submit electrical load study report with supporting detailed load calculations.
4. Where a facility is served by a secondary selective system (with double-ended switchboard and automatic transfer scheme), the load on each side of the switchboard (along with its transformer and main breaker) shall be balanced and not exceed 50% of the capacity to maintain full redundancy.
5. Power distribution shall be in accordance latest ASHRAE Std. 90.1- and OBC supplementary standard SB-10 requirements.
6. Outdoor power distribution equipment enclosure shall be NEMA 3RX minimum with stainless

9.34.2 Electrical Energy Monitoring

1. Measurement devices shall be installed in new buildings to monitor the electrical energy use for each of the following separately:
    a. Total electrical energy,
    b. HVAC systems
    c. Interior lighting
    d. Exterior lighting
    e. Receptacle circuits
2. For buildings with tenants, these systems shall be separately monitored for the total building and (excluding shared systems) for each individual tenant.
3. Exception- Up to 10% of the load for each of the categories shall be allowed to be from other electrical loads.
4. If possible and practical ,each incoming feeder circuit shall be supplied from separated independent utility sources physically and electrically isolated from each other
5. All Product shall be from same manufacturer.

9.34.3 Low Voltage AC Switchboard- 600 V

1. The low voltage AC Switchboard assembly, components and accessories shall conform to the latest edition of CSA, NEMA, EEMAC and ANSI Standards.
2. The major components of the low voltage AC switchboards include Power circuit breakers, Moulded case circuit breakers, metering compartment, and connections to transformers.
3. Main incoming breaker shall use draw- out power circuit breaker.
4. Double ended with tie breaker shall use draw-out power circuit breakers.
5. Draw-out power circuit breaker or fixed moulded case circuit breakers with individual compartment may be used as secondary feeder breakers supplying loads.
6. Equipment shall be monitored by and integrated to the EPMS as per Section9.41 Electrical Power Management System (EPMS).

9.34.4 Enclosure Sections

1. Indoor Type 1 enclosure complete with drip hood, free standing.
2. Fabricate from minimum 2.68mm (12 gauge) steel, metal clad, bolted assembly with gasketed top plates, continuous channel-iron floor sills and steel lifting eyes.

3. Each circuit breaker to be housed behind a separate minimum 14-gauge hinged steel inner door painted to match switchgear. Meters and instruments to be mounted in the upper compartment on a 14-gauge minimum, hinged steel panel, suitable braced for mounting meters.
4. Overhanging drip-proof and sprinkler proof louvres to be provided for ventilation of ionized gases from the structure where necessary to maintain a maximum internal air temperature of 15°C. rise above 40°C. ambient temperature
5. Front, side and rear accessible, with full height hinged doors (side and rear can be bolted cover plates). Two latching points and padlocked handle operating extended bar to latching points at top and bottom. Door to swing 135°.
6. Fabricate vertical sections with compartments for draw-out type circuit breakers.
7. Rear doors to have special infrared scanning compatible viewing windows for infrared scanning of bolted bus bar joints, bus ducts and cable terminations to all breakers. Infrared scanning windows shall be compatible for Longwave and shortwave with all cameras.
8. PLC –HMI based transfer scheme to be discussed with GTAA.

9.34.5 Static Transfer Switch

1. Static transfer switch shall be provided for equipment fed from double ended power source in medium and high voltage system as required by GTTA
2. Static switch shall automatically transfer power to the stable alternate source in less than 4ms under normal operating conditions. The requirement shall be discussed with GTAA.

9.34.6 Busbars

1. All bus bars shall be copper tin plated and Insulated.
2. Interrupting capacity withstand rating shall be sized in accordance with fault current level resulted from short circuit analysis.
3. Mark incoming line terminals with corresponding phase. (Phase A, B, C).
4. Ground bus: 6mm x 50mm extending full length of switchboard, solderless connector at each end suitable for No. 4/0 AWG copper ground wire.
5. Enclosure cells shall have provisions for future bus extensions on either side.
6. Control Wiring and Terminals:
7. Provide internal control wiring and include terminal blocks for external connection. Number wiring at both ends.
8. Permanently identify terminals and control wiring terminations.

9.34.7 Main circuit breakers

1. Three-pole manually/motorized operated draw-out type power circuit breaker, 100% rated, 600 V, 60Hz.
2. Dead front, latched in, trip free, with closing and tripping mechanisms manually operated. Closing mechanism stored energy type for quick-make operation.
3. Breaker shall be equipped with solid state or micro-processor based with trip units with selectable rating plugs mounted in circuit breakers. Trip unit to have long time, short time, and instantaneous and ground fault elements, easily adjustable. Trip units equipped with trip indicators and communication port for remote monitoring. Rating plugs to allow field selection and interchange. Metering functions to communicate with Integrated Operations Control Centre.
4. Breaker shall have interrupting capacity withstand rating sized in accordance with available fault current level.

5. Provide and connect to terminal blocks, six auxiliary contacts for remote annunciation, two for "open", two for "closed" and two for "tripped". Three Form “A” and three Form “B” rated at 10A, 250V minimum, on each main circuit breaker.
6. Provide mechanical interlocks to positively prevent withdrawing or inserting breaker unless in open position. Provide lamacoid nameplate at key block and on key.
7. Circuit Breaker mechanism should be functional for “Close, Open, Trip” operation with door closed, in positions as follows:
8. Fully connected.
9. Fully withdrawn, with contacts disconnected.
10. Provide circuit breakers with provision for multiple padlocking in open position only and equip with following:
    a. Mechanical close and trip pushbuttons.
    b. Open-close indicator.
    c. Charging mechanism status indicator.
    d. Manual charging handle.
    e. Operation counter.

9.34.8 Branch Circuit Breakers

1. Power circuit breaker/Moulded case circuit breakers, trip free, fixed mounted dead front, manually operated.
2. Breakers rated 225A or above shall be equipped with solid state or micro-processor based direct acting trip units with selectable rating plugs mounted in circuit breakers. Trip unit to have long time, short time, and instantaneous and ground fault elements.
3. Provide Power Release trip units with features such as Breaker health includes breaker operations, short circuit fault levels, operation time, internal temperature, and overload. Multiple Load Alarms, and Ground Fault Alarm to help avoid costly downtime through predictive and preventative maintenance .Trip units equipped with trip indicators and communication port for remote monitoring at Integrated Operation Control Centre. Rating plugs to allow field selection and interchange.
4. Digital PQ meter with Modbus protocol shall be equipped on all Main Switchboards (main and feeder breakers), MCC’s and downstream distribution panels (main). Each feeder breaker to be equipped with a 3-phase true RMS digital meter with local LCD display to indicate phase current for each phase, present and peak demand, power consumption, voltages, pf, indicates individual harmonics up to 31st . The digital PQ meter shall be connected and communicate with centralized PMCS system for power monitoring and load data acquisition.
5. Provide and connect to terminal blocks, six auxiliary contacts for remote annunciation, two for "open", two for "closed" and two for "tripped". Three Form “A” and three Form “B” rated at 10A, 250V minimum, on each breaker for remote monitor for remote operation.
6. Provide and connect to terminal blocks, six auxiliary contacts for remote annunciation, two for "open", two for "closed" and two for "tripped". Three Form “A” and three Form “B” rated at 10A, 250V minimum, on each breaker for remote monitor for remote operation.
7. Door(s) to be gasketted, with overhanging drip shield, with T-handle 2-point locking system complete with lock and latch, protecting breakers and all other components.
8. Breakers rated at less than 225A shall be adjustable thermal magnetic type.
9. Breaker shall have interrupting capacity withstand rating sized in accordance with available fault current level.

10. Provide metering compartment in accordance with Toronto Hydro Metering standard. Coordinate with Toronto Hydro / ESA for size of compartment, supply of revenue CT's, PT's, and installation. Coordinate with Toronto Hydro for the Work.

9.34.9 Customer Metering

1. Provide digital information metering on the load side of the main circuit breaker

9.34.10 Digital Information Metering

1. Microprocessor based metering complete with display, and at a minimum, provide following information and quantities:
2. Current, per-phase and neutral, Voltage, phase-to-phase and phase-neutral, Real Power (kW), per phase and three-phase total Reactive Power (kVAR), per phase and three phase total. Apparent Power (kVA), per phase and three phase total, Power Factor (true), per-phase and three-phase total, Frequency, Demand Current, per-phase and neutral, present and peak, Real Power Demand (kWd), three phase total, present and peak, Reactive Power Demand (kVARd), three phase total, present and peak, Apparent Power Demand (kVAd), three phase total, present and peak,
3. Real Energy (kWh), three phase total Reactive Energy (kVARh), three phase total, Apparent Energy (kVAh), three phase total, Energy Accumulation modes, signed, absolute, energy in, energy out.
4. Total Harmonic Distortion (THD), voltage and current, per phase.
5. Ethernet and fiber optic ports.
6. Metering system will have remote monitoring capability.
7. Digital meters shall be Schneider Electric ION900 or equal with network capability and shall be connected to the EPMS as per Section 9.41 Electrical Power Management System (EPMS) for power monitoring and load data acquisition.

9.34.11 Phase Designation

1. Coloured phase designations or numbering markings to be readily visible in each bus compartment, current transformer compartment, circuit breaker compartment and line and feeder cable compartment.
2. Instrument Transformer
    a. Potential transformers and current transformers required to operate relays, meters and other devices to be coordinated so that the ratio and accuracy are suitable for each individual application, taking into account the burdens imposed. Construction of transformers to conform to ANSI Standards. All terminals to have permanent polarity designations.
    b. Potential transformers to be of the 0.3 accuracy class, per ANSI Standards and of sufficient capacity to serve the maximum burden imposed.
    c. Current transformers to be capable of carrying at least 125% of CT rating continuously and have a short time rating at least equivalent to that of the switchgear bus. Accuracy class: C1 00/ 0.6 B-1.
3. Transient Voltage Surge Suppressors (TVSS):
    a. Transient Voltage Surge Suppressors (TVSS) to be designed, factory assembled and tested in accordance with the latest applicable EEMAC, CSA, NEMA, UL, IEEE, and ANSI standard.
    b. TVSS shall be installed on the load side of main circuit breaker, as close as possible to phase and ground/neutral buss bars. Install TVSS with properly sized disconnect switch hard bussed to switchboard bus bars.
    c. TVSS units to have a maximum continuous operating voltage (MCOV) of not less than 115% of the nominal system operating voltage.

9.35 Distribution Panels

1. Construction Features:
    a. To CSA C22.2 No. 5, 29 and Canadian Electrical Code requirements, including barriers.
    b. Indoor sprinkler proof construction CSA Enclosure 2. Door(s) shall be gasketted, and overhanging drip shield, complete with lock and latch, protecting breakers and all other components.
    c. All Distribution panels Transient Voltage Surge Suppression.
    d. Product of one manufacturer.
    e. Panels shall be finished with two coats of paint. Color code for emergency, Normal power and UPS power panels to be checked with GTAA.
    f. Bus bars: Cooper tin plated. Cells to have future bus extension on each side.
    g. One lock key for all panel in the project.

9.36 Molded Case Circuit Breakers

1. All branch circuit breakers shall be molded case type suitable for interrupting capacity based on short circuit calculation at 600 V. Refer to section 7.1.15 for the short circuit study.
2. Provide Power Release trip units with features such as breaker health includes breaker operations, short circuit fault levels, operation time, internal temperature, and overload. Multiple Load Alarms, and Ground Fault Alarm to help avoid costly downtime through predictive and preventative maintenance.
3. Provide molded case circuit breakers to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping characteristic.
4. Provide circuit breakers with interchangeable trips above 150A.
5. Provide molded case circuit breakers to operate by means of a solid-state trip unit with associated current monitors and self-powered shunt trip devices to provide an inverse time vs current trip characteristic under overload conditions, and longtime, short time and instantaneous tripping for phase ground fault short circuit protection. The trip unit shall be fully adjustable current and time characteristics.
6. All breakers 400A or above frame with interrupting capacity as calculated, shall be with solid state trip unit with individually adjustable long, short and instantaneous time and current elements.

9.36.1 Lighting and Receptacle Panelboard

1. CSA C22.2 No. 29
2. Tin platted copper with neutral of same ampere rating as mains
3. Panel to be flush and surface mounted.
4. Panels shall be dead front type in code gauge steel enclosure.
5. Contactors in panel mains shall be electrically operated, mechanically held and shall be rated to control loads.
6. Breakers shall have bolted type connections
7. Panels for 120/208 volts, three phase, and four wire systems shall be complete with full size breakers, having a symmetrical interrupting rating of at least 10,000 A. Refer to section 7.1.15 for the short circuit study.
8. with breakers having a symmetrical interrupting rating of 18,000 Amps minimum.
9. Lock on device as required by GTAA.
10. Flush mounted panels shall have concealed hinges and flush type combination lock latch. Doors shall open minimum 135 degrees.

11. Surface mounted panels shall be constructed in accordance with CSA Type 2 enclosures with overall door assembly protecting all circuit breakers. Door(s) shall be gasketted, with overhanging drip shield, with T-handle 2-point locking system complete with lock and latch.
12. Provide Equipment Identification and Complete circuit directory with typewritten legend showing location and load of each circuit.

9.37 Transformer

9.37.1 General

1. 27.6 kV, 300 kVA and greater- liquid filled.
2. 5 kV, 300 kVA and greater – liquid filled.
3. 600 V, 500 kVA and greater- liquid filled.
4. All other transformers may be of liquid or dry type.
5. Losses and Efficiency – Comply with current CSA requirements as a minimum. In evaluating competitive bids for transformers, losses over the life cycle will be taken into consideration.
6. Ventilation – Ventilation requirements must be taken into consideration and GTAA must be informed if changes to the ventilation system are required.

9.37.2 Transformers- Liquid Cooled

1. Power Transformers (CSA-C88 M90) or Pad-Mounted, Indoor or Outdoor transformers (CSA-227.4) are acceptable. In general transformers shall comply with the following. Complete specifications and load calculations must be submitted for GTAA review:
    a. Pad mounted outdoor transformers shall be dead front, tamper proof.
    b. Outdoor – Mineral Oil, ONAN or ONAF with PCB content less than 2ppm.
    c. Indoor- R-Temp, LNAN or LNAF; PCB content less than 2ppm.
    d. Containment – for indoor units provide containment for liquid spillage.
    e. System Voltage- 27.6/16 kV, 60Hz, 3 phase, 4 wire with solidly grounded neutral.
    f. Primary winding – solidly grounded copper wye.
    g. Secondary winding – solidly grounded copper wye unless otherwise specified.
    h. BIL- Primary125 kV (full wave), 600 V secondary 30 kV.
    i. Taps – off-load 2.5% on HV winding, 2FCAN and 2FCBN.
    j. Temperature Sensors – Winding temperature and top oil; dry contacts for monitoring.
    k. Insulation – 65deg.C. rise above 30deg.C. Ambient and a winding temperature by resistance of 95deg.C.
    l. Load Break Switch – where specified.
    m. Fuses – as specified.
    n. Tank – sheet steel and welded construction.
    o. Colour – ANSI 61-Grey .
    p. Drain and Sampling Valves – bronze ball-type.
    q. Pressure relief device.
    r. Oil Level Gauge.
    s. Filler plug.

9.37.3 Transformer Dry Type-600 V Primary

1. Design, manufacture and test the dry type transformers in accordance with good industry practice and in accordance with the following Standards:
2. CSA C22.2 No.47 and CSA C9 – Dry Type Transformers.
3. CSA 802 Standard. – Minimum efficiency values for dry type transformer.

4. NEMA- ST-20
5. ANSI 57.12.01 General requirements of dry type distribution & power transformers.

9.37.4 Transformer

1. Transformers with primary windings shall have the following characteristics:
    a. Voltage and kVA ratings, Single or three phase, Delta connected for three phase transformers ,1.2 kV insulation class with standard B.I.L, Four 2 1/2% taps, 2 FCAN and 2 FCBN.
2. Transformers with secondary windings shall have the following characteristics:
    a. Voltage rating, Wye connected for three phase transformers.
3. Provide full width electrostatic shield resulting in a maximum effective coupling capacitance between the primary and secondary of 33 Pico farads.
4. Transformers for non-linear loads shall have the following characteristics:
    a. The transformers shall be K-13 rated transformers.
    b. Transformers shall be specifically designed to supply 100% of the 60hz fundamental rated current, 33% of the fundamental current as third harmonic, 20% of the fundamental current as fifth harmonic, 14% of the fundamental current as seventh harmonic, 11% of the fundamental current as ninth harmonic, and lower proportional percentages of the fundamental current through the 25th harmonic.
    c. Transformers shall be marked with a label stating 'Suitable for Non-Sinusoidal Current Load with K factor 13.
    d. Type ANN
    e. Class 220 C insulation. Neither the primary nor the secondary temperature shall exceed the 220 C at any point in the coils while carrying their full load.
    f. 115-degree Celsius temperature rise.
    g. Vacuum impregnated polyester resin construction.
    h. Transformer to be suitable for loads with crest factor up to 4.5 and capable to deliver full nameplate kVA for loads of up to K-factor of 13, without exceeding 115 C°temperature rise.
    i. Average sound level: 40dB (up to 9 kVA), 45dB (10-15 kVA), 50dB (51-150 kVA), 55db (151-300 kVA), 60db (above 301 kVA).
    j. Neutral connection to be rated at twice the ampacity of the secondary phase current.
    k. The 200% neutral ampacity to be established at the star point of the transfer coils and extended through to the neutral connection.
    l. CSA enclosure 1, sprinkler proof with removable front cover and drip shield for indoor applications.
    m. Acid etch the enclosure, prime with zinc chromate primer
    n. The transformer on normal power, emergency or backup power shall be finished with two coats powder coated paint. The color of the paint to be coordinated with GTAA.
    o. A minimum efficiency per latest CSA-802 and ASHRAE 90.1
    p. A core constructed of laminations of high permeability silicon steel M6 or better grade with low hysteresis and eddy current losses
    q. Windings shall be of high conductivity copper.
    r. Provide vibration mounting pads for all transformers
    5. Three phase harmonic cancellation type transformers, 600 V delta connected primary and 120/208 V WYE secondary, with an integral zero sequence zig zag winding configuration designed to cancel secondary winding zero sequence harmonic fluxes and eliminate primary winding circulating current.

9.37.5 Dry Type Transformers Primary +1000V

9.37.5.1 Standard

1. Dry type transformers to CSA C22.2 No. 47 and CSA C9, and CSA 802.2

9.37.5.2 General

1. Transformers shall be self-contained, free standing units suitable for floor mounting shall have voltage and kVA rating.
2. Transformer windings and all current carrying parts shall be copper
3. Transformers shall be self-contained, free standing units suitable for floor mounting
4. Coil to be designed to minimize eddy losses and provide high short circuit strength
5. Transformers shall be equipped with grounding provision
6. Transformers to have 5-2 1/2% full capacity primary taps, two above and two below nominal voltage.
7. Indoor ventilated, forced air cooled type
8. Enclosure: Type 3R
9. Transformer enclosure to have primary metal treatment and to be finished with 2 coats powder coat finishing paint.
10. Provide equipment identification in accordance with GTAA standard

9.37.6 Ratings

1. KVA capacity to be based on Class 220-degree C insulation, 150-degree C rise.
2. Transformers shall be type ANN.
3. Transformer noise level to be as per Table 8 of CSA Standard.
4. Transformer full load voltage regulation not more than 3% at 80% power factor.
5. Transformers rated 300 kVA and larger to have a noise level 3 dB below that shown on Table 8 of CSA Standard
6. Transformer audible sound level to not exceed 65db at 1.8 m (6') at full load rating and 100% rated primary voltage
7. Transformer BIL as follows:
    a. 5 kV Class: 60 kV BIL
    b. 15 kV Class: 95 kV BIL
    c. 30 kV Class: 150 kV BIL
    d. 35 kV Class: 170 kV.

9.37.7 Lightning Arrestors

1. MCOV porcelain station class surge arrestors shall be connected to the primary terminals.

9.37.8 Grounding Resistors for Resistance-Grounded systems

1. Neutral grounding resistors shall be designed and tested to IEEE-32 standards to limit the fault current to 5 ampere. Mount resistor in a suitable enclosure on transformer.

9.38 Lightning Arrestors

1. MCOV porcelain station class surge arrestors shall be connected to the primary terminals.

9.39 Grounding Resistors for Resistance-Grounded systems

1. Neutral grounding resistors shall be designed and tested to IEEE-32 standards to limit the fault current to 5 ampere. Mount resistor in a suitable enclosure on transformer.

9.40 Electric Vehicle Charging System

1. Provide Distribution center for electric vehicle charging equipment (EVSE) for automobiles, buses trucks, vans etc. as required by GTAA. Distribution Center shall be equipped with digital power quality meter with integration into the GTAA centralized Electrical Power Management System as per Section 9.41Electrical Power Management System (EPMS).
2. Electric Vehicle charging system shall be in accordance with the latest CEC and its amendment.
3. Determine all requirements to size transformers, main disconnect switch, breakers, cables and conduits. Make provisions for future units as required.
4. Electric vehicle charging equipment to include a complete assembly consisting of cables, connectors, devices, apparatus , and fittings installed for the purpose of power transfer and information exchange between the branch circuit and the electrical vehicle.
5. Each parking spot is to have independently mounted, dual port level 2/3 charging stations for automobiles including buses. Confirm requirements with the GTAA.
6. Chargers will be mounted on new concrete pads and protected by new bollards as required.
7. Suitable for outdoor locations subject to harsh weather conditions, certified to operate between minus 40-degree C and plus 50-degree C.
8. Chargers to have cUL, CSA compliance, minimum 0.9 P.F, have Ultra flex cable min 20' long.
9. Provide non-proprietary, open source communications and networking and has the ability for remote data acquisition, monitoring and control as required.
10. All electric vehicle charging equipment shall be connected and integrated to a centralized Electric Vehicle Energy Management System (EVEMS) with the ability to remotely monitor and control each individual charging equipment. The EVEMS shall be one single platform with non-proprietary, open-source communications and networking protocol.
11. Reference Architectural Design Requirements for bollard and guarding requirements.

9.41 Electrical Power Management System (EPMS)

1. The GTAA has implemented comprehensive Electrical Power Management System (EPMS) platform across all Terminal facilities. This state-of-the-art system provides real-time monitoring, recording, alarming, trending, reporting and troubleshooting capabilities for base building's power distribution network.
2. The current EPMS platforms include:
    a. For Terminal 1 (Pier F), Terminal 3 and Infield Concourse – Schneider EcoStruxture Power Monitoring Expert and Power Operation
    b. For Terminal 1 (Central Processor, Pier D and Pier E only) – Siemens WinPM.NET
3. Integration of new power distribution and metering equipment with the current EPMS platform is mandatory for all buildings and facilities. Consult with the GTAA further requirement.

10. Roadway and Parking Lighting Requirement

10.1 Standards and Codes

1. The design and construction of all lighting fixtures and equipment shall conform to the following:
    a. IES
    b. IDA and other applicable standards
    c. Provincial regulations or City By-Laws for illumination standards for illumination
    d. CSA Approved materials and equipment
    e. Canadian Electrical Code
    f. Requirements and guidelines provided in this section

10.2 General Requirements

1. Requirements and guidelines given in this section are general only. The GTAA shall review specifics of each lighting installation.
2. The following information pertaining to the installation shall be submitted for review:
    a. Fixture and lamp details and optical characteristics.
    b. Pole and pole ballast.
    c. Mounting heights, spacing and locations.
    d. Lighting controls.
    e. Power supply with source panel ID and circuit number
    f. Illumination levels
3. Lighting shall be adequate for comfortable visibility and for safe and effective movement of vehicular and pedestrian traffic at night.
4. Parking lot lighting shall take into consideration CCTV image visibility when determining layout and illumination levels.
5. External pole mounted luminaires shall be provided with individual photocell built into each luminaire.
6. The use of energy efficient fixtures and lighting controls is recommended for lighting installation and shall be designed for optimum efficiency without sacrificing the essential provisions.
7. High mast poles shall be hot dipped steel galvanized after fabrication as per ASTM A123. The silicon content if the galvanized steel shall be between 04%-15%. The pole shaft assembly shall conform to ASTM A595 Grade A. Anchor bolts conform to ASTM F1554 Grade 55. Finish- Standard finishes are Galvanized (GV) or Finish Painted (FP) to be discussed with GTAA.
8. Tapered steel post: The pole shaft is a 1-piece assembly conforming to ASTM A595 Grade A or A572 Grade 55. A reinforced hand hole with grounding to be provided at 1'-6" from the base end of the pole assembly. Each hand hole includes a cover and the cover attachment hardware. Base cover to include the dart square (2T) cast aluminum cover. NE Anchor bolts conform to ASTM F1554 Grade 55. All structural fasteners are galvanized high strength carbon steel. Standard finishes are Galvanized (GV) or Finish Painted (FP) to be discussed with GTAA
9. Designers and consultants shall refer to Civil and Structural Engineering standards as needed.

10.2.1 Maintenance

1. Lamp and controller replacement, cleaning optical assembly, retractable poles, etc. shall be considered in the design of the lighting installation.
2. Location of lights permit performing routine maintenance with minimum interference of traffic flow.

10.2.2 Glare& Pollution

1. Lighting systems shall not interfere with night visibility of the Air Traffic Control Tower operators and pilots.
2. Transmitted light on the Air Traffic Control Tower windows from direct and indirect reflected light sources shall not exceed 1 lux.
3. The lighting system shall conform to municipal standards for upward light pollution and glare

10.2.3 Zoning and Obstruction Clearances

1. Light standard heights shall comply with NAV Canada and GTAA obstruction limitation surface requirements

10.2.4 Illumination Levels

1. The minimum illumination levels shall conform to the latest edition of Illuminating Engineering Society of North America (IESNA) Lighting Handbook.
2. Refer to GTAA Lighting Standard for additional requirements.

10.3 Apron Floodlighting System

10.3.1 Compliance Requirements

1. The design shall conform to the following:
    a. International Civil Aviation Organization (ICAO)
    b. CSA approved materials and equipment.
    c. Canadian Electrical Code.
    d. Requirements and guidelines provided in this section.

10.3.2 General Requirement

1. Requirements and guidelines given in this section are general only. The Construction Control Office shall review specifics of each lighting installation.
2. The following information pertaining to the installation shall be submitted for review:
    a. Fixture and lamp details and optical characteristics.
    b. Pole and pole base details.
    c. Mounting heights, spacing, and locations.
    d. Lighting controls.
    e. Power supply.
    f. Illumination levels.
3. Flood lighting producing minimum glare for pilots maneuvering aircraft and for the Air Traffic Control Tower operators shall evenly illuminate apron areas.
4. Lighting of apron areas shall take into consideration CCTV image visibility when determining layout and illumination levels.
5. The aircraft stand shall receive illumination aimed on the immediate area from two or more light sources to minimize shadow casting.
6. The spectral distribution of illumination shall be such that the colours used for markings are correctly identifiable.
7. Fixtures shall be individually fused either inside the fixture or at the pole base.
8. The lighting load shall be balanced on three phases. Lighting installations shall be designed for optimum efficiency by using energy efficient fixtures and lighting controls.
9. High mast apron flood lighting shall be connected to the existing lighting control or similar type for the new installation.

10.3.3 Maintenance

1. Lamp and ballast replacement, cleaning optical assembly, retractable poles, etc. shall be considered in the design of lighting installation.
2. Location of lights permit performing routine maintenance with minimum interference of Apron Operations

10.3.4 Glare and Pollution

1. Lighting systems shall not interfere with night visibility of the Air Traffic Control Tower operators and pilots

2. Transmitted light from direct and indirect reflected light sources on the Air Traffic Control Tower sources windows shall not exceed 1 lux.
3. The lighting system shall conform to municipal standards for upward light pollution and glare

10.3.5 Zoning and Obstruction Clearances

1. Light standard heights shall comply with NAV Canada and GTAA obstruction limitation surface requirements.

10.3.6 Apron Illumination Levels

1. The minimum illumination levels shall comply with the latest edition of ICAO, Annex 14, Volume I - Aerodrome Design and Operations.

10.4 Power Distribution and Duct Bank

10.4.1 Operation

1. The GTAA 27.6 kV power distribution system is operated, maintained and managed by a GTAA contracted utility company (the Operator). Written approval must be obtained from the GTAA and the Operator before carrying out any work related to the 27.6 kV system.
2. The GTAA 27.6 kV system is a SCADA controlled utility-type design with standardized equipment including transformers, switchgear, duct-banks, manholes, terminations and splices. All work carried out on the system must adhere to Alectra and GTAA standards. Written approval is mandatory for any exceptions prior to proceeding.
3. All construction to be performed on the Airport power distribution system shall be fully documented, including:
    a. single-line diagrams.
    b. revised site plan drawings indicating placement locations, duct routing and utilization.

10.4.2 Concrete Encased Duct Bank

8.4.2.1 PVC Ducts and PVC fitting

1. Rigid PVC ducts EB1, encased in reinforced concrete.
2. Rigid PVC opaque solvent welded type couplings, bell end fittings, plugs, caps, adaptors, Expansion joints, Rigid PVC 5° angle couplings.
3. Concrete and Re-enforcing as per GTAA standards
4. 6 mm (1/4”) stranded nylon polypropylene pull rope tensile strength 5 kN continuous throughout each duct run with 3 m (10') spare rope at each end.
5. Concrete type cable markers: 600 mm x 600 mm x 100 mm with words: "cable", "joint" or "conduit" impressed in top surface, with arrows to indicate change in direction of duct runs.
6. Encase duct bank with 75 mm thick concrete cover. Use galvanized steel conduit for sections extending above finished grade level.
7. Grounding copper wire in concrete encasement and terminated on a ground bus in each maintenance hole throughout duct bank system, and to ground busses at origin and destination.
8. Use bell ends at duct terminations in manholes or buildings.
9. Manhole (Power or Communication) shall be drained to a nearby catch basin by gravity.
10. Pull through each duct a steel mandrel not less than 300 mm long and of a diameter 6 mm less than internal diameter of duct immediately after placing of concrete.
11. Lay concrete markers flat and centered over duct above earth surface.

11. Communication System

11.1 Telephone Service

1. GTAA Telephone rooms are shared by Bell Canada, AT&T Canada, Advantis (Air Canada), and by the GTAA's service provider. All space within them shall be allocated by the GTAA subject to availability and shall remain within its control. The Tenant shall request permission to use defined space within a telephone room for communication services before installing. If cable terminations are made within GTAA telephone rooms, each Tenant or their service provider shall provide its own terminals and shall not connect to other terminals except by permission from the respective service provider.
2. Telephone rooms and closets, including backboards and cabinets shall remain readily accessible and have working space as wide as the backboard, cabinet or door opening of the closet, but not be less than 750mm wide.
3. Telephone rooms and closets shall not be located underneath building floor areas that contain services including supply and drainage systems or activities involving fluids of any kind.
4. One conduit shall be supplied from the nearest telephone room to the Building Space lease line for the exclusive use by Bell Canada. Tenants shall extend Airport provided conduits into the Building Space as required. Any additional conduits requirements from telephone rooms, closets and panels within the Terminal buildings may be extended to the Building Space lease line by the GTAA at the Tenant's expense.
5. Each aircraft loading bridge location shall have one 25mm diameter empty conduit extended from the nearest telephone panel for communication connection by airline Tenants.

11.2 Cable Duct Systems

1. All underground cabling shall be placed in approved conduit ducts either loose laid in backfill or concrete encased.
2. Installation of cable ducts may use either directional boring or open trench methods determined by site conditions and the requirements of the GTAA.
3. Manhole locations for duct systems shall be spaced a maximum of 200m apart.
4. Manholes shall be constructed to Airport standards.
5. Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
6. Do not use backfill material which is frozen or contain ice water and frozen ground.
7. Place back fill material in uniform layers exceed 300 mm compacted thickness up to grades. Compact each layer before placing succeeding layer.
8. Refer to the Airport Construction Code for securing of manhole and chamber access covers.

11.3 FIDS/ BIDS

1. The installation of Flight Information Display System/Baggage Information Display System (FIDS/BIDS) video monitors by airline Tenants in unleased Airport Space shall be governed and permitted by the following requirements:
    a. No video monitors will be installed without prior approval of location and design by the GTAA, for which approval and design shall not be unreasonably withheld.
    b. Airlines shall not place advertising on cabinetry (except on screen side only, 25mm high letters, matching the Airport's lettering style and stating the airline's name with approved logo).
    c. Primary Tenants with subleased gates may be required by the GTAA to provide access to use of video monitors by sub-lessee in order to reduce the number of such units.

d. All other FIDS and BIDS installations shall be the responsibility of the GTAA for providing and maintaining.
e. All FIDS and BIDS installations shall be protected by SPD Surge Protective Device.

11.4 Public Address Speaker System

1. All alterations, extensions and removals of the Terminal building speaker system shall be coordinated with the Construction Control Office where it involves the development of new Building Spaces.

11.5 Antennas

1. The GTAA policy on antennas is to limit the number of antennas and to assure that they do not distract from the visual harmony of the Airport and its buildings.
2. Installing cable television systems within buildings would reduce the need for TV antennas mounted on roofs.
3. Users installing antennas and satellite dishes do so with the understanding that when requested and within a reasonable time determined by the GTAA, they shall be required to remove the antennas at their own expense and relocate them to a new location identified by the GTAA.
4. The Construction Control Office on an individual basis for approval shall review each proposed antenna installation with each final location identified by a label stating the owner's name and the purpose.
5. No antenna allowed on the roof of any building shall be visible from public areas of the Airport. Antenna locations shall not affect the views from the Air Traffic Control Tower and may need approval from Nav Canada before given GTAA approval.
6. No antenna is permitted to be installed on the ground within the aircraft maneuvering areas but may be permitted on the structures in these areas provided they are not visible from public areas.
7. Installation methods for antennas shall use care to ensure that materials and finishes of buildings/structures are not damaged and that roof penetrations are properly sealed watertight where permitted.
8. Antennas shall not be attached to roof mounted equipment or piping.
9. All cabling connecting antennas shall be contained in non-corrosive conduit for exposed attachment to the building where permitted, but generally conduit shall immediately be routed inside and continue in conduit to the terminus point. All shall be run in a neat manner, adequately supported and not to interfere with the removal or access of other equipment and ceiling tiles.
10. Tenants within Terminal Buildings shall confirm prior to ordering any electronic equipment to be installed, such as antennae, that it will not cause any type of interference with other electronic signals from electronic equipment in place by other persons operating it within the same Terminal Building. Upon detection of such problem and notice given by the GTAA, the Tenant shall take the necessary measures at its sole expense to have it cease.
11. Where new openings or penetrations are being introduced to the existing building enclosure, the openings shall be details to maintain continuity of air and moisture control layers, and to eliminate thermal bridging.

12. Passenger Boarding Bridges

For all matters relating to Passenger Boarding Bridges, Designers, Consultants and Engineers are directed to reference "Aircraft Gating Equipment Requirements for Supplier Contract at Toronto Pearson" dated October 9, 2022, version 2.0.

1. All passenger boarding bridges must be supplied with a safety loop encircling the wheels. The safety loop must have a pressure bar in the front and back at minimum with options for side mount if desired.
2. Safety loops are to be supplied with all necessary documents, electrical drawings, and specifications for GTAA reference.

13. People Moving Devices

13.1 Automated People Mover

1. For all matters relating to the Automated People Mover (APM), Designers, Consultants and Engineers are directed to reference ASCE APM 21 standards.
2. AMP designs to comply with the Ontario Structure Inspection Manual (OSIM) published by Ministry of Transportation requirements inclusive of ability to inspect structures.
3. Designs shall permit GTAA to easily and effectively operate and maintain Automated People Mover in accordance with "OM Manual Terminal Link" procedures and "Working Near Automated People Mover" protocol.

13.2 Elevating, Escalating and Moving Walk Devices

1. The following sections apply to all the moving walkways, escalators, and elevators at GTAA. A People Moving Device (PMD) is defined as a collection or equipment system that provides vertical and horizontal transportation to persons and/or freight inside a building.
   PMD includes the following:
   a. Elevator (EL) – provides vertical transportation primarily for passengers inside a car serving two or more levels inside a building.
   b. Passenger Elevator (PE) – intended for transportation of air travelers and/or airport employees.
   c. Freight Elevator (FE) – intended for transportation of cargo and airport employees only. Not considered in this document.
   d. Escalator (ES) – provides inclined vertical transportation for passengers via means of continuous stairway. Not considered in this document.
   e. Moving Walk (MW) – provides uninterrupted horizontal transportation for passengers to stand or walk through.
2. CSA B44 applies.
3. Reference the latest applicable codes to make sure of any new changes.

13.3 Acronyms and Abbreviations

Acronyms in section 13.3 are specific to PMDs.

American Bearing Manufacturers Association	ABMA
Authority Having Jurisdiction	AHJ
American Public Transportation Association	APTA
American Society for Testing and Materials	ASTM
Building Management System	BMS
Canada Occupational Health and Safety Regulations	COHSR
Canadian Electrical Code	CEC
Canadian Standards Association	CSA

Degrees Celsius	^{o}C
Decibels	dBA
Electrical Equipment Manufacturers Association of Canada	EEMAC
Elevator	EL
Escalator	ES
Factory Acceptance Test	FAT
Freight Elevator	FE
Greater Toronto Airports Authority	GTAA
Hollow Metal	HM
Institute of Electrical and Electronics Engineers	IEEE
Infield Concourse	IFC
Integrated Operations Control Center	IOCC
International Standards Organization	ISO
Left Hand	LH
Light-emitting Diode	LED
Lux – lumens per square meter	lux
Maintenance Control Program	MCP
Manual Transfer Switch	MTS
Minimum Efficiency Reporting Value	MERV
Moving Walks	MW
Machine Room-Less	MRL
Newtons	N
National Building Code	NBC
National Electrical Manufacturers Association	NEMA
National Fire Protection Association	NFPA
Operation and Maintenance	O&M
Passenger Elevator	PE
Project Manager	PM
People Moving Devices	PMD
Project Management Office	PMO
Polyvinyl Chloride	PVC
Right Hand	RH
Society of Automotive Engineers	SAE
Testing Commissioning Acceptance Turnover	TCAT
Toronto Pearson International Airport	CYYZ
Technical Standards and Safety Authority	TSSA
Underwriters Laboratories (Canada)	cUL or ULc
Uninterruptible Power Supply	UPS
United States	US
Voltage – Alternating Current	VAC
Voltage – Direct Current	VDC
Variable Frequency Drive	VFD

13.4 Expected Life

1. Expected life of passenger elevators is 20 years, at an average utilization of 8,760 operational hours per year.

13.5 Power Connection

1. A Critical Unit is defined as a PMD that is identified as essential for the movement of passengers, light cargo, and safety personnel. Critical Units shall be supplied and connected to the emergency power system of the building.

13.6 Governing, Regulatory and Safety Requirements:

1. GTAA and YYZ are federally regulated and the Technical Standards and Safety Authority (TSSA) of Ontario is not an Authority Having Jurisdiction. Responsible party shall comply with the requirements in this document.
2. The PMDs shall be provided to comply with applicable Sections of CSA B44-2019.
3. PMDs shall be provided to comply with the latest revision of CSA B651 – Accessible design for the built environment when possible and applicable.
4. When applicable, PMDs shall be provided to conform to heavy-duty design guidelines per appropriate American Public Transportation Association (APTA) published document.
5. All PMDs and its electrical systems shall be provided with Arc Flash and Shock Hazard warning labels on appropriate electrical equipment in accordance with the latest edition of CSA Z462.
6. All PMDs and its electrical systems and components shall be CSA or cUL certified with appropriate marking and/or sticker.
7. All PMDs, its auxiliary components, trade practices, installation and fabrication, and testing and commissioning shall be carried out and provided in accordance with the following references:
    a. CSA B44-2019
    b. Ontario Regulation 277/19
    c. CSA C22.1 – CEC Part 1
    d. CSA C22.2 – CEC Part 2
    e. Ontario Electrical Safety Code
    f. National Building Code of Canada (where applicable)
    g. Accessible Design for the Built Environment
    h. APTA-RT-EE-RP-001-02 – Heavy-duty Escalator Design Guidelines
    i. APTA-RT-EE-RP-002-03 – Heavy Duty Transportation System Elevator Design Guidelines
    j. APTA-RT-EE-RP-003-04 – Heavy Duty Transportation System Traction Elevator Design Guideline
    k. APTA-RT-EE-RP-004-02 – Heavy-duty Machine Room-less Elevator Design Guidelines
    l. APTA-RT-EE-RP-005-04 – Heavy Duty Transportation System Moving Walk Design Guideline
    m. Ontario Building Code (where applicable)
    n. GTAA Airport Construction Code (where applicable)
    o. GTAA TCAT Manual
    p. Canada Labour Code
    q. Occupational Health and Safety Act and Regulations
    r. NEMA
    s. IEEE
    t. EEMAC
    u. SAE

v. ASTM

13.7 Safety

13.7.1 The PMDs and its components shall be fail-safe and be provisioned with mechanical stops to prevent dangerous over-travel wherever disengagement is possible.

13.8 Environmental

1. All PMDs shall be provided with components and systems with corrosion protection.
2. All PMDs shall be provided with protection of all components from outdoor and weather elements, or the components shall be outdoor rated.
3. All PMDs components and systems shall be fully functional and operable between the temperatures-20^{o}C to 35^{o}C.
4. Fasteners shall be provided with equal or better corrosion resistance than the most corrosion resistant metal that is fastened to.

13.9 Noise and Sound

1. All PMDs shall be provided with audible indicators at both ends that complies with CSA B44-19 Section E-10.3.1.

13.10 Structure & Material

1. The construction and structure shall comply with CSA B44-2019.
2. The ES shall be provided with balustrades, decking, and skirt panels that comply with CSA B44-2019.
3. No wood, wooden or PVC material products shall be used.
4. The PMDs shall be provided with steel support frame for the drive machine. Vibration isolation pads shall be utilized to minimize noise and vibration to the ES truss.
5. At minimum, all exposed surfaces and panels shall be provided with minimum 3mm thick solid type SAE 304 or 316 or ASTM A480 stainless steel – No. 4 finish.
6. No visible fasteners shall be located on the balustrades or skirt panels.
7. Decking shall be a minimum of 2mm thick solid type SAE 316 stainless steel.
8. Floor plates at each landings of the ES and PE and at each end of MW shall be light weight, rigid and have a ribbed or anti-slip grooved surface.
9. Floor plates shall have stainless steel frames at floor openings and supported on truss heads.
10. Glass balustrades shall be provided with the following:
    a. Comply with CSA B44-2019.
    b. Minimum 10mm laminated (preferred) or tempered safety glass.
    c. 2mm to 5mm gap between glass panels.
11. The individual step shall be new, single piece, die-cast aluminum with maximum copper content of 0.3%.
12. The step assembly shall allow removal of an individual step without disturbing the balustrades.

13.11 Mechanical Requirements

1. All mechanical assemblies and components shall have a proven reliability and performance for a minimum of five (5) years.

2. All critical mechanical systems and components shall be serialized and be provided with maintenance schedule and instructions, including end of life predictions.
3. These components shall be included in the critical spares parts list for consideration and delivery upon completion of project.
4. Rotating parts shall be provided with a means for lubrication and retention of lubricants.
5. Sealed bearings are preferred.

13.11.1 Drive Machine – General

1. Provide a drive machine contained at the downstream end of intended direction of the passenger flow.
2. The drive machine shall be designed to provide quiet and smooth operation.
3. Drive machine shall be engineered for continuous operation under heavy duty, transit grade conditions.
4. Drive machine to be capable of being reset by authorized personnel via the Control Station following a power failure without the requirement to reset at the controller.
5. Exposed, moving drive elements shall be protected by metal housings, which shall provide access for lubrication of components.
6. Machine shall include a high efficiency motor, brake assembly and heavy-duty gearbox (if applicable).
7. Means for hand winding of the motor flywheel shall be provided in order to move the pallet/step band manually if required.

13.11.2 Gearbox Requirements (if equipped):

1. If equipped, gear bearings shall be rated with an ABMA L10 life of 200,000 hours as a minimum and housed in an oil-tight, dust-proof case. The case shall provide a convenient method of draining the oil.
2. A low-oil sensor should be provided to prohibit starting of the PMD on automatic operation with low oil in the gear case.

13.11.3 Motor Requirements

1. The driving motors shall be AC induction motors with starters. 600 VAC, three phase, frequency 60 Hz.
2. Motor shall be sized to match duty cycle as stated in the design criteria.
3. The motor protection class shall be equivalent to IP55 insulation Class F.

13.11.4 Pallets/steps

1. The pallet/step and pallet/step chain rollers shall have polyurethane tires on hubs, sealed roller bearings and have a minimum of 90 Shore A rating.
2. The pallet/step and pallet/step chain rollers shall not require any additional lubrication and be rated for severe, heavy-duty service.
3. The pallet/step and pallet/step chain roller bearing should have a minimum L10 rating of 100,000 hours.

13.11.5 Pallet/step Chain (if applicable)

1. Pallet/step chains shall be endless, roller-type chains provided one on each side of the Pallet/step.
2. Pallet/step chains shall be lubrication free and rated for severe, heavy-duty service.
3. Pallet/step chains shall maintain constant distance between one another and between

Pallet/step axles (if applicable).

4. Pallet/step chains shall be automatically tensioned, compensate for wear, and prevent sagging and buckling.

13.12 Electrical Requirements

1. Terminal buildings at CYYZ supplies 3-phased 60 Hz, 600 VAC in 3 wires.
2. Two power feeds are available from the terminal buildings:
   a. Emergency Power
   b. Normal Power
3. All PMDs shall be provided to be powered by the Normal Power feed only with the following exception:
   a. All PMDs identified as "critical unit" shall be powered through the Normal Power feed and Emergency Power feed via automatic transfer switch.

13.12.2 Electrical Disconnects

1. The PMDs shall include disconnects as means of protection.
2. Power supply disconnect labels shall be of Lamacoids and show source location and have arc flash warning.
3. The PMD shall be provided with a lockable switch or disconnect inside the pit.

13.12.3 Electrical Power Quality

1. All PMDs and its components that utilize solid state equipment or are installed with other system components sensitive to the quality of the power supply shall be provided with power conditioning located in the equipment cabinet.

13.12.4 Electrical Cables

1. All electrical cables shall be provided to comply with the requirements of the CEC – CSA C22.1.
2. All electrical cables shall be labelled at both ends.
3. Insulated wiring shall have a flame retardant and moisture resistant outer cover and shall be run in metal conduit, metallic tubing, or wire ducts.
4. Travelling cables between end pits shall have flame retardant and moisture resistant outer cover. They shall be flexible and shall be suitably suspended to relieve the strains in the individual conductors. Provide minimum 4 shielded twisted pair plus minimum 10% spares pit to pit.

13.12.5 Receptacles

1. Provide duplex GFCI receptacles, un-switched, 120 VAC, 1 phase, 60 Hz, 20 amp, separate circuits with cover in each pit.
   a. Wire size to all receptacles shall be a minimum of AWG 12.
   b. Receptacles shall not be mounted on doors.

13.12.6 Communication Cables

1. All communication cables shall comply with GTAA Communications Cabling Standard.

13.13 Lighting

1. The PMDs shall be provided with LED lighting.

2. Provide continuous, white, long life lighting at the skirt panels along the length of both sides of the moving walk. Lighting to meet 4800K to 5000K colour rating.
3. LED comb-plate illumination devices and LED pallet demarcation lights located under the pallets at each end of the unit that shall shine up through the gaps in the pallets to provide reference points for riders.
4. LED lighting shall be provided at both pits of the PMDs.
5. The PMDs shall be provided with direction lanterns at each end.
    a. The LED lanterns shall show red (exit) or green (entrance) depending on the travel direction of the PMD.
    b. The lanterns shall automatically change colours when the PMD travel direction is reversed.
    c. The lanterns maybe integrated with the skirt panel lights as described in point 2 above.

13.14 Motor Controls Requirements

1. Provide AC VVVF solid state drive with closed loop feedback technology designed to work in harmony with the PMD control system.
2. All provided VFDs shall be CSA listed, mounted in CSA Standard C22.1 Type 2 enclosure with door mounted disconnect switch handles on compartment.
3. Input harmonic filters to limit total harmonic distortion (THD) measure at filter input terminals to values set in IEEE 519 voltage distortion to be 3% as set out in Table 10.2 of IEEE 519.
4. Provide protective devices for over-voltage and under-voltage, loss of phase, phase reversal or overload conditions.
5. Provide diagnostic recording on fault history of drive operation conditions, at the instance of the last fault occurrence.

14. Building Management System

14.1 Building Automation Systems

Please see section 5.1.22 of this document.

15. Operational Technology and Cyber Security

15.1 Definition of Operational Technology

Operational Technology (OT) is a programmable system or device that interact with the physical environment (or manage devices that interact with the physical environment). These systems/devices detect or cause a direct change through the monitoring and/or control of devices, processes, and events.

15.2 Definition of Industrial Control System

Industrial Control Systems (ICS) are information systems used to control industrial processes such as manufacturing, product handling, production, and distribution. General term that encompasses several types of control systems, including supervisory control and data acquisition (SCADA) systems, human-machine interface (HMI), distributed control systems (DCS), and other control system configurations such as programmable logic controllers (PLC) often found at Greater Toronto Airports Authority (GTAA). An ICS consists of combinations of control components (e.g., electrical, mechanical, hydraulic, pneumatic) that influence kinetic and physical operations within the airport campus.

15.3 Systems

The following is a representative list of systems that are contained in the definitions of OT and ICS.

a. Programmable Logic Controllers

b. Distributed Control Systems
c. Human Machine Interfaces
d. Historians
e. SCADA Systems
f. Application Servers
g. Engineering Disaster Recovery Servers
h. Programmable sensors
i. Programmable meters
j. Gateway and telemetry hardware
k. Any auxiliary infrastructure (not limited to server, network infrastructure, engineering database, and wireless access points

15.4 Standards

The table below provides a list of all ISC and OT standards applicable to the GTAA

Standard	Description
ICS-SCADA Access Control Standard v0.6.docx	Management of GTAA user accounts and access privileges.
ICS-SCADA Asset Identification and Lifecycle Management Standard v1.6.docx	Tracking and management of assets and their lifecycles across ICS/SCADA environments in GTAA
ICS-SCADA Cyber Response and Recovery Standard v1.2.docx	Cyber response and recovery functions for incidents that occur within the ICS/SCADA environment of the GTAA
ICS-SCADA Exception Policy v1.3.docx	Granting an exception from policy sections or policies in their entirety, where enforcing compliance will cause an unacceptable negative impact to system or asset operations
ICS-SCADA Password Management Standard v1.3.docx	Creation and management of passwords to protect ICS/SCADA systems, devices, and networks within the GTAA
ICS-SCADA Personnel Security Standard v1.3.docx	Requirements to ensure that personnel security safeguards are applied to the access and use of ICS/SCADA technology resources and data
ICS-SCADA Physical and Environmental Security Standard v1.3.docx	Deployment and management of physical and environmental security controls.
ICS-SCADA Remote Access Standard v1.3.docx	Management and implementation of remote access solutions that will be used by the GTAA
ICS-SCADA Risk Management Standard v1.3.docx	Risk management activities, including risk classification and assessment on assets and systems within the ICS/SCADA environment of the GTAA
ICS-SCADA Secure Architecture Implementation Standard v1.5.docx	Implementing a secure architecture within the ICS/SCADA environment at GTAA
ICS-SCADA Security Information Protection Standard v1.3.docx	Protecting all information that is related to the ICS/SCADA environment of the GTAA

ICS-SCADA Technology Procurement and Services Acquisition Policy v0.1.docx	Operating parameters for 3rd party vendors and contractors that require access to GTAA OT assets, systems, or data, and their responsibilities for compliance with all related policies
ICS-SCADA Vulnerability Management Standard v1.3.docx	Vulnerability management activities, including vulnerability assessments on assets and systems within the ICS/SCADA environment of the GTAA.

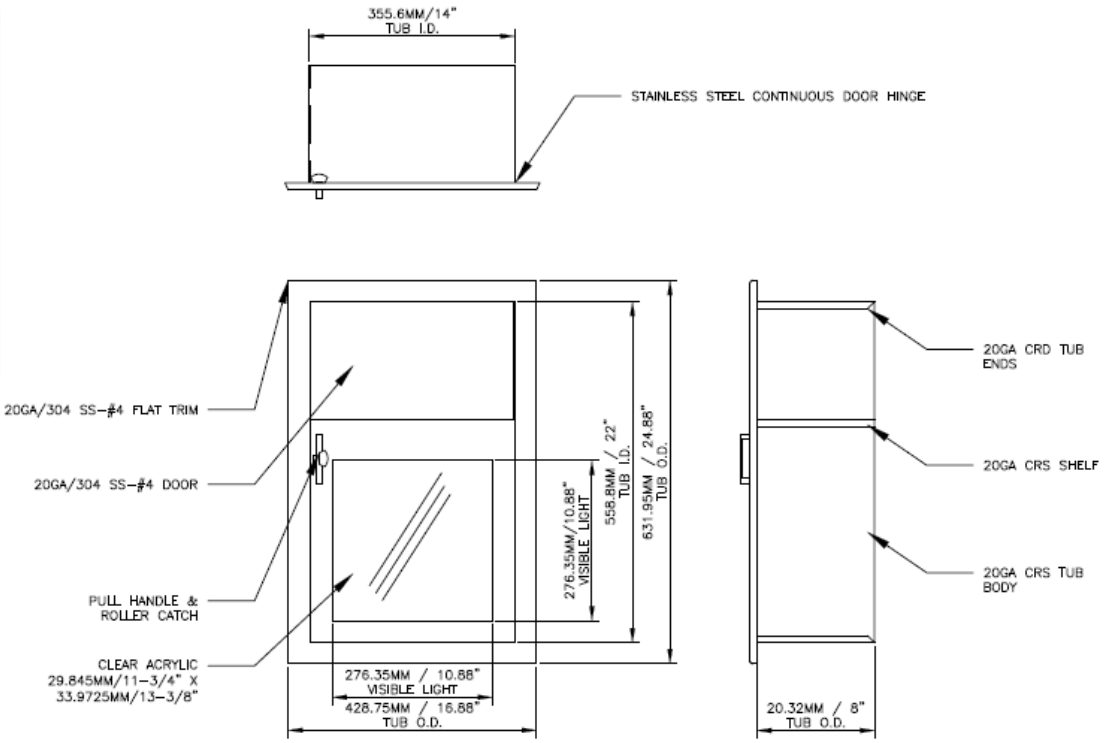
Appendix: GTAA Design Standards - Life Safety Details

Available in pdf.

19-01-31 GTAA Design Standards - I

TORONTO PEARSON

AED PICTOGRAM

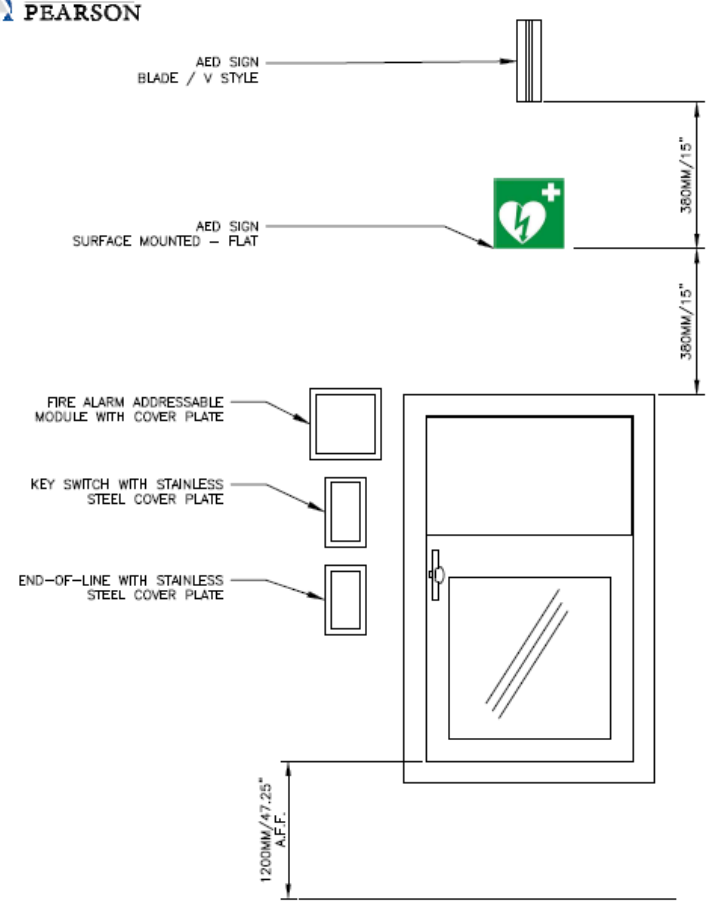


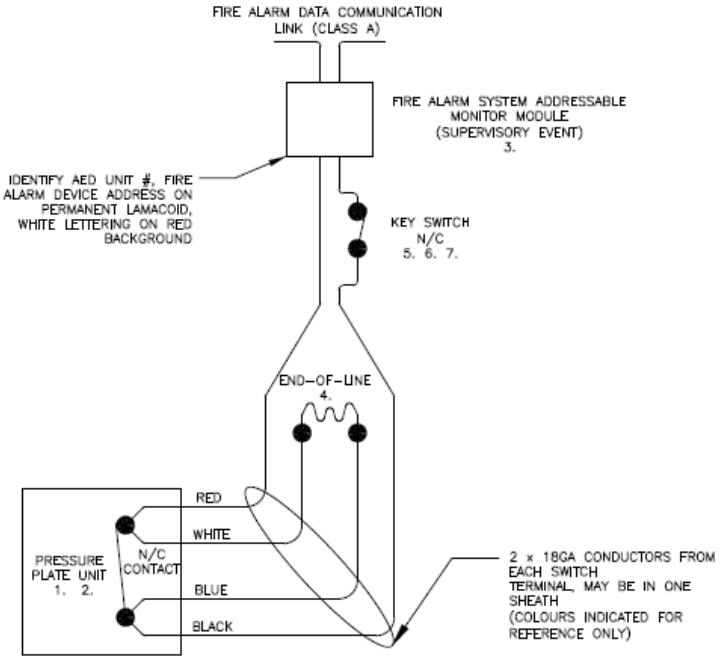
AED CABINET
1. STAINLESS STEEL CABINET
2. MOUNT 1200MM FROM BOTTOM OF INSIDE CABINET TO FINISHED FLOOR
3. AED SIGN TO MATCH GRAPHIC SHOWN
4. MOUNT SIGN ABOVE TOP OF CABINET
   4.1. SINGLE SIDED SIGN – 380MM TO TOP OFF SIGN
   4.2. BLADE / V STYLE SIGN – 760MM TO BOTTOM OF SIGN

GTAA LIFE SAFETY DETAILS
DEFIBRILLATOR CABINET

REVISION NUMBER	DETAIL NUMBER
18-12-21 - R1	AED-1

TORONTO PEARSON





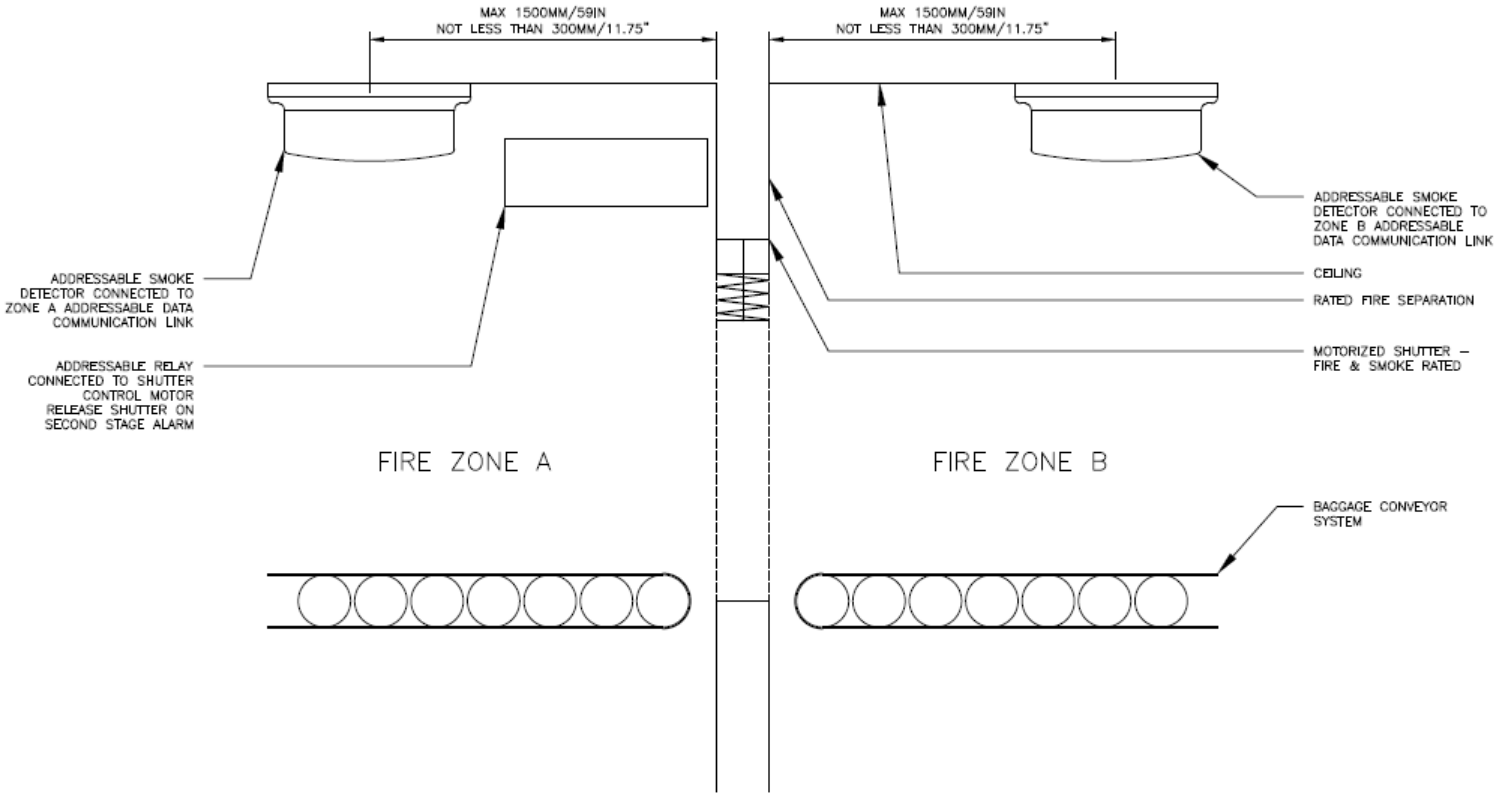
AED PLACEMENT MONITOR

1. AED PRESSURE PLATE CONTACT IS NORMALLY CLOSED WHEN THE AED IS NOT ON THE PRESSURE PLATE AND WILL OPEN WHEN THE UNIT IS IN PLACE
2. REMOVAL OF THE AED WILL CLOSE THE CONTACT CAUSING FIRE ALARM SUPERVISORY CONDITION
3. THE FIRE ALARM PANEL WILL INDICATE THE AED HAS BEEN REMOVED FROM THE CABINET AS A SUPERVISORY EVENT AND PROVIDE THE LOCATION ON THE FIRE ALARM GRAPHIC DISPLAY
4. THE END–OF–LINE WILL SUPERVISE THE WIRING, FLUSH MOUNTED IN A 2"X4" JUNCTION BOX WITH STAINLESS STEEL PLATE AND CIRCUIT IDENTIFICATION LABEL
5. THE KEY SWITCH IS TO BE FLUSH MOUNTED IN A 2"X4" JUNCTION BOX WITH STAINLESS STEEL PLATE AND CIRCUIT IDENTIFICATION LABEL
6. THE KEY SWITCH CONTACT IS NORMALLY CLOSED IN THE 0 DEGREE POSITION WHERE THE KEY MAY BE REMOVED
7. TURNING THE KEY TO THE 90 DEGREE POSITION WILL OPEN THE CONTACT AND RESULT IN A TROUBLE CONDITION ON THE FIRE ALARM SYSTEM.
   7.1. THE KEY MAY NOT BE REMOVED IN THIS POSITION
8. NO VISIBLE WIRING WITHIN AED CABINET

GTAA LIFE SAFETY DETAILS
DEFIBRILLATOR WIRING DIAGRAM

REVISION NUMBER	DETAIL NUMBER
18-12-21 - R1	AED-2

TORONTO PEARSON



BAGGAGE FIRE SHUTTER

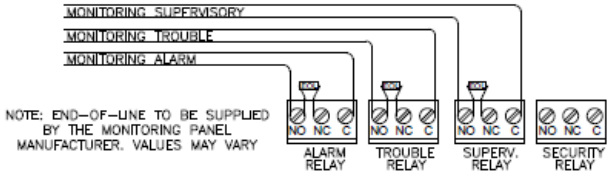
1. PROVIDE ADDRESSABLE SMOKE DETECTOR ON BOTH SIDES OF FIRE SHUTTER
   - 1.1. MAXIMUM DISTANCE FROM SHUTTER IS 1600MM/63IN
   - 1.2. CEILING BEAMS MAY AFFECT SPACING OF DETECTORS
   - 1.3. CONNECT TO ADDRESSABLE FIRE ALARM DATA COMMUNICATION LINK FOR APPLICABLE FIRE ZONE
2. PROVIDE ADDRESSABLE RELAY AND CONNECT TO FIRE SHUTTER MOTOR
3. FIRE ALARM ACTIVATION OF SMOKE DETECTOR ON EITHER SIDE OF SHUTTER WILL CAUSE FIRE ALARM CONDITION
4. SECOND STAGE ALARM CONDITION WILL ACTIVATE RELAY AND CLOSE SHUTTER
5. RESET OF FIRE ALARM CONDITION WILL OPEN SHUTTER
6. INSTALL ALL FIRE ALARM DEVICES AS PER ULC–S524
7. TEST & VERIFY ALL FIRE ALARM DEVICES AS PER ULC–S537
8. CONFIRM AND RECORD OPERATIONS OF FIRE SHUTTER

GTAA LIFE SAFETY DETAILS
BAGGAGE FIRE SHUTTER

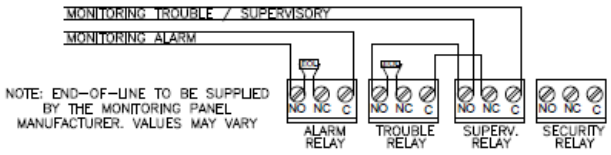
REVISION NUMBER	DETAIL NUMBER
18-12-21 - R1	BFS

TORONTO PEARSON

UNIQUE ALARM / TROUBLE & SUPERVISORY MONITORING

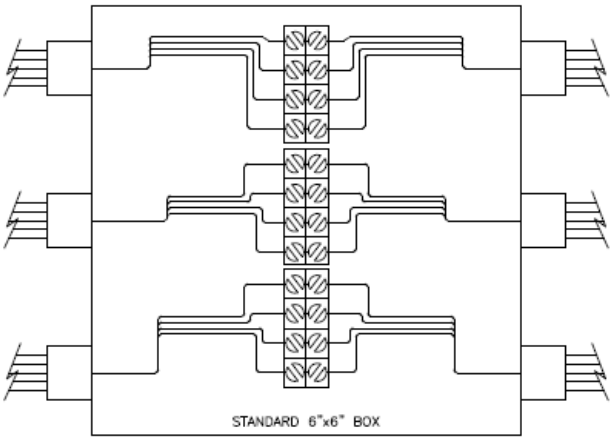


COMMON TROUBLE & SUPERVISORY MONITORING



NOTIFIER OR SIMILAR PANEL WITH THREE COMMON RELAYS BUT ONLY TWO POINTS PROVIDED BY MONITORING COMPANY OR BASE BUILDING FIRE ALARM SYSTEM.
TERMINAL BLOCKS MUST BE CONNECTED AS INDICATED TO PROVIDE SUPERVISION IN CASE TERMINAL BLOCK IS REMOVED FROM PANEL

FIRE ALARM TERMINAL BOX



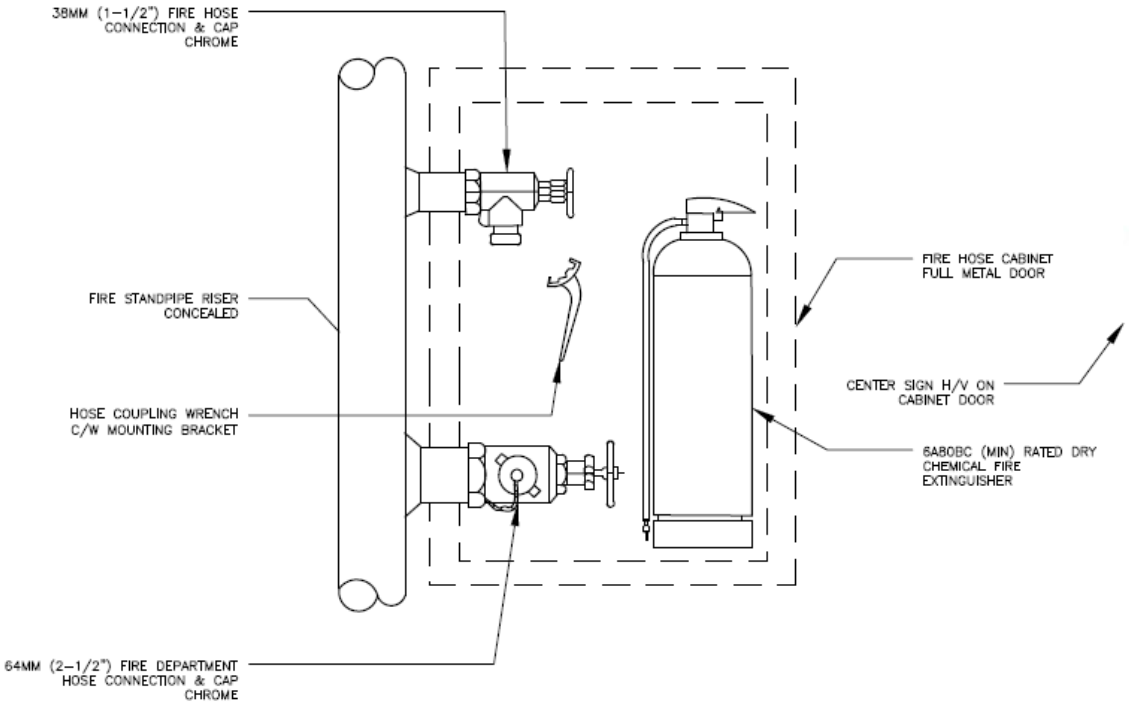
FIRE ALARM SYSTEMS

1. FIRE ALARM CABLE
   - 1.1. FAS RATED
   - 1.2. MINIMUM 18GA
   - 1.3. GREEN CONDUCTOR SHALL ONLY BE USED FOR BOND/GROUND
   - 1.4. ALL JUNCTIONS SHALL BE MADE ON TERMINAL STRIPS, NO TWIST TYPE CONNECTORS
2. FIRE ALARM RACEWAY – RED IN COLOUR
3. DAMP / WET AREAS
   - 3.1. LIQUID TITE FLEXIBLE RACEWAY WITH WATER TIGHT COUPLINGS
   - 3.2. WATER RESISTANT JUNCTION BOXES
4. ALL TERMINAL BOXES SHALL INCLUDE PERMANENT PRINTED LEGEND FOR ALL JUNCTIONS INSIDE JUNCTION BOX
5. ALL TERMINAL BOX COVER PLATES SHALL BE PAINTED RED WITH WHITE "FA" STENCILED ON PLATE

GTAA LIFE SAFETY DETAILS
FIRE ALARM JUNCTIONS

REVISION NUMBER	DETAIL NUMBER
18-12-21 - R1	FA1

TORONTO PEARSON

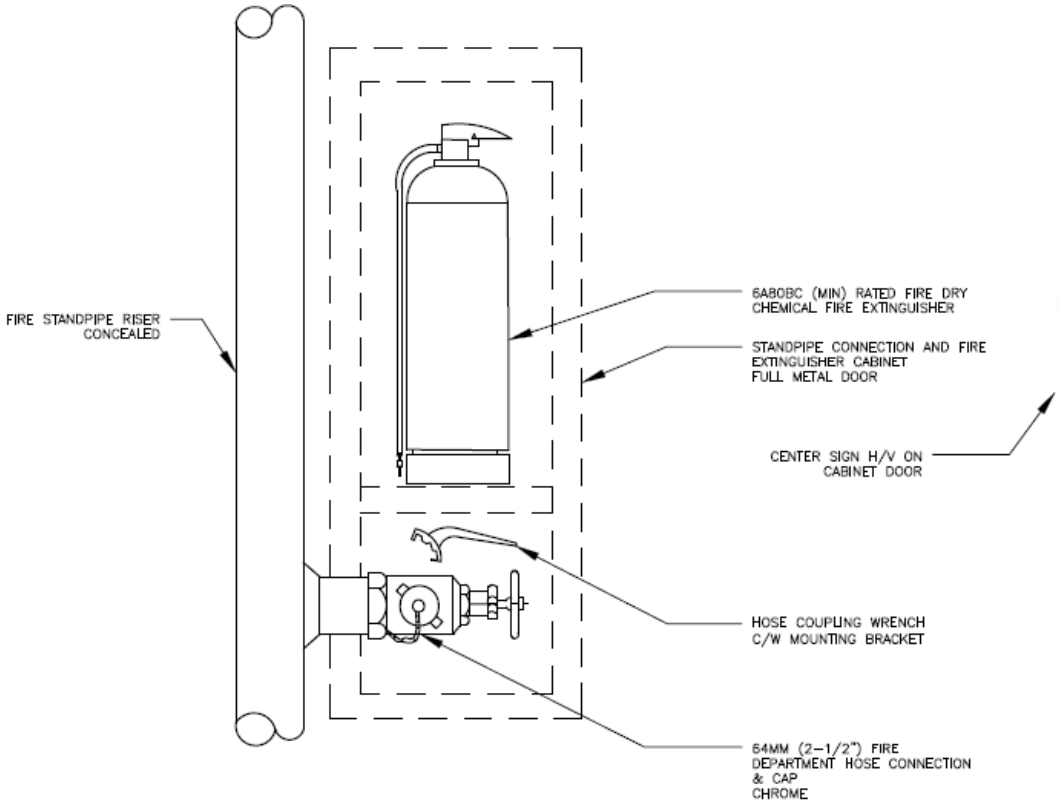


FIRE HOSE / EXTINGUISHER CABINETS
1. FULLY RECESSED STAINLESS STEEL
   1.1. FULL METAL DOOR
2. DAMP / WET AREAS (GARAGE)
   2.1. ABS CABINET
3. ALL VALVES, CAPS & COUPLINGS SHALL BE CHROME
4. CABINET SIGNAGE
   4.1. DIMENSIONS: 20" X 8"
   4.2. TEXT HEIGHT: 0.24"
   4.3. MATERIAL: 3M GTAA GREY APPLIED VINYL
   4.4. COLOURS: PMS 336 GREEN, GTAA GREY, WHITE

GTAA LIFE SAFETY DETAILS
FIRE CONNECTION CABINET DETAIL

REVISION NUMBER	DETAIL NUMBER
18-12-21 - R1	FCC

TORONTO PEARSON



FIRE HOSE / EXTINGUISHER CABINETS
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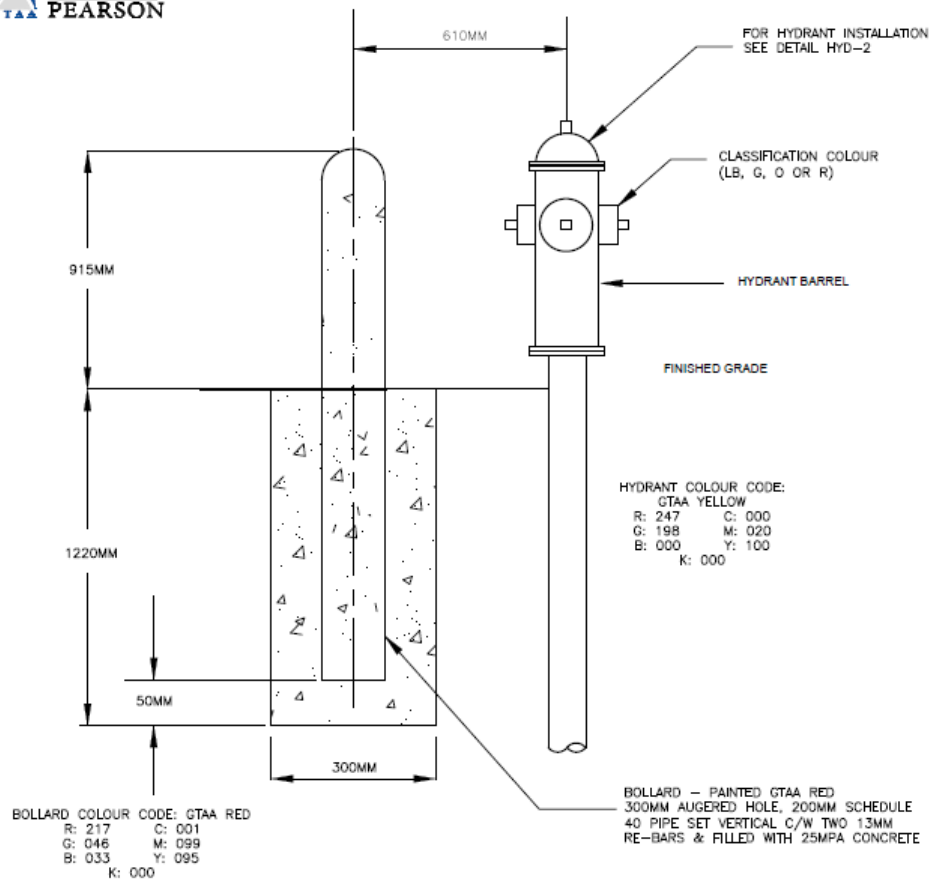
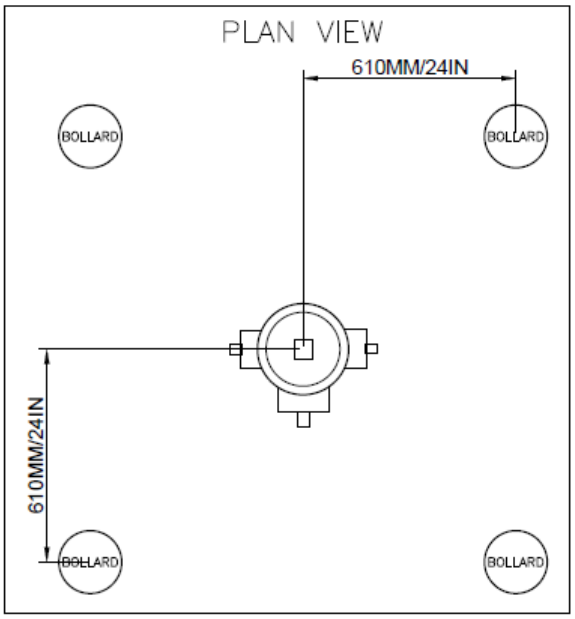
3. ALL VALVES, CAPS & COUPLINGS SHALL BE CHROME
4. CABINET SIGNAGE
   4.1. DIMENSIONS: 20" X 8"
   4.2. TEXT HEIGHT: 0.24"
   4.3. MATERIAL: 3M GTAA GREY APPLIED VINYL
   4.4. COLOURS: PMS 336 GREEN, GTAA GREY, WHITE

GTAA LIFE SAFETY DETAILS
STANDPIPE & FIRE EXTINGUISHER CABINET

REVISION NUMBER	DETAIL NUMBER
18-12-21 - R1	CAB

TORONTO PEARSON





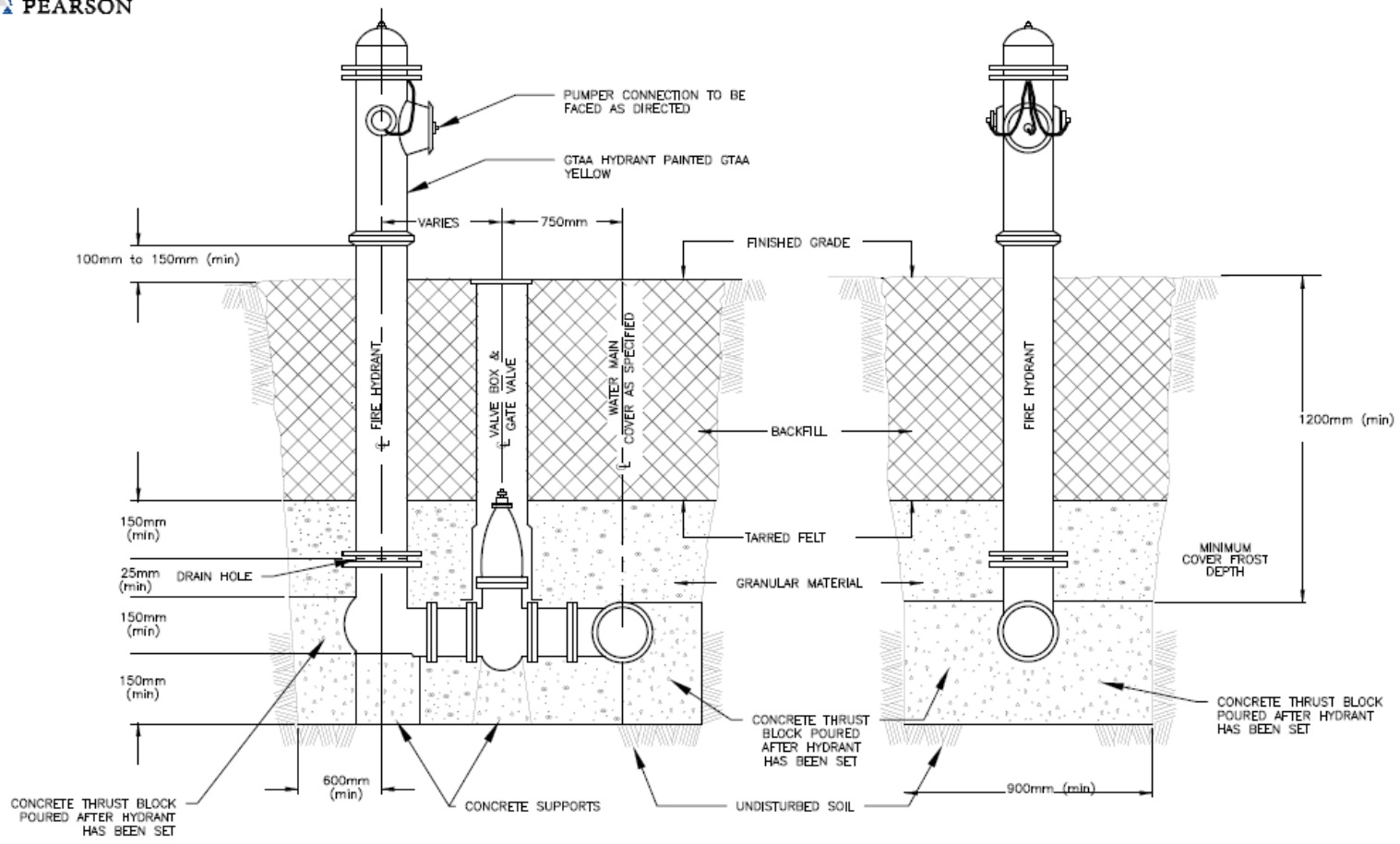
HYDRANT CLASSIFICATION & COLOUR CODING:

1. ALL HYDRANT BARRELS ARE TO BE PAINTED GTAA YELLOW. THE TOPS AND NOZZLE CAPS SHOULD BE PAINTED BASED ON THEIR CLASSIFICATION CAPACITY
2. FIRE HYDRANTS SHOULD BE CLASSIFIED IN ACCORDANCE WITH THEIR RATED CAPACITIES AT 20 PSI RESIDUAL PRESSURE AS FOLLOWS:
   - 2.1. CLASS AA – LIGHT BLUE – RATED CAPACITY OF 1500 GPM (5680 L/MIN) OR GREATER
   - 2.2. CLASS A – GREEN – RATED CAPACITY OF 1000–1499 GPM (3785–5675 L/MIN)
   - 2.3. CLASS B – ORANGE – RATED CAPACITY OF 500–999 GPM (1900–3780 L/MIN)
   - 2.4. CLASS C – RED – RATED CAPACITY OF LESS THAN 500 GPM (1900 L/MIN)

GTAA LIFE SAFETY DETAILS
HYDRANT CLASSIFICATION & IDENTIFICATION

REVISION NUMBER	DETAIL NUMBER
18-12-21 - R1	HYD-1

TORONTO PEARSON
GTAA



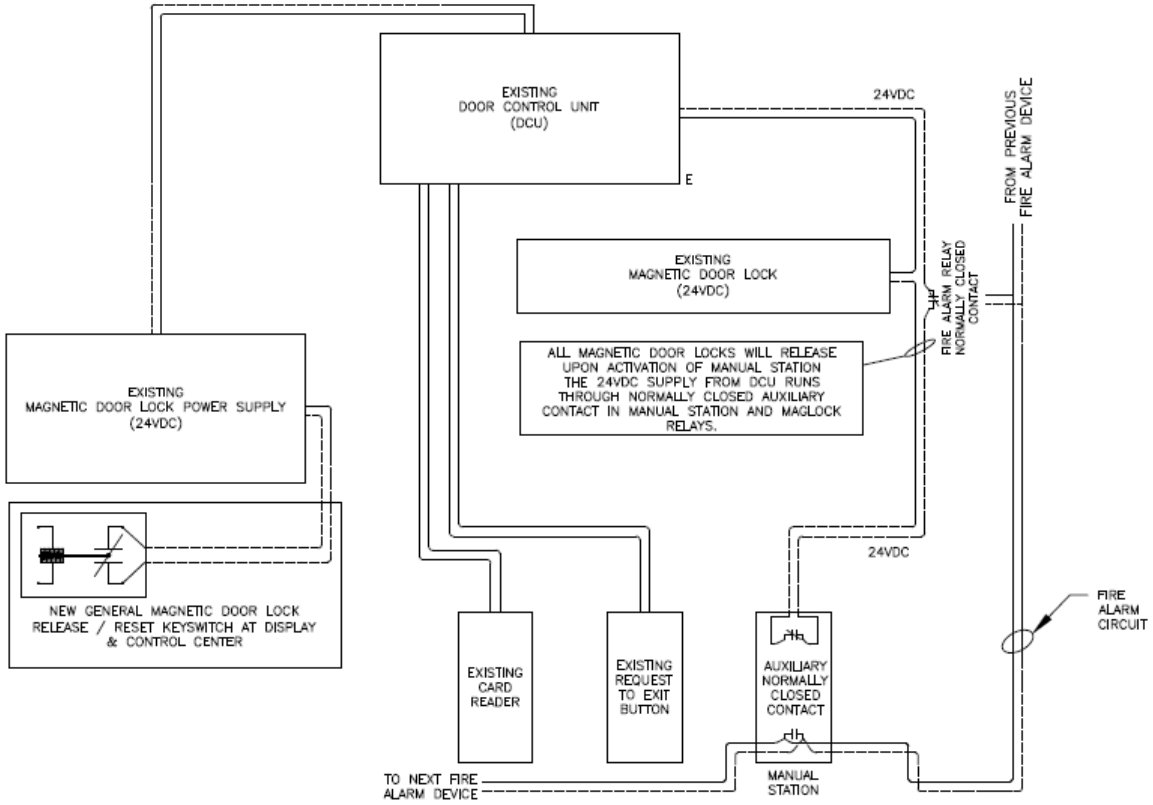
NOTES:
1. METRIC VALUES SHOWN IN APPROXIMATE MILLIMETER UNITS
2. PROVIDE CONCRETE THRUST BLOCKS AT ELBOWS AN D CHANGES IN DIRECTION
3. ALL CONCRETE BACKING TO BE POURED AGAINST UNDISTURBED GROUND
4. POLYETHYLENE BOND BREAKER TO BE USED BETWEEN CONCRETE AND FITTINGS
5. BOLTS FOR BURIED FLANGE CONNECTIONS ARE TO BE STAINLESS STEEL
6. CONCRETE FOR THRUST BLOCKS TO BE 25MPa

HYDRANT COLOUR CODE: GTAA YELLOW
R: 247 C: 000
G: 198 M: 020
B: 000 Y: 100
K: 000

GTAA LIFE SAFETY DETAILS
HYDRANT GENERAL INSTALLATION DETAILS

REVISION NUMBER	DETAIL NUMBER
18-12-21 - R1	HYD-2

TORONTO PEARSON



UPON ACTIVATION OF THE FIRE ALARM SYSTEM, THE EMERGENCY SHUTDOWN IN EACH POWER SUPPLY IS CONNECTED THROUGH A NORMALLY CLOSED AUXILIARY CONTACT IN A FIRE ALARM SYSTEM RELAY

THE MAGLOCK RELEASE / RELAY KEY SWITCH AT THE ANNUNCIATOR WILL CONTROL THE MAGNETIC DOOR LOCKS

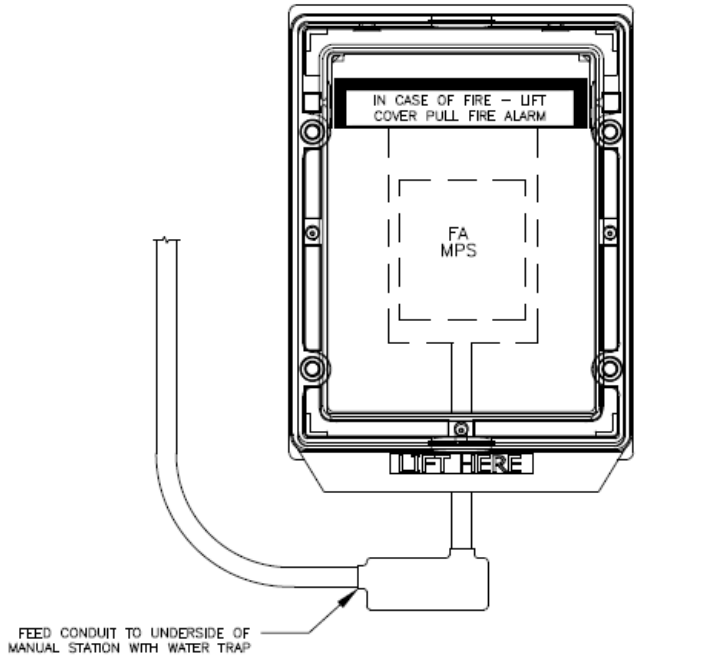
ACTIVATION OF THE MANUAL STATION AND/OR THE MAGLOCK FIRE ALARM RELAY WILL IMMEDIATELY INTERRUPT THE POWER SUPPLY TO THE MAGNETIC DOOR LOCK RELEASING THE DOOR

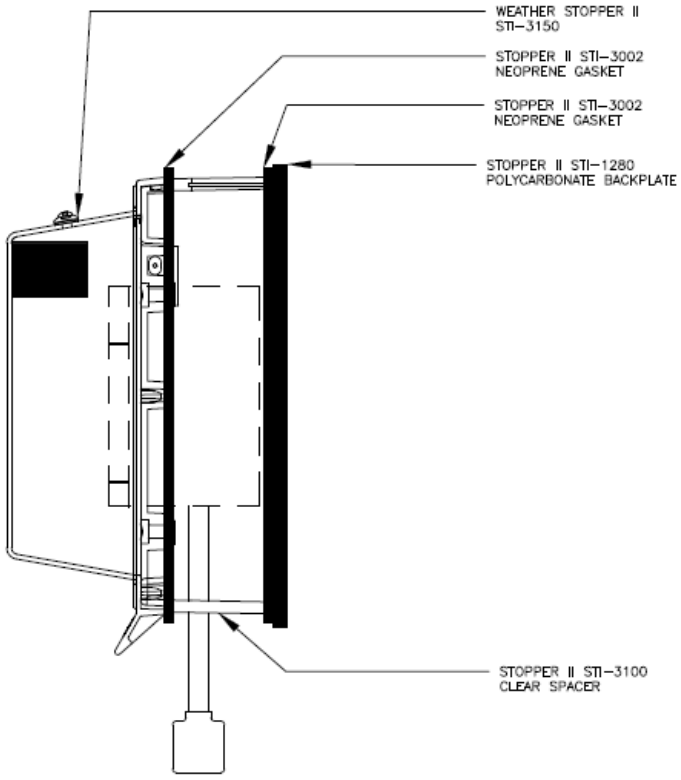
GTAA LIFE SAFETY DETAILS
FIRE ALARM / MAGLOCK INTERFACE

REVISION NUMBER	DETAIL NUMBER
18-12-21 - R1	ML1

TORONTO PEARSON
GTAA

WEATHER STOPPER STI–3150 WITHOUT HORN AND CLEAR SPACER



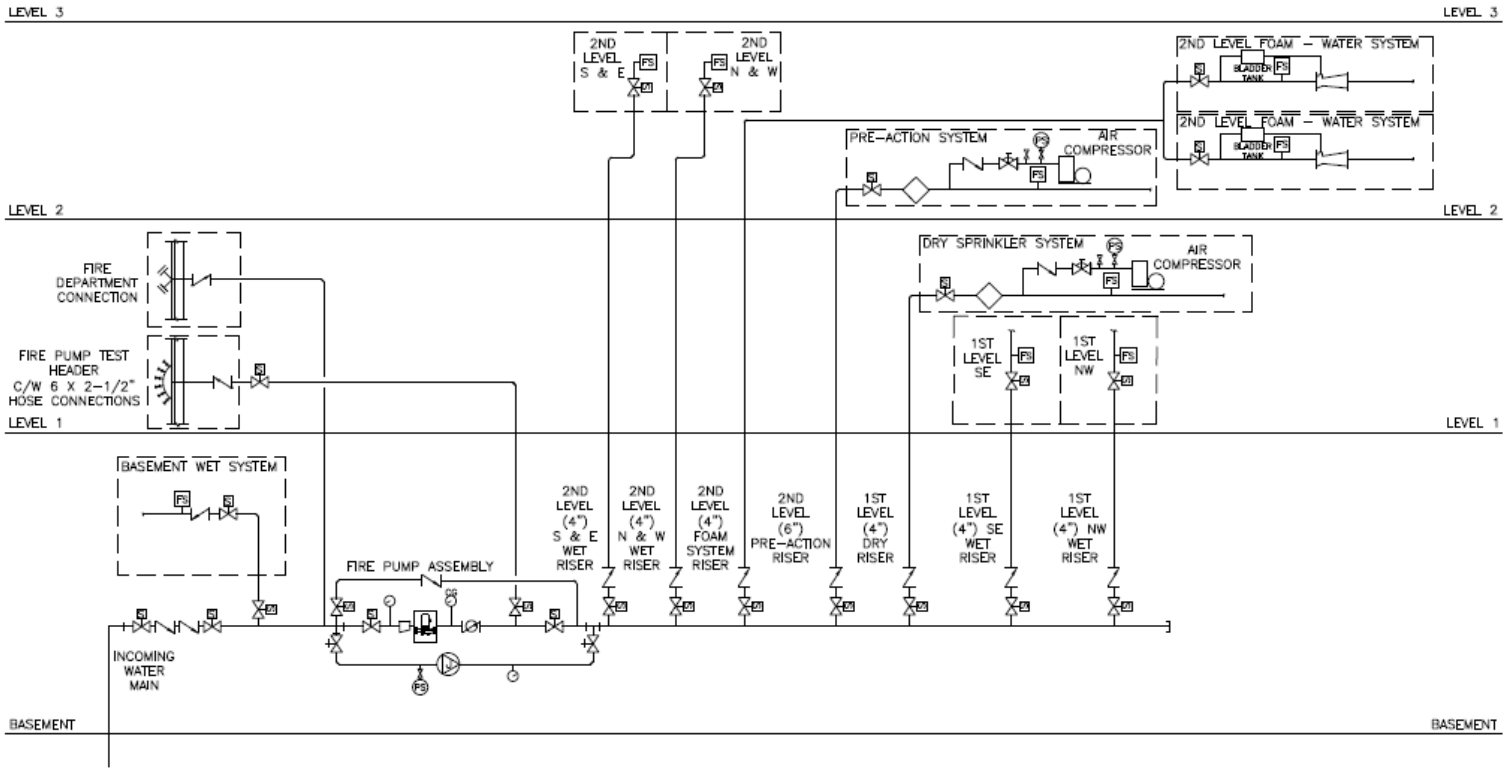


1. PROVIDE WEATHER PROOF COVER ON ALL MANUAL STATIONS SUBJECTED TO ADVERSE WEATHER CONDITIONS
2. INSTALL ADDRESSABLE MODULES WITHIN HEATED SPACES
3. USE CONVENTIONAL DEVICES WHERE SUBJECT TO COLD AND ADVERSE WEATHER CONDITIONS

GTAA LIFE SAFETY DETAILS
OUTDOOR MANUAL STATION

REVISION NUMBER	DETAIL NUMBER
18-12-21 - R1	OMS

TORONTO PEARSON



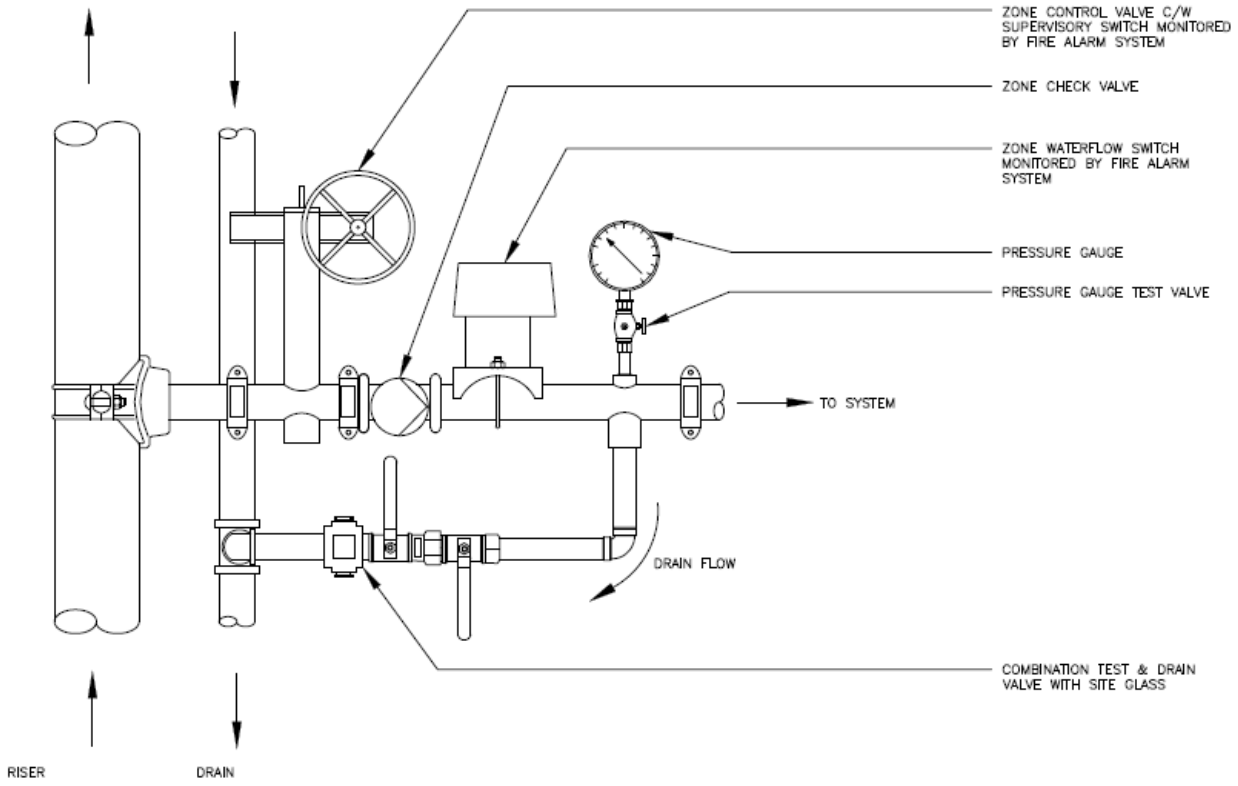
1. ZONE ISOLATION VALVES SHALL BE INSTALLED ON THE PROTECTED FLOOR
2. ALL SPRINKLER SUPERVISORY EQUIPMENT SHALL BE MONITORED BY THE FIRE ALARM SYSTEM
   2.1. SUPERVISORY VALVE, FLOW SWITCHES, LOW PRESSURE SWITCHES, FIRE PUMPS, AIR COMPRESSORS

GTAA LIFE SAFETY DETAILS

SPRINKLER RISER / HEADER DETAIL

REVISION NUMBER	DETAIL NUMBER
18-12-21 - R1	SP1

TORONTO PEARSON



1. ZONE ISOLATION VALVES SHALL BE ON PROTECTED FLOOR AREA

GTAA LIFE SAFETY DETAILS
TEST & DRAIN ASSEMBLY

REVISION NUMBER	DETAIL NUMBER
18-12-21 - R1	TDA

Appendix: GTAA Communications Cabling Standards Manual