Amendment Notice: Minor Communications Updates

This bulletin applies to and amends the following document:

GO Design Requirements Manual (DRM):

- Section 2.1 Abbreviations – Table 1 – List of Abbreviations: New abbreviations were added and abbreviations not in use were deleted.
- Section 4.2 Operational Facilities – Table 20 – Communications: Revised security system to Access Control and Intrusion Detection System
- Section 4.2 Operational Facilities – Table 36 – Other – Interior Spaces: Reference to the communication closet was removed and the hub room was added.
- Section 5.2.2.8.2: Clarified third party UPS requirements supplied by Metrolinx.
- Section 5.2.8 Stations & Facilities – Table 42 – Electrical Requirements at Station and Facilities: Enclosure requirements were updated.
- Section 5.2.10 Wiring Methods: Clarified restriction for the use of free air cabling.
- Section 5.2.10.1.4: Added conduit fill requirements for communication backbone raceways sized 53mm.
- Section 5.2.10.2 Conduits: Clarified conduit use requirements.
- Section 5.2.10.3.5: Clarified use of wire cable trays.
- Section 5.2.10.6: Clarified enclosure rating requirements. Added requirements regarding the locations of the handholes. Clarified splice requirements for the PA wiring.
- Section 5.2.24.1.3 Clarified access to electrical and communications room.
- Section 5.2.24.1.5, 5.2.24.1.6, 5.2.24.1.10, 5.2.24.6.1, 5.2.24.8.1, 5.2.24.8.2, and 5.2.26: Clarified hub room and mini-hub room design requirements.
- Section 5.2.24.1.8: Added clearance requirements for communication rack.
- Section 5.2.24.1.9: Clarified location of the work surface for the communication room.
- Section 5.2.24.1.10: Updated sprinkler systems requirements.
- Section 5.2.24.1.12: Clarified use of EMT conduit.
- Section 5.2.24.1.13: Added requirements for the third party equipment.
- Section 5.2.24.2.1 and 5.2.24.2.2: Clarified requirements for the use of fire-rated plywood.
- Section 5.2.24.3.1: Updated slope requirements for service room floor design.
- Section 5.2.24.9.1: Clarified emergency cooling location requirements.
- Section 5.2.26.3: Clarified communication room location requirements and protection requirements.
- Section 5.2.26.5.1: Clarified mini-hub room use, location, and grounding requirements.
- Section 5.2.26.6: Clarified mini-hub room interior, finishes and material requirements

- Section 5.2.26.7.9: Level boarding requirements added for wall mounted equipment and conduits.
- Section 5.2.26.8.2: Clarified intent of the mini-hub room.
- Section 5.2.26.8.3: Clarified location guidelines for the mini-hub room.
- Section 5.2.26.10 System Controller: Updated system controller primary functions.
- Section 5.2.26.11 Communications and Hub Rooms Construction – Table 43 – Minimum Room Dimensions: Updated requirements for the size of various locations.
- Section 5.2.26.12.1: Clarified dedicated conduit requirements for connectivity from the main communications room to each hub room and mini-hub room.
- Section 5.2.26.12.2: Clarified conduit requirements for communications power.
- Section 5.2.26.13 Conduit Infrastructure: Clarified conduit requirements for communications and power.
- Section 5.2.26.14.1: PRESTO exception to be connected to the non-UPS panel has been removed. PRESTO is now required to be fed from the UPS panel.
- Section 5.2.26.15.2: Clarified power requirements for communication racks.
- Section 5.2.26.15.4: Clarified receptacle requirements for communication equipment.
- Section 5.2.27.2: Clarified CCTV use with high mast lighting poles.
- Section 5.3.1: Clarified communications infrastructure design requirements.
- Section 5.3.4.8 Access Control and Intrusion Detection System: Clarified CCTV requirements for access control and intrusion detection systems.
- Section 5.3.4.11.1: Updated CCTV head end location requirements.
- Section 5.3.4.12: Clarified CCTV design criteria and housing requirements.
- Section 5.3.4.14: Updated data and power transmission design requirements.
- Section 5.3.4.15: Updated CCTV cabling PoE extenders requirements.
- Section 5.3.4.16: Clarified CCTV conduit requirements.
- Section 5.3.4.19 CCTV Camera Placement – Table 51 CCTV Camera Placement - Parking: Clarified area and view requirements.
- Section 5.3.4.19 CCTV Camera Placement – Table 52 CCTV Camera Placement – Stations Exterior and Interior: Clarified and updated area and view requirements.
- Section 5.3.5.4.1: Clarified PA system announcement infrastructure requirements.
- Section 5.3.5.10: Updated prioritizing paging requirements.
- Section 5.3.5.11.2: Updated amplifier power requirements.
- Section 5.3.5.12.1: Updated PA system controller rack requirements.
- Section 5.3.5.16: Updated PA requirements such as zone cards, amplifiers, speaker mounting, location of speakers, number of speakers, features, volume control, temperature, etc.
- Section 5.3.6: Clarified analog lines intent for the network.
- Section 5.3.7: Updated Chubb to Metrolinx Vendor.
- Section 5.5.5.5: Clarified elevator two-way call device and emergency call system requirements.

Amendments to the GO DRM are provided in the following attachment:

- GO DRM – Minor Communications Updates

On MyLinx, the Bulletin is located on the Go Manual page.

The Bulletin is also available for external users to download via the Metrolinx public download site (http://www.gosite.ca/engineering_public/).

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Table 1. List of Abbreviations

CP	Canadian Pacific
CPTED	Crime Prevention Through Environmental Design
CPU	Central processor unit
~~CQD~~	~~Credit Query Device~~
CRI	Colour Rendering Index
CSA	Canadian Standard Association
CSRS	Canadian Spatial Reference System
CT	Current Transformers
cUL	Canadian Underwriters Laboratories
DC	Direct Current
DGZ	Dedicated Ground Zone
DHW	Domestic Hot Water
DRM	Design Requirements Manual
DTMF	Dual tone multi-frequency
DWA	Designated Waiting Area
EEMAC	Electrical Equipment Manufacturers Association of Canada
EIA	Electronic Industries Alliance
EMT	Electrical Metallic Tubing
EPA	Environmental Protection Agency
ERV	Energy recovery ventilators
ESA	Electrical Safety Authority
EV	Electrical Vehicle
FCC	Federal Communications Commission
FLC	Fuzzy Logic Control

MTM	Modified Transverse Mercator
MTO	Ministry of Transportation
MUP	Multi-Use Path
NAD	North American Datum
NEMA	National Electrical Manufacturer Association
NFPA	National Fire Protection Association
NPT	National Pipe Thread
NRC	National Research Council
OBC	Ontario Building Code
OESC	Ontario Electrical Safety Code
OHSA	Occupational Health and Safety Act
OPSD	Ontario Provincial Standard Drawing
PA	Public Address
PA	Public Address System
PCB Card	Printed circuit board card
PDF	Photometric Digital File
PIR	Passive Infrared Radiation
PLC	Programmable Logic Controller
PoE	Power over Ethernet
Project Co.	Project Consortium (a company/ entity that enters into a Project Agreement with Metrolinx)
PSR	Pre-Start Health and Safety Reviews
PT	Potential Transformers
PTZ	Pan Tilt Zoom
PUC	Public Utilities Commission

Communications	
Feature	***Design Requirements***
Key Components	• The key components of communications in bus maintenance facilities are as follows: • CCTV • Security and Telephone (interconnected with GO regional offices) • Network synchronized clock and coax cable distribution. • PRESTO
System Interface	• The following systems shall interface with existing GO related services: • Radios Ttrunking System • Telephones • IT/LAN • Public Address System • Intercom System • Cable TV Distribution System • Access Control and Intrusion Detection System ~~Security System~~ • Building Automation System (BAS) • Refer ~~T~~to Metrolinx Standard Building Automation Systems Performance Specification 25 05 10 For Details. • Tank a~~A~~nd Fuel Card Lock System • CCTV System • Signal Lights

Table 21: Mechanical

Table 36: Other – Interior Spaces

Other–Interior Spaces	
Space	***Design Requirements***
Sprinkler Room	• Refer to Metrolinx Standard Fire Protection Sprinkler System Specification 21 13 00 • Connect Sprinkler System to Fire Alarm and BAS systems
Mechanical Room	Adjacent to Shipping / Receiving Dock, shelving requirements
Electrical Room	Refer to technical requirements, Service Room Requirements
Hub Rooms ~~Communications Closets~~	Placed as needed, easily accessible, located to support Metrolinx Network Power over Ethernet (PoE) Architecture
Janitor's Room	In Administration Office Area • Floor mounted slop sink with easy access clean out for slop sink P- trap • Faucets and floor drains • High stability (24 hour) Aqueous Ozone Cleaning System (AOCS) • Domestic cold water complete with shut-off valve, dedicated for AOCS, water pressure shall be minimum 30 PSI (207 kPa) and maximum 65 PSI (488 kPa).
Garbage Recycling Room	-
Other	Catwalk by the clerestory windows provides access to bay fluid lines on/off valves. Sound Isolation shall be provided for all noise generating equipment. High Pressure hot water equipment shall not be located in wet areas.
PRESTO Room	Placed as needed, easily accessible
Electrical Closet	Placed as needed
Generator	Refer to Technical Requirements, Backup Power Systems

Balancing of Phases

5.2.2.3.1 Where single-phase power is taken from a 3-phase source, the loads shall be balanced among the three distribution phases.

5.2.2.3.2 Sites that have a single-phase source are to maintain the load on the distribution panels balanced.

5.2.2.3

Voltage Drop

5.2.2.4.1 The maximum allowable voltage drop is 2%.

Power Factor

5.2.2.4

5.2.2.5.1 The overall system power factor shall be greater than 90% or .9 PF.

5.2.2.5 5.2.2.5.2 Power factor design calculations are to be done using an 80% or .8 PF.

Backup Power Systems

5.2.2.6.1 This subject describes the functional requirements for Metrolinx facilities backup power system.

5.2.2.6

5.2.2.6.2 The power generated by the backup system shall be either true sinusoidal 60 Hz or DC, depending on the requirements. The intent is to ensure the continuing operation of essential equipment and services, and to effectively move passengers from station buildings and train platforms to outside parking areas in the event of a sustained power failure.

5.2.2.6.3 The final design of the backup power system must include an as-built schematic drawing of the system distribution. It shall also include a checklist for commissioning, operation, and maintenance, respectively.

5.2.2.6.4 Back-up power generators shall be installed in accordance with the Electrical Safety Authority (ESA), Technical Standards and Safety Authority (TSSA) and the regulations of the electrical inspection agency having jurisdiction. The back-up power generator shall be protected from surface deterioration caused by exposure to conditions (i.e: condensation, weather, winter maintenance and de-icing chemicals) producing corrosion. Flat surfaces which may retain water are not permitted. Provide safe access (min 1m).

5.2.2.7

Backup Required Time

5.2.2.7.1 Back-up power generators are a mandatory requirement, for providing the majority of our operational elements/ systems for 48 hours system operational duration for the following:

a) GO Rail Line Stations (including Parking Structures);
b) GO Bus Terminals (facilities with a station building only);
c) GO Rail Layover Facilities;
d) GO Operational Support Facilities (i.e. Wolfedale, GTCC, Middlefield);
e) GO Bus Maintenance Facilities;
f) GO Rail Maintenance Facilities.

5.2.2.7.2 Backup Power System's design can include components such as Generator, UPS, Inverter, Rectifier, etc. As a minimum, the backup Power System shall include diesel or natural gas generator complete with UPS systems having a minimum of 30-minute duration or UPS systems with 90-minute minimum duration if there is no diesel/natural gas generator set.

5.2.2.7.3 In each case, the UPS shall be double conversion continuous duty type to provide the electronic communications systems with clean sine wave power. The UPS/Inverter shall be rated for life safety applications and be provided with signals for indication of general alarms and with dial in remote monitoring control, plus a remote alarm to the station alarm system and Network/ BAS.

5.2.2.7.4 There shall be one UPS for the site for operations critical equipment and one UPS/ Inverter dedicated to Life Safety equipment support as per the OESC. For further information on UPS inverters, rectifiers etc., refer to Metrolinx Standard Inverter Rectifier and Charger Specification 26 33 33.

5.2.2.7.5 Diesel is the preferred fuel for backup generators. Where site and operational conditions do not allow for the use of diesel fuel, natural gas fuel powered generators are acceptable with Metrolinx approval.

5.2.2.7.6 Rectifiers shall be used for backup DC power in maintenance and layover facilities where required.

5.2.2.8 Design Requirements

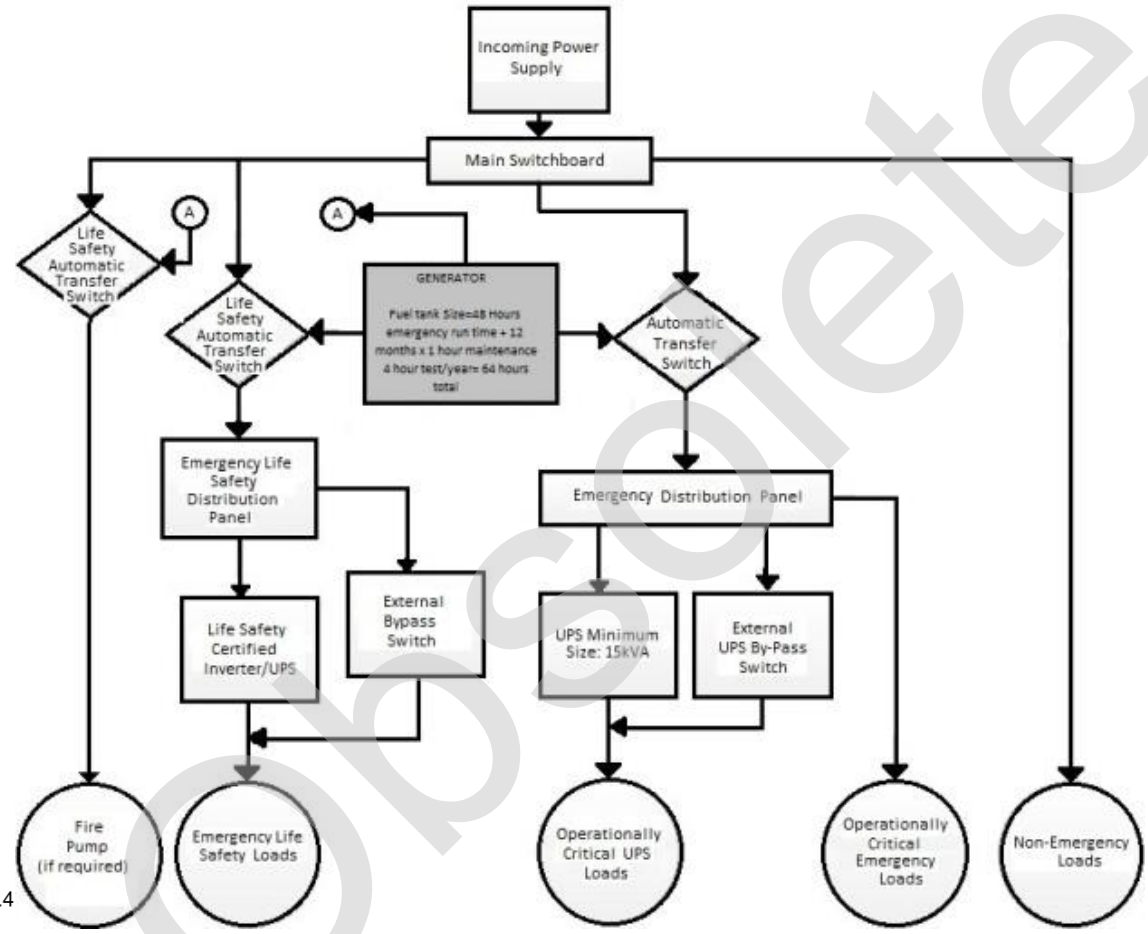
5.2.2.8.1 The following Table 39 shows a list of items that are considered essential. The table shows both backup power system conditions (i.e. Generator + UPS or UPS only).

5.2.2.8.2 The actual power draws shall be provided in the detail design. Third party ~~vendor equipment~~systems shall not be connected to UPS power supplied by Metrolinx.

Table 39: Backup Power Systems - Design Requirements

Emergency Lighting:	• Include inside enclosure, 50 lumens, DC battery powered, two hour operation, in accord with CSA C282.
Engine Fluid Containment Pan:	• Sized to 110 percent of available fluid in accord with CSA-C282.

Figure 18: Emergency Power Distribution with Generator



5.2.4

5.2.4 Uninterruptible Power Supply (UPS)

Uninterruptible Power Supplies (UPS) are used to support Life Safety systems and protects computers and other sensitive electronic loads from power outages and other power anomalies. This Section includes 3 phase ≥ 3 kVA and Single phase < 3 kVA, on-line, static-type, UPS system, comprising the following:

a) Complete rectifier/charger-battery-inverter system with automatic static switch and maintenance by-pass circuit;

b) Central Monitoring System for all UPS units, along with proper interfacing with Metrolinx software, Metrolinx I&IT communication, and station operations shall be provided in order to display and control all required parameters;

Electrical Requirements at Stations and Facilities	
Feature	***Design Requirements***
Studies	The following studies need to be completed for design: • Short circuit • Protective device • Device evaluation and arc flash hazard with coordinated ground fault protection • Electrical, for information on Arc Flash Hazards and labeling • Feeder plus main brace feeders on the main switchboard
System Voltages	Ensure that system voltages are adequately selected. Provide appropriate main incoming service and transformer.
Power Factor Correction System	Provide a power factor correction system with the following characteristics: Capacitors in banks, automatic switching of banks, maintain power factor between 0.9 and 1.0. Ensure that power is supplied by the nearest available utility freestanding enclosure, located near the main switchboard.
Utility Power Failure	In the event of a utility power failure, provide emergency power by means of a standby diesel generating set or a group of generator sets connected to a common bus. Provide an uninterruptible power system for critical components.
Electrical Handholes	Electrical handholes shall be precast concrete and designed for heavy traffic areas. Cast iron covers shall be bolted down. All metal components are to be grounded, except the cover.
Surface Mounted or Suspended Equipment	Provide galvanized steel mounting channel for all surface mounted or suspended equipment. No equipment is to be mounted directly to any wall or structural element.
Enclosures	Provide enclosures with the following characteristics: • Sprinkler proof, NEMA type 1 (indoor, dry and damp) • NEMA Type 4X (outdoor and damp/wet ~~non-conditioned~~ spaces) • NEMA Type 4 (~~conditioned~~indoor and damp/wet spaces) • 100mm concrete housekeeping pads for floor mounted equipment, disconnect switch at each motor

Receptacles	All receptacles are to be duplex type spec grade to code use. Receptacles are to be located in the following places: • Offices • Control and Electrical Room • On a dedicated circuit, at each workbench • On the roof adjacent to each HVAC unit • GFCI in wet and outdoor locations • Distributed equally along the building perimeter • Pendant cord mounter single receptacles in the repair garage and the front and rear of each hose location
Welding Outlets	Welding outlets shall be installed at appropriate location for supplying power to portable welders.
Traffic Signals	Provide traffic signals as required near the entrances of the facility.
Fire Alarm Systems	Multiplex fire alarm system to be provided.
Storage Garage	Lighting not to interfere with structural components, gas lines, power lines (easily accessible for maintenance).
Stair Shaft	Lighting to be easily accessible for maintenance

5.2.9 Service Duct Banks

5.2.9.1 Service duct banks shall conform to OESC (Ontario Electrical Safety Code) latest edition inside property line, or rail corridor per AREMA, CSA Standard C22.3 No. 7 Underground Systems, and OESC, coordinate with local Hydro and Bell for area having jurisdiction and for utility requirements.

5.2.9.2 Provide concrete encased duct banks in heavy vehicular areas and fire routes. Minimum 30% spare conduits with no cables or wires except for the ground wire and pull-cords shall be provided in duct banks for future use, coordinate with Metrolinx.

5.2.10.1

5.2.10 Wiring Methods

Raceways and conductors

5.2.10.1.1 Raceways and branch circuitry shall be implemented to minimize failure of a complete system due to failure or malfunctioning of any single electrical component.

5.2.10.1.2 Distribution minimizing conductors of different circuits sharing common raceways and pull-boxes, etc., shall be implemented. No free air cabling is allowed. All wiring shall be in conduit of the proper type, size and material as identified in the DRM and GO Specifications

5.2.10.1.3 Raceways shall not exceed a maximum of 40% capacity.

5.2.10.1.4 Communication backbone raceways sized 53mm shall not exceed a maximum of 30% capacity for communication cabling.

~~5.2.10.1.3~~5.2.10.1.5 Raceways selected shall suitably resist mechanical damage and environmental deterioration effects. In particular, special attention shall be applied to corrosion inhibitors and protective coatings or treatments on surface mounted conduit in underground areas (e.g., tunnels, below grade electrical rooms, Bridges and parking structures etc.).

~~5.2.10.1.4~~5.2.10.1.6 A minimum 12 AWG stranded copper wire green insulated RWU90 below grade and RW90 above grade shall be placed inside each raceway. This wire is to be used as a tracer wire inside a buried raceway for the purpose of locates after installation.

~~5.2.10.1.5~~5.2.10.1.7 Slack wire shall be provided. In all runs, the amount of slack shall be no less than 1.0m at each termination point and 600mm in each pull point. Access wire is to be neatly coiled and be available for future use.

~~5.2.10.1.6~~5.2.10.1.8 When installing wires in an existing raceway, it shall be the responsibility of the installer to ensure that new wires are neatly installed and tied together with all existing wiring.

~~5.2.10.1.7~~5.2.10.1.9 Drip loops shall be provided on all outside hanging raceways or conductors.

~~5.2.10.1.8~~5.2.10.1.10 Refer to Metrolinx Standard Specifications: Rail Corridor Raceway Requirements, Raceway for Electrical Systems 36 05 34 and Electrical Conductors and Cables 26 05 21 Refer to Metrolinx electrification standards for electromagnetic interference (EMI) protection of devices and cables.

5.2.10.2 Conduits

5.2.10.2.1 All conduit that is located in ~~non-conditioned~~damp (outdoor/indoor) ~~,~~and wet (outdoor/indoor) spaces shall be RGSEC (Rigid Galvanized Steel Epoxy Coated).~~Rigid galvanized steel conduit, or other Metrolinx approved cabling protection methods shall be used for all exposed work in normally dry areas not likely to present corrosion problems~~.

5.2.10.2.2 Conduit that is exposed and in ~~conditioned~~dry, indoor, HVAC controlled spaces shall be RGS (Rigid Galvanized Steel).

5.2.10.2.3 PVC Conduit shall be used in concrete encased or direct buried applications.

5.2.10.2.4 Conduits in finished areas shall be concealed and not visible to the public.

~~5.2.10.2.2~~5.2.10.2.5 Concrete encasements shall be provided for bus loops, road crossings, and railway right-of-ways. ~~Rigid steel or rigid PVC conduit may be used embedded in slabs where high impact protection is required~~.

~~5.2.10.2.3~~5.2.10.2.6 Rigid non-metallic conduit shall be used below ground, either direct buried or concrete encased.

~~5.2.10.2.4~~5.2.10.2.7 PVC or epoxy coated rigid galvanized steel conduit or other Metrolinx approved raceway methods shall be used in areas that can have condensation on metal or corrosion problem areas.

~~5.2.10.2.5~~5.2.10.2.8 PVC conduit shall not be installed above ground, or in exposed locations. Conduit, having a minimum of 53mm shall be used in parking lots when deemed necessary.

~~5.2.10.2.6~~5.2.10.2.9 Concrete encasements shall be provided for bus loops, road crossings, and railway Right-of-Ways.

In finished areas, all conduits shall be concealed.

~~5.2.10.2.7~~5.2.10.2.10 Refer to GO Standard Specifications 26 05 34 Raceway for Electrical Systems for detailed requirements.

Cable Trays

5.2.10.3.1 Where required, cable trays shall be ladder type; hot dip galvanized steel or aluminum or non-metallic as required for the application, complete with vertical barriers to separate systems or cables as required.

5.2.10.3

5.2.10.3.2 Class shall be selected based on conductor weight plus 50% spare capacity as a minimum.

5.2.10.3.3 Cable trays shall be cantilever-supported for ease in installation of cables.

5.2.10.3.4 Fire barriers of multi-transit type shall be provided at firewalls and fire separations, and shall be in accordance with the O.B.C. and CAN4-S115-M.

5.2.10.3.5 Types of Cable trays to be used:

a) Wire Cable Trays: Used ~~under~~ in Data Center raised floor~~s~~ configuration and GO Transit Radio rooms only;
b) Ladder Cable Trays: Used in Electrical/Communication Rooms;
c) Enclosed Cable Trays-Cable bus from transformers to main substation switch gear, outdoors.

5.2.10.4

Wire and Cable

5.2.10.4.1 All conductors shall be stranded copper.

5.2.10.4.2 Conductors smaller than No. 12 AWG shall not be permitted for lighting or motor branch circuit wiring, except that No. 14 AWG multi-strand type conductors may be used for control circuits only. Provide appropriate connection for terminating and standard wire.

5.2.10.4.3 Conductors shall have a minimum insulation temperature rating of 90°C, but design shall be for 75°C. All conductor insulation shall be colour coded.

5.2.10.4.4 An approved transition method shall be established when different gauges of wire are to be terminated together.

5.2.10.5

~~5.2.10.4.4~~5.2.10.4.5 Refer to Metrolinx Standard Electrical Conductors and Cables Specification 26 05 21 for more information on Wire and Cable.

Responsibility

5.2.10.5.1 The Consultant shall specify responsibility for wiring and equipment connections. Examples: For voice-activated intercoms, the type of wiring is to be as recommended by the equipment supplier, and is to be installed by the electrical contractor, but connected by the equipment supplier.

5.2.10.5.2 For the PA, CCTV, ~~and~~ Access Control and Intrusion Detection Systems~~security systems~~, the electrical contractor shall provide conduit with pull-strings, and the equipment supplier shall install wiring and the equipment, making all connections, testing and commissioning. Any equipment customization shall have appropriate seals from approved standards authority.

Enclosures

5.2.10.6.1 Enclosures shall be selected for the environment in which they are intended to be installed. In general, enclosures for indoor, dry application shall be EEMAC sprinkler proof type 1 or type 12 where applicable. Enclosure for ~~non-conditioned spaces~~dampoutdoor and damp/wet areas ~~(e.g., exterior boxes exposed to the weather, tunnels and escalators or elevator pits)~~ shall be EEMAC type 4X or NEMA type 4X equivalent~~4x~~. The enclosures requirements are as follows:

5.2.10.6

a) Where installed in public areas, all enclosures, cover-plates, outlets plates, access panels, and handwells shall be provided with method of securing doors and covers. All enclosures and panels shall have a common key and in an enclosed, protected area where possible;

b) Manholes ~~and handholes~~ shall be located remotely from doors, ~~shelters and~~ main road, and pedestrian traffic areas;

c) Handholes shall be located remotely from doors, shelters and main road and pedestrian traffic areas;

~~b)~~

~~c)~~d) Electrical and communication pull points such as manholes or boxes shall have a maximum 45m distance between manholes;

~~d)~~e) No splices are permitted~~,~~ ~~with the only exception being PA speakers spliced above grade and in approved enclosures~~permitted ~~below grade~~;

~~e)~~f) Underground conduits entering Mechanical, Electrical and Communications Rooms from the exterior shall be sloped to ensure positive drainage away from room;

~~f)~~g) Underground raceways entering any Mechanical, Electrical or Communications Room shall be interrupted by a drained manhole or handhole within 3000 mm of the room;

~~g)~~h) The minimum opening in the top of the handhole shall be no smaller than 460 mm;

~~h)~~i) The lip of the handhole and manholes shall be identified as to the type of service within by means of grooves cut into the collar of the handhole or manhole;

~~i)~~j) These markings are on the collar shall be 2 grooves; 3 mm deep for communications in the direction of conduit in and out and 1 groove; 3 mm deep in the direction of conduit in and out for electrical;

~~j)~~k) All electrical or communications handholes placed in the path of vehicular traffic or snow removal equipment shall be OPSD-2112.040 with OPSD-401.030 covers. If OPSD-2112.02 handholes are used, the covers shall be reinforced.

5.2.11.1

5.2.11 Relay Protection and Metering

Relays shall have RS485 communication port and connectivity to monitoring system using Modbus RTU protocol as a minimum. Communication ports of relays and meters on the bus shall be daisy chained from breaker cell to breaker cell and connected to a separate terminal block for connection to a SCADA system.

Phase overcurrent and ground fault devices shall be coordinated such that ground faults, short circuits, or overloads will trip only the immediate upstream protective device from the point where the fault or overload occurs.

5.2.11.2 The Preliminary Arc Flash hazard study analysis shall be submitted along with the design drawings prior to the co-ordination study. The preliminary arc flash study shall be used to modify the design in order to minimize the hazard. The study shall also be used for the floor boundary marking. The Preliminary Short Circuit, Load Flow, and Coordination study analysis shall be submitted with design. The final studies shall be provided after purchasing

5.2.11.3 of equipment.

5.2.11.4 Dedicated incoming digital metering shall be provided, beside Hydro metering, and shall measure true RMS current, voltage and display and provide 2 years history capabilities per phase.; Volts, Amps, kW, KVA KVAR, ~~P~~pf, Hz, kW demand and peak. Communication port shall be provided; Meters shall be mounted at eye level (approximately at 5'-6" A.F.F) Metering devices shall be housed in a separate compartment enclosure, have no exposure to 600 Volt bus or terminators. Contractor to obtain validation certificate from Hydro Utility for the meter installed on behalf of the owner.

5.2.11.5 Surge Protective Devices (SPD, formerly known as TVSS), Lightning, Phase Over & Under Current and Ground Fault Protection shall be provided as required for protection and safety of building, equipment and personnel. SPD is to be distributed through the distribution system.

5.2.11.6 Dedicated incoming digital metering, besides Hydro metering, and sub-metering, shall be provided, and shall measure true RMS current, voltage, and display, minimum 3 years history capabilities. Units to be measured: per phase Volts, Amps, also kW, KVA KVAR, Pf, Hz, kW demand, and peak.

5.2.12 Receptacles

5.2.12.1 Receptacles shall be specification grade suitable for back and side wiring and complete with wire ground terminal. Receptacles shall be 20 amp 120 volt duplex non-locking grounding type (CSA configuration 5-20R) in service and public areas. Stainless steel face plates shall

5.2.12.2 be used throughout. Twist lock receptacles and special coloured ground receptacles to be used in communications.

5.2.12.3 Receptacles shall not be on lighting circuits, and there shall be no more than six (6) receptacles per circuit in public areas, and no more than four (4) receptacles per circuit in service areas.

5.2.12.4 In general, building areas–janitorial outlets are required for cleaning and maintenance. In public open areas, receptacles shall be spaced at 5 m centres maximum, and at ceiling level for Christmas Lights as directed by GO transit. Tunnel and exterior building receptacles shall be GFCI type outdoors, located at spacing to suit 15 m extension cords or as required by GO user groups during detail design review.

5.2.12.5 If switched receptacles are required, or receptacles on UPS, these shall have a unique standard colour identifying the type of receptacle and the use at the site. The colour or marking shall differentiate regular, regular backed up, UPS, and switched or controlled receptacles.

Other receptacle requirements are as following:

5.2.21.6.5 Use a #12AWG cable, type multi-strand, for the 120V power feed.

Commissioning

5.2.21.7.1 When the installation activity performed by the electrician is done and that all monitoring units are functional, commissioning of these units must be performed.

5.2.21.7.2 An agreement with GO/ Metrolinx has to be signed for commissioning activities.

5.2.21.7 5.2.21.7.3 Commissioning agent to be present on site and verify the quality of installation, program and calibrate the monitoring units, verify the communication between the units and between the Power Measurement controller master unit and the server.

Power Monitors–Monitoring Program

5.2.21.8.1 Install Monitoring Program to locally monitor all Power Meters at selected sites.

5.2.21.8 5.2.22 Wayside Power

Wayside power and control requirements are for the storage of trains. Wayside power may be 600 -V ac or 480 V ac depending on the consist being stored at the site. Refer to
5.2.22.1 Metrolinx Standard Drawings.

5.2.23 EV Charging

EV charging shall be provided for operations fleet of vehicles.

5.2.22.2 5.2.23.1

5.2.22.3 5.2.23.2 Provide empty conduit, complete with #12 AWG green insulated grounding conductor RWU90 for easy tracing terminated in a handwell, sized as per OESC (Ontario Electrical Safety Code) but, not smaller than 2” (50mm).

5.2.23 5.2.24 Service Rooms Requirements (General)

5.2.23.1 5.2.24.1

Design Considerations

5.2.23.1.1 5.2.24.1.1 Incoming utility services at Metrolinx facilities shall be located in the primary Substation and/or Electrical Room, kiosk, bunker, Hub and Communications Room.

5.2.23.1.2 5.2.24.1.2 All Electrical Rooms and Communications Rooms shall be dedicated and not be shared with other functions, including, but not limited to: custodial, access services, communications, electrical, mechanical and storage.

5.2.23.1.3 5.2.24.1.3 Access to Electrical Rooms and Communications Rooms via ~~(~~pass through~~)~~ ~~shall be avoided~~is not allowed.

5.2.23.1.4 5.2.24.1.4 The main Electrical Room and the main Communications Room shall be located next to each other with exterior access.

5.2.23.1.5 5.2.24.1.5 Electrical Room, Hub Room, Mini-Hub Room, and Communications Room walls shall not have windows, skylights, roof access hatches/doors, etc.

~~5.2.23.1.6 Locating Electrical Room and Communications Room on perimeter curtain walls where windows comprise the entire surface of walls shall be avoided.~~

5.2.23.1.75.2.24.1.6 The Service rooms' floor plan shall always be rectangular or square in shape. ~~The room shall never be L- shaped, triangular or any other odd shape.~~ Electrical Room, Hub Room, Mini-Hub Room and Communications Room shall always be a one level room and these rooms shall be ~~preferably~~ above grade. The room shall be sized for the known equipment with a provision for a minimum of 25% extra wall space to accommodate future additional equipment.

5.2.23.1.85.2.24.1.7 Drawings shall indicate to scale the arrangement of allocated equipment inside Electrical Rooms, Hub, and Communications Rooms, including spaces and clearances. Elevation drawings shall show to scale all related wall mounted equipment for each wall.

5.2.23.1.95.2.24.1.8 A minimum 1 m clear working space shall be provided in front of access points, which may occur behind equipment~~. and patch panels, and in front of and behind racking~~. Provide a minimum of 1.5 m clearance in front of the racks and minimum 1m clearance at the sides and rear of the rack. ~~Racking shall not be positioned closer than 1 m from any wall.~~

5.2.23.1.105.2.24.1.9 A wall mounted, flip down work surface will be provided in each communication room. The work surface will be 25.4 mm thick, 762 mm wide by 610 mm deep, solid wood, plastic laminate on both main surfaces with a vinyl self-edge. The work surface will be mounted at a height of 915 mm above the finished floor. The ~~location of the~~ work surface shall be located near the entry door~~will be adjacent to the main communication cabinet rack~~ and maintain all regulatory clearances from exit and equipment as required by code when in the open position. One (1) duplex receptacle and one (1) RJ-45 data connection will be provided at the workstation and mounted above the tabletop in the open position. Provide heavy duty stainless steel mortise hinges, mechanism to hold the table open and blocking in the wall as required.

5.2.23.1.115.2.24.1.10 No liquid piping, steam piping, drainage piping, and/or dry liquid piping shall pass through or within walls of any Electrical Room, Hub Room, Mini-Hub Room, or Communications Room, except for refrigerant and condensate piping for the A/C unit ~~in the~~dedicated for that room. ~~Sprinkler systems that are located in these rooms shall be a dry type pre-action system.~~ Sprinkler systems shall only be installed where mandated by applicable codes. ~~or occupancy requirements. The exception to this requirement is Data Centre rooms that are identified and approved by Metrolinx.~~ For sprinkler system requirements refer to Table 58 – Fire Protection System.

5.2.23.1.125.2.24.1.11 All Electrical Rooms, Hub, and Communications Rooms shall have a break in all ducts within 3000 mm of the building by a junction box, handhole, or manhole. All manholes or handholes shall be designed so that water is drained away. All ducting shall have the piping slope away from the room.

5.2.24.1.12 Ducting in the Electrical Room, Hub, Mini-Hub and Communications Room shall be tray and rigid galvanized steel conduit above floor. ~~EMT is accepted only with compression type connectors (screw connectors are not allowed)~~Electrical Metallic Tubing (EMT) requires Metrolinx approval before being used on site.

5.2.24.1.13 Third party equipment shall not be installed in Metrolinx service rooms. It shall be designed as per project specific requirements as a separate secured room and shall be approved by Metrolinx ~~project delivery team~~. Third party systems shall be a standalone system and not require Metrolinx network or infrastructure support.

5.2.23.1.135.2.24.1.14 Refer to section 5.2.10.6 – Enclosures, for additional design requirements regarding Service Rooms.

Walls Design Requirements

5.2.23.2.15.2.24.2.1 The building envelope shall be insulated to meet or exceed ASHRAE 90.1 requirements. Walls shall extend from finished floor to the structural ceiling and shall be structurally sound for wall-mounted equipment. Concrete cinder blocks shall be used on all walls where poured concrete structural walls are not present. Studded walls are not permitted. Walls shall be fire-rated as required by the applicable codes and regulations and shall be painted with a minimum of two coats of non-dust producing white or light gray paint. All Electrical Rooms, Sub-Electrical Rooms, Communication Rooms, Hub Rooms, Mini-Hub Rooms, Mechanical Rooms and other service rooms shall have fire-rated plywood on all four walls. For rooms with Plywood on the walls the Plywood must be fire rated and have two coats of fire retardant paint.

5.2.23.25.2.24.2

5.2.23.2.25.2.24.2.2 A 1200 mm wide x 2440 mm x 21 mm A class C grade or better fire retardant rated sheet of plywood, void free, shall be installed all around Communications and Hub Room walls for wall mounted communications equipment. The bottom of plywood shall be mounted 150 mm above finished floor. Paint plywood with a minimum of two coats of fire-retardant white or light gray paint. The fire rating designation shall be placed displayed in an area that is easily visible and shall not be painted over. One visible designation per sheet of plywood is required.

Floors Design Requirements

5.2.23.35.2.24.3

5.2.23.3.15.2.24.3.1 Poured concrete sealed floor shall be provided in Electrical Room, Hub Room, Mini-Hub Room and Communications Room. Floor finish shall be antistatic dissipative light gray epoxy sealer, applied per manufacturer's published specifications. A 100 mm rubber wall base shall be provided. No floor drain is allowed. The floor shall have a 1% slope to provide a way for water to exit the room in a manner that does not create any slipping hazards.

5.2.23.45.2.24.4

Doors Design Requirements:

a) The doors shall be at least 915 mm wide x 2135 mm high and shall be hollow metal slab type (no windows) with hollow metal frames;
b) Double or oversized doors shall be provided for rooms that have large equipment to be installed and maintained;
c) If the door to the Room is in a fire separation, then the door shall have an appropriate fire resistance rating per O.B.C.;
d) When feasible, the rooms shall have exterior access, but doors shall not open onto a public space;
e) The Electrical Room and Communication Room within a parking structure may be exempt from having an exterior door access, providing access to the Room door is unrestricted;
f) Doors shall not open in to the path of vehicle traffic;
g) Access shall be provided through GO Transit uniform master key system and a centrally controlled alarm keypad and proximity access device system, with an access override feature;
h) The door shall be lockable from outside only.

Ceiling Design Requirements:

a) No suspended ceiling shall be installed;

b) Finished ceiling minimum height shall be 3050 mm (10'- 0");

c) Prime and paint the ceiling with a minimum of two coats of non-dust producing paint. White paint is required;

~~5.2.23.5~~5.2.24.5 d) Where OWSJ are present, prime and paint all exposed structures to meet flame spread and smoke developed ratings designated by local Code requirements.

Flood Prevention Design Requirements

~~5.2.23.6.1~~5.2.24.6.1 Locate all Electrical Rooms, ~~and~~ Communications/Hub Rooms and Mini-Hub Rooms at or above grade away from any threat of flooding. Avoid locations that are below

~~5.2.23.6~~5.2.24.6 grade or adjacent to potential water hazards ~~(restrooms, tunnels, etc.)~~. Roof drains and pipe penetrations into the room shall be avoided.

Fire Protection Design Requirements:

a) Fire-stop all room penetrations (cables, pipes, pathways, trays, conduit slots). Ensure

~~5.2.23.7~~5.2.24.7 that the fire-resistance rating of installed fire-stopping assembly shall be not less than the fire-resistance rating of surrounding floor and wall assembly to match the corresponding fire rating of fire separation.

b) For fire suppression, install a hand held 10lbs CO2 (10 B:C rated) fire extinguisher, with current certification, meeting NFPA 10 requirements. The extinguisher shall be wall mounted on the latch side of the entry door and installed in accordance with manufacturer's recommendations. All panels, boxes, and conduit shall be sprinkler proof if required.

~~5.2.23.8~~5.2.24.8 HVAC Design Requirements:

~~5.2.23.8.1~~5.2.24.8.1 Heating, ventilation, and air conditioning of Electrical Room, Hub Room, Mini-Hub Room, Elevator Control Room, and Communications Room shall be provided by a dedicated heat pump AC unit with the following features:

a) Low ambient cooling;

b) Heating at -25°C;

c) R 410A refrigerant;

d) Variable compressor speed.

~~5.2.23.8.2~~5.2.24.8.2 A fan-forced heater shall be provided as a redundancy in case the heat pump does not provide enough heating during the extreme cold days. Because ~~a~~ Hub Rooms and Mini-Hub Rooms ~~is~~ are smaller than a typical Communications Room and a bunker or kiosk is smaller than an Electrical Room, a heat pump with hyper-heating may not be available on the market. If this is the case, a split A/C unit with ambient cooling would provide cooling and the fan-forced heater will provide heating. Control of both systems shall be central in order to avoid both systems fighting each other. The heat pump and heater shall be fed from the regular power panel located in the Room. Temperature and humidity requirements are on a 24 hours, 7 days a week basis, regardless of the heat generated by normally operating electrical and communications equipment.

~~5.2.23.8.3~~5.2.24.8.3 The required capacity shall be calculated based on the following:

a) For sensible heat gain from electrical equipment use a minimum 5000 Watts per rack (in the Communications Room);
b) Sensible heat gain from lighting;
c) Include the future growth of systems by 25%;
d) Determine heat gain/loss to the room from the outside (heat transfer through building structures, including solar load) g the following design criteria;
e) Outdoor temperatures.

~~5.2.23.8.4~~5.2.24.8.4 Use 1% winter & 2½% summer design temperatures per Ontario Building Code for the geographical location. Indoor temperatures:

a) Winter design: 15°C;
b) Summer design: 22°C D B with a maximum of 50% relative humidity;
c) An infiltration rate from outside of 0.5 air changes per hour;
d) A recirculation rate of 100% for the air conditioning system;
e) A safety factor of 5%.

~~5.2.23.8.5~~5.2.24.8.5 The air conditioning system shall be selected to suit the specific capacity by taking into consideration the room's very high sensible load factor. Heat loss calculation shall not include credit for equipment and lighting heat gain.

Emergency Cooling

~~5.2.23.9~~5.2.24.9

~~5.2.23.9.1~~5.2.24.9.1 Provisions for emergency cooling in ~~mini hub room~~Hub Room, ~~hub room~~Mini-Hub Room, ~~elevator~~ Elevator ~~control~~ Control ~~room~~Room, ~~communication~~ Communications Room and ~~electrical~~ Electrical ~~rooms~~Room:

a) Provide a 150mm diameter vent opening provision, secured from inside, for portable A/C unit in both electrical and communication rooms, venting to the outside;
b) Provide dedicated 120V, 20A, 5-20R and 120V, 30A, 5-30R power receptacles (generator backed-up) from dedicated circuit breakers for portable A/C unit, in Electrical and Communication rooms;
c) Receptacles to be mounted at 300mm height above finished floor;
d) Contractor to provide Labels above receptacles stating: the respective Amps, panel and circuit numbers and "DEDICATED FOR PORTABLE A/C UNIT";
e) Provide an exhaust fan controlled by a reverse acting thermostat and an override switch;
f) High/low temperature alarm;
g) All alarm inputs to be placed in ~~Chubb~~ Metrolinx Vendor System and BAS.

~~5.2.23.9.2~~5.2.24.9.2 The sequence of operations shall be as follows:

a) When A/C unit fails and temperature starts rising the high temperature sensor sends an alarm to the current corporate supplier of security and monitoring services;
b) Station Operations will be notified to send a portable A/C unit and the HVAC service contractor is notified to repair the broken A/C unit;
c) The ventilation system will then kick-in to help reduce the temperature until a portable A/C unit is installed;
d) Station Ops will install the portable A/C unit and switch off the ventilation system.

~~5.2.24~~5.2.25 Electrical Rooms

Design Considerations

~~5.2.24.1.1~~5.2.25.1.1 Electrical service Substations are typical at GO/ Metrolinx Rail Service Centres but can occur at a large station, maintenance facilities or where ever else Metrolinx requires them.. For an example of a substation, see Standard Layover drawings. Install HVAC in all electrical rooms w/auto changeover.

~~5.2.24.15.2.25.1~~
~~5.2.24.1.2~~5.2.25.1.2 Whenever possible there shall be one main Electrical Room that feeds the entire site, as it is the goal at most facilities to have only one utility power source. Sub Room(s) shall be strategically placed around the main Electrical Room to facilitate an efficient distribution of power to loads to boilers, tunnels, bridges, main and sub- structures (e.g. parking structures, stations, service and storage buildings and maintenance facilities), as required. Electrical closets shall be provided to minimize the number of home runs from distribution panels to their respective sub-panels or equipment loads, and to reduce the number of conductors and minimize voltage drop or in preparation for future requirements.

~~5.2.24.1.3~~5.2.25.1.3 The typical Electrical Room at Metrolinx facilities shall include space for locating:

a) Distribution panels, switches and boards;
b) Metering Cabinets;
c) Transformers;
d) Uninterruptible power supply (UPS);
e) Transfer Switches;
f) Battery Pack backup emergency lighting above and beyond the generator backed up lighting and UPS lighting of the space;
g) Automatic Transfer Switch (ATS);
h) Data and telephone outlets;
i) A service-working station by the door with power and data connections;
j) The station shall be a cabinet-lectern combination sized to hold ANSI B drawings, to serve as a working surface and storage for drawings, manuals and onsite component and parts;
k) A minimum continuous 17 m of wall space is required for equipment installation.

~~5.2.24.1.4~~5.2.25.1.4 All wall installed panels and conduits or ducts shall be installed on strut channel mounting system. All floor mounted panels and equipment shall be installed on housekeeping concrete pads. The housekeeping pad shall be a minimum of 100 mm above the floor and shall extend beyond the equipment footprint as per manufacturer's requirements.

~~5.2.24.1.5~~5.2.25.1.5 A non-fade single line diagram of the electrical system related to the room shall be framed and posted under a polycarbonate cover adjacent to the entrance of the Electrical Room. The diagram shall be legible from a distance of 1 m.

~~5.2.25.1~~5.2.26.1
~~5.2.24.1.6~~5.2.25.1.6 Provide markings on the floor showing the arc flash boundaries in around equipment and panels.

~~5.2.25~~5.2.26 Communications, ~~and~~ Hub, and Mini-Hub Rooms Design Considerations

All Communications Rooms shall be designed in accordance with ANSI/TIA/EIA-569-A-Commercial Building Standard for Telecommunications Pathways and Spaces.

The Communications, Hub, and Mini-Hub Rooms shall accommodate the following equipment (refer to Metrolinx I&IT Telecommunications and Systems Standards Document for a list of IT equipment):

a) Network System Rack;
b) CCTV System Rack;
5.2.25.25.2.26.2 c) PA System Rack;
d) Passenger Notification System (PINS, Whiteboard, etc.);
e) Telephone Infrastructure;
f) Two-way Communication Infrastructure (elevator cab intercom and information intercom);
g) Fare Collection Equipment: Presto and legacy;
h) Alarm and Security Monitoring Equipment;
i) Fire Safety System;
j) Space Counting System (in parking structures);
k) Building Automation System Server (all support systems shall be located appropriately with the equipment).

5.2.25.35.2.26.3 Communications Room shall be located next to the Electrical Room with exterior access if possible, within parking garages these rooms shall open onto the interior of the garage and be protected from vehicular traffic by a delineated marking on the ground and bollards bordering the area of delineated marking.

5.2.25.45.2.26.4 At facilities where the distance of cable runs exceeds 90 m (300 ft.) between the end device and accumulation point as deemed necessary by Metrolinx, Communications Hub Room(s) shall be implemented. Hub Rooms are satellite Communications Rooms, designed to accommodate a minimum of two floor-mounted racks. Hub Room's purposes are to minimize the number of home runs from remote devices to their respective head end equipment; reduce usage of optical fiber and associated equipment; concentrate the distribution of collocated devices; facilitate future implementation of Communications
5.2.25.55.2.26.5 systems.

Mini-Hub Rooms

5.2.25.5.15.2.26.5.1 Mini-Hub Rooms are strategically located on or beside the rail platform to service rail platforms and all PoE devices within the limitation of the Metrolinx I&IT standard (PoE extenders, multipliers, etc. are not allowed). Mini-Hub roomsCommunication Hub Rooms on the rail platforms are termed "Mini Hub Rooms". Mini Hub Rooms shall be provided on at rail platforms to span beyond the 90 m limitations of Power over Ethernet (PoE) I&IT Architecture and in areas where devices are deployed in numbers that require consequential1 infrastructure. Standalone cabinets, wall mounted or otherwise, shall not be used on rail platforms or where devices are deployed in numbers. Grounding shall be provided from a single point within the Mini-Hub room utilizing the "HALO" distribution method. Refer to section 5.2.332.6 Grounding of Electrical and Communication Rooms, and Fixed Machinery for further details.

5.2.25.5.2 A Mini Hub Room is the preferred solution to span beyond limitations of the Communications Hub Room on rail platforms. Where an alternative to the Mini Hub Room is identified in early design stages, the Consultant shall engage Metrolinx Business Technology Team to ensure Business Technology standards are addressed in the alternate solution to Mini Hub Rooms.

5.2.25.5.35.2.26.5.2 Consequential infrastructure is defined as the use of multiples of support enclosures and devices, additional/costly components and resource and infrastructure intensive to install and maintain.

Interior

5.2.25.6.15.2.26.6.1 Mini--Hub Rooms shall, at a minimum, be of sufficient size to house one full size floor mounted network rack that is capable of pivoting to allow technicians to access the rear of devices which are mounted on the rack thus minimizing the room's footprint. Mini-Hub room interiors, finishes, and materials shall follow the DRM requirements for Communication/Hub Room, System Room finishes. Refer to Metrolinx I&IT Standards for rack type and size.

5.2.25.65.2.26.6

5.2.25.6.2 All interior walls shall be constructed from concrete block, and be finished with 23mm thick fire resistant plywood, void free, with two coats of white or light gray fire rated paint.

5.2.25.6.3 Doors for the Mini Hub Room shall be fire rated per applicable codes, and have the capability to be held in the open position during maintenance periods.

5.2.25.6.4 The Mini Hub Room floor shall be slightly raised to prevent pooling and be coated with an anti-static finish.

5.2.26.6.2 An HVAC system shall be provided by a heat pump type A/C unit, a fan-forced heater shall be provided as a redundancy. A multi-split unit may be provided for elevator area and Mini Hub Room, where feasible. A dedicated heater and condensing unit shall be located within the Mini Hub Room.

5.2.25.75.2.26.7 Power

5.2.25.7.15.2.26.7.1 Grounding shall be provided from a single point within the main Electrical Room utilizing the "HALO" distribution method. The size of the ground bus shall be 50 mm x 6 mm or sized to provide Ggrounding shall be provided to all systems, racking and supporting infrastructure within the room including doors and door frames. Refer to section 5.2.332.6 Grounding of Electrical and Communications Rooms, and Fixed Machinery for further details.

5.2.25.7.25.2.26.7.2 Power panels shall be provided, minimum one UPS and one regular power.

5.2.25.7.35.2.26.7.3 Provide a cable tray and cable ladders to facilitate wiring infrastructure within the Mini--Hub Room.

5.2.25.7.45.2.26.7.4 Two receptacles shall be provided on the cable tray above the network rack with each having a distinct and separate UPS circuit to provide power for systems within the rack.

5.2.25.7.55.2.26.7.5 Provide two wall mounted GFI receptacles on generator power for maintenance.

5.2.25.7.65.2.26.7.6 Illumination shall be provided in front of the racks and be tied to a hinge switch.

5.2.25.7.75.2.26.7.7 High/Low temperature sensors and access control utilizing Keypad/FOB for entry shall be implemented.

5.2.25.85.2.26.8

5.2.26.7.8 Power bars shall not to be used within the Mini--Hub roomsRoom.

5.2.25.7.85.2.26.7.9 All wall mounted equipment shall be mounted at level boarding height. All stub up conduit shall be cut to above level boarding height to allow for the raised platform height.

Utilization

~~5.2.25.8.1~~5.2.26.8.1 Rail platforms used by GO Transit are minimum 315 m long. To provide infrastructure for the number of current and future systems, it ~~is~~ will be necessary to provide more than one Mini-Hub Room for each rail platform.

~~5.2.25.8.2~~5.2.26.8.2 Mini-Hub rooms provide infrastructure and connectivity for Metrolinx network devices on Metrolinx platforms, tunnels, and bridges. Metrolinx networking architecture utilizes PoE architecture. To implement 100% PoE support, consideration and location planning is essential~~Mini Hub Rooms shall be located adjacent to elevator enclosures to maximize infrastructure support for all platform devices and adjoining tunnel and bridge area devices. When this location is not available or feasible, locate the Mini Hub Room at the closed end of a stairwell opening. All alternative locations shall be pre-approved by Metrolinx~~.

~~5.2.25.8.3~~5.2.26.8.3 The Mini-Hub Rooms shall be located at platform grade in a manner that will minimize passenger flow disruptions and in compliance with ~~be mindful of~~ CPTED practices. Mini-Hub Rooms shall not be located beyond the ends of the platforms extending into the rail corridor.~~The Mini Hub Rooms location shall not impede with passenger flow and be positioned so they don't disrupt sight lines to be compliant with CPTED~~.

~~5.2.25.8.4~~5.2.26.8.4 Mini-Hub Rooms shall meet or exceed rail corridor regulations and all regulatory items that apply.

Exterior

~~5.2.25.9~~5.2.26.9

~~5.2.25.9.1~~5.2.26.9.1 Exterior cladding shall match adjoining structural material palette to give a consistent, cohesive, uniform appearance. This includes the wall shared by the Mini-Hub Room and an enclosure.

~~5.2.25.9.2~~5.2.26.9.2 Where a Mini-Hub is located under a platform canopy, extend the exterior enclosure of the Mini-Hub Room to be continuous to the underside of the platform canopy. Where the location does not have a canopy, extend the exterior finish of the Mini-Hub Room to the height of the adjacent structure (elevator or stairwell).

~~5.2.25.9.3~~5.2.26.9.3 Where possible, the Mini-Hub Room shall be installed outside of the OCLZ.

~~5.2.25.9.4~~5.2.26.9.4 At multi-level parking structures, Communications Hub Room(s) shall be strategically placed directly above the main Communications Room and centrally located to meet the 90 m (300 ft.) cable run distance limitation. One Hub Room can serve more than one floor. In Parking Structures, careful planning is required when locating the Communications and Hub Rooms. Attention must be paid to equipment placement within these rooms in relation to the structural ceiling elements. The required vertical clearance above the racks must also be taken into account. Ideally, cable trays shall be kept level, precast openings in structural "T's" as determined by the structural engineer, to get to the sidewalls of the room.

~~5.2.25.9.5~~5.2.26.9.5 Communications Hub Rooms and Mini-Hub Rooms shall be dedicated and not be shared with other functions, including, but not limited to: custodial, access services, electrical, mechanical and storage. Access to Communications Hub Rooms and Mini-Hub Rooms via (pass through) Electrical, Mechanical, Maintenance/Janitor Rooms, etc., shall not be permitted. The Hub Rooms may share space with an electrical-sub room e.g. at stairways for bridges, tunnels and elevator machine rooms, provided that the following requirements are met:

a) There is sufficient clearance between the electrical equipment and the communication racks;
b) The electrical equipment is limited to 100 A at 120/208 V, 3 phase or 100 A at 120/240 V, single phase; and
c) There is no electrical equipment rated 600 V, or 600 V-120/208 V stepdown transformers.

~~5.2.25.9.6~~5.2.26.9.6 For further information regarding Mini-~~-~~Hub Rooms refer to the Service Rooms Requirements (General) section of this document and the Electrical Communications Infrastructure Mini-~~-~~Hub Rooms drawing in the GO Standard Drawings and Specifications.

System Controller

~~5.2.25.10.1~~5.2.26.10.1 The System Controller shall provide the following primary functions:

~~5.2.25.10~~5.2.26.10 a) Switches of audio channels to the required zone drivers;
b) The switching function shall be performed by the zone switching card;
c) Allows programming and testing through a RS 232 /RS 485 port;
d) Supplies power to the system processor, display and interface cards;
e) Four audio input channels that can each provide an audio output on any pre-configured group combination or manually selected zone;
f) Provision shall be made for an ALL Call broadcast to all zones simultaneously;
g) Appropriate Zone Driver and Zone Relay Cards for the requisite number of drivers/zones within the system;
h) The audio channels are interfaced to the driver input/output circuits by zone driver and relay cards;
~~i) Provides appropriate Paging Telephone interface;~~
~~j) Configurable automatic Day/Night audio level capability;~~
~~5.2.25.11~~5.2.26.11 ~~Automatic Daylight saving time adjustments.~~

Communications and Hub Rooms Construction

~~5.2.25.11.1~~5.2.26.11.1 For Room dimensions (minimum wall to wall) Refer to Table 43.

Table 43: Minimum Room Dimensions

Location	Size
Communications Hub Room	Space for 2 racks. Refer to Metrolinx I&IT requirements for rack sizes~~3200 mm wide x 3600 mm long~~
Communications Mini-Hub Room	Site specific. Follow Mini-Hub Room design requirements
Communications Rooms at stations and small to medium sized facilities	Space for 5 racks. Refer to Metrolinx I&IT requirements for rack sizes~~3200 mm wide x 4800 mm long~~
Communications Rooms at Large Facilities and/or Parking Structures Note: Small, medium, and large size facilities are determined by the number of racks that are needed to house all equipment systems and varies per facility.	Space for 6 racks. Refer to Metrolinx I&IT requirements for rack sizes~~3200 mm wide x 5400 mm long~~
For Type A Bus and Rail Facilities	~~3200 mm x 6600 mm~~ Space for 6 Racks. Refer to Metrolinx I&IT requirements for rack sizes
Type B Bus Facilities	~~3200 mm x 5400 mm~~ Space for 5 Racks. Refer to Metrolinx I&IT requirements for rack sizes
Type C Bus Facilities	~~3200 mm x 4800 mm~~ Space for 4 Racks. Refer to Metrolinx I&IT requirements for rack sizes

~~5.2.25.12~~5.2.26.12 Communications and Hub Rooms Communications Connectivity

~~5.2.25.12.1~~5.2.26.12.1 A minimum of nine ~~(9)~~ 53 mm ~~(2")~~ dedicated conduits shall provide connectivity from the Main Communications ~~Hub~~ Room to each Hub Room and Mini-Hub Room. Note that the required number of power conduits are not part of these nine dedicated communication conduits.~~its respective Communications Room~~. If more than one Hub Room is required, then each Room must have its own direct dedicated set of conduits linking it to the Main Communications Room, which may be designed as a pass-through layout. Spare communication conduits (excluding tracks and signals) shall be 53mm.

5.2.26.12.2 If more than one Communications Room on site, provide eight 53mm conduits for communications power to each Hub Room and Mini-Hub Room from the Main Communications Room. A ~~a~~ minimum of nine ~~(9)~~ 53 mm ~~(2")~~ dedicated conduits shall provide connectivity from one Communications Room to the other. Refer to I&IT Telecommunication~~s~~ and Systems ~~Document~~ Standards for list of equipment. Spare communication conduits (excluding tracks and signals) shall be 53mm.

Conduit Infrastructure

5.2.26.13.1 Communications conduit shall be included in all rail platforms, power, communication, and mechanical systems.

5.2.26.13.2 Power shall be run in a dedicated duct bank. Communications shall be run in a dedicated duct bank.

5.2.26.13

5.2.26.13.3 Power and Communications shall run the entire length of the platform and be fed from the Systems designated Main Electrical Room and Main Communications Room respectively.

5.2.26.13.4 For platform communications provide nine 53mm conduits and eight 53mm conduits for communication power for the entire length of the platform.

~~5.2.25.12.2~~5.2.26.13.5 Provide routing of all conduits with the capability of connecting the Mini-Hub rooms and terminating at each end of the platforms in hand-wells that can provide future connectivity to rail corridor systems.

Communications and Hub Rooms Electrical Requirements

~~5.2.25.13.1~~5.2.26.14.1 All communications equipment in the Communications Room shall be serviced by a dedicated 120/208 V 3 phase 4W 225 A panel located inside the Room, and fed from an UPS placed inside the Main Electrical Room. If 208 V service is not available, 120/240 V 1 phase 3W 225 A panels shall be used. ~~There is one exception, Presto shall be fed from a dedicated 120/208 V 3 phase 4W 225 A regular generator backed up panel located inside the Room~~

~~5.2.25.13.2~~5.2.26.14.2 All communications equipment in the Hub Room shall be powered from a sub-panel fed from the dedicated back-up electrical panel located in the Communications Room.

~~5.2.25.13.3~~5.2.26.14.3 A dedicated electrical panel shall be provided for regular power inside each Communications Room. This panel grounding shall be connected to the Electrical Room grounding system.

~~5.2.25.13.4~~5.2.26.14.4 All panels shall be sized to meet DRM requirements. All panels shall have remote monitoring and control of all circuits' capabilities.

~~5.2.25.13.5~~5.2.26.14.5 All panels and boxes shall have NEMA ratings designations.

~~5.2.25.13.6~~5.2.26.14.6 Half of the light fixtures inside Communications, Hub and Mini-Hub Rooms shall be powered from the UPS backed-up panel.

~~5.2.25.13.7~~5.2.26.14.7 Heating and air conditioning of the Communications and Hub Room shall be generator backed-up only (no UPS back-up).

~~5.2.25.13.8~~5.2.26.14.8 All panels, boxes, and conduit shall be sprinkler proof.

Communications and Hub Rooms Power Outlets

~~5.2.25.14.1~~5.2.26.15.1 Each communications equipment rack shall be fed from two independent tray mounted twist lock L-20R single specification grade receptacles. Each such receptacle shall be fed from a dedicated circuit. Refer to the Metrolinx I&IT Ttelecommunications and Systems ~~document~~ Standards for detailed specifications.

5.2.26.15.2 Metrolinx communications racks shall be powered by two individual dedicated circuits fed from the UPS panel located in the Communications Room.

~~Communication racks are required to be on UPS~~.

~~See Presto subsection under Fare Handling Systems section for power requirements~~.

~~5.2.25.14.2~~5.2.26.15.3 Provide a minimum of three ~~(3)~~ normal power 5-20R 120 V duplex receptacles, powered from three dedicated circuits, for maintenance and identified as such. These receptacles shall be wall mounted and not located on cable tray or cable ladders, as not to be confused with communication-dedicated receptacles. Power bars are not allowed.

~~5.2.25.14.3~~5.2.26.15.4 All power receptacles shall be mounted on Class C or better fire-rated plywood with nameplates to provide power tracing ease. All equipment connecting to the receptacles shall have nameplates indicating model, capacity, and electrical data. Refer to Metrolinx Specification 26 05 53 – Electrical Identification and Nomenclature for more details.~~Provide an approved for use power bar for the equipment mounted on the plywood backboard. Each connection on the power bar shall have nameplates to provide power tracing ease. The power bar shall be a multi-outlet raceway. All equipment connecting to the power bar shall have nameplates indicating model, capacity, and electrical data. Install equipment in accordance with manufacturer's recommendations.~~

~~5.2.26~~5.2.27 Illumination

Lighting Design

~~5.2.26.15.2.27.1~~
~~5.2.26.1.1~~5.2.27.1.1 This section addresses interior and exterior illumination and lighting design strategy for GO site and building facilities. The intent is to provide good uniform quality lighting design strategy that meets the locations application. The Lighting design strategy shall be applied as a sequential overlay of Guiding Principles; followed by lighting design considerations, lighting typology applications and selection criteria and individual lighting design requirements.

~~5.2.26.1.2~~5.2.27.1.2 Lighting Design Guiding Principles → Design Considerations → Typologies → Design Requirements

~~5.2.26.1.3~~5.2.27.1.3 Refer to Metrolinx Lighting and Controls Specification 26 50 00 for detailed requirements.

~~5.2.26.2~~5.2.27.2

Lighting Design Guiding Principles as follows:

a) A cohesive and adaptable hierarchy of lighting;
b) Provide a consistent and flexible lighting approach across all sites will promote intuitive wayfinding;
c) Utilize built site elements with internal lighting as beacons to support wayfinding;
d) Associate lighting types with the same conditions/activities at each element, to provide a recognizable visual language;
e) The hierarchy of lighting is identified as:
    1) Areas of transition and boarding of Metrolinx services that are highlighted to enhance the experience;
    2) Illuminated built structures that serve as lanterns and aid wayfinding throughout the site. The lighting shall provide comfort, feel and uniformity with accent lighting for points of interest and art;
    3) Pedestrian scaled illumination for areas of rest and waiting that promote activity specific design, comfort and feel of the space;

o) Daylight–Particular attention shall be directed to parking structure, rail station and bus terminal entrance/ exit areas, especially on large projects. Illumination shall provide for a visually comfortable transition from outdoors to facility entry areas during all hours of system operation. Illumination levels will likely have to be graduated during the daylight hours to minimize otherwise abrupt changes from outdoors to indoors, and vice versa. Photoelectric cells for the automatic operation of additional lighting fixtures may be utilized;

p) Sundry: All rail platform poles shall be hinged ~~to avoid flagman services~~. Hinged poles shall be installed in such a manner to avoid obstructions when lowered. Hinging shall be always parallel to the track. CCTV camera(s) shall have dedicated split pole(s). ~~-~~PA speakers can be installed on existing lighting poles only if they are split. ~~High mast lighting poles shall no objects attached onto (e.g. parking identification, PA speakers, etc.) to avoid obstruction of the lowering device.~~ High mast poles are not allowed for CCTV use.

q) Standard Light Pole Drawings~~: Digital drawing files~~ are available for 3 and 6 meter hinged pole, 6 meter, 12 meter and 30 meter (high mast) pole on the public GO Site under ~~PMPS GO~~ Standard Drawings and Specifications;

r) The following are the Uniformity Ratio:

1) Maximum to minimum: 4:1 or better;

2) Average to minimum: 3:1 or better;

s) Where lighting is of a complex or unique nature or if required by GO, the Consultant shall engage the services of a qualified Illumination Designer;

t) Design photometric digital file in PDF or DWG format, complete with printouts using recognized computer lighting design software, shall be provided for GO review of design illumination levels. These photometric files shall be included in the As-built drawings.

u) Lighting Design Requirements

~~5.2.26.4~~5.2.27.4

Pole design shall adhere to the Metrolinx standard lighting drawing for poles (3, 6, 12 and 30 meter) unless instructed otherwise by Metrolinx.

~~5.2.26.5~~5.2.27.5

Bus Loops lighting requirements:

a) General illumination for bus platform shall be provided by a line of full cut-off single-headed downlights on lampposts aligned with the back of bus shelters;

b) Lamppost height shall be kept to a minimum, based on site layout and context. Refer to Figure 19;

5.2.31.11.15.2.32.11.1 The high resistance grounding system shall limit the ground fault through the transformer neutral. The equipment will be located indoors in a climate-controlled building. The resistor shall be stainless steel edge wound type. The resistor shall be provided with taps for the adjustment of ground current magnitude in several steps.

5.2.31.11.25.2.32.11.2 Meter relay with auxiliary contacts shall sense voltage across the grounding resistor and initiate remote annunciation of a ground fault condition. The resistor to include appropriate taps to limits the ground current flow between 0.9 to 5.0 Amperes for 600V.

Service, Communications and Hub Room Grounding

5.2.31.12.15.2.32.12.1 The Communications rooms and Hub rooms shall form a Dedicated Ground Zone (DGZ).

5.2.31.12.25.2.32.12.2 All communications equipment in the Communications and Hub Room shall be electrically insulated from the building structure.

5.2.31.12.35.2.32.12.3 A single point grounding method shall be employed in grounding the communications equipment.

5.2.32.12.4 The access doorframe and door to the communication room shall be grounded using the same grounding method and loop as the Communications and Hub Room.

5.2.31.12.45.2.32.12.5 Refer to section 5.2.323.6 Power, Grounding of Electrical and Communications Rooms, and Fixed Machinery for additional grounding requirements.

5.2.325.2.33 Lightning Protection

5.2.32.15.2.33.1 Lightning protection system is designed to protect structures from damage due to lightning strikes by intercepting such strikes and safely passing their extremely high voltage and current to “ground.” Such system shall be installed were there are no surrounding structures that would provide a cone of protection.

5.2.32.25.2.33.2 Lightning protection systems shall include a network of lightning rods, metal conductor, and ground electrodes, designed to provide a low resistant path to ground for potential strikes.

5.2.33.15.2.34.1
5.2.335.2.34 Identification

5.2.33.25.2.34.2 Label and identify all wiring, equipment, instruments, control and electrical devices etc. to indicate duty, nomenclature identification number, service/function, to the satisfaction of GO. Identifications shall be in English. Alternative methods of labelling may be submitted for approval.

For information on Identification and nomenclature to be used refer to Metrolinx Electrical Identification and Nomenclature Specification.

5.3 Communications

5.3.1 The Communications Infrastructure design shall provide a method and means to deliver forward facing infrastructure that prioritizes security, redundancy and scalability. Physical and networked strategies are used to increase security. Redundancy is accomplished through digital and analogue connectivity architecture with the ability to facilitate ease of growth for the next generation of Metrolinx communication systems.

~~5.3.1 Communications design is meant to be a proactive, preventive approach to security through the identification and development of strategies that minimize potential threats and vulnerability to employees and customers, protects company assets from theft, abuse, and vandalism, and reduces unnecessary damage or waste.~~

5.3.2 The level of design and installation at each station, facility, or wayside layover will depend upon the unique conditions of each site and in accordance with GO Metrolinx corporate policy. Monitoring and recording requirements will be determined by the stakeholders.

5.3.3 This Section outlines the design requirements for Communications of GO Transit fixed facilities in terms of the following subjects:

a) Close Circuit Television (CCTV);
b) Public Address System (PA);
c) Innovation and Information Technology (I&IT);
d) Telephone Network;
e) ~~Security~~ Access Control and Intrusion Detection System~~SystemAccess Control~~;
f) Fare Handling Systems;
g) Service Counter Talk Thru Systems;
h) Building Automation Systems;
i) Radio.

5.3.4 Closed Circuit Television (CCTV)

5.3.4.1 Closed Circuit Television (CCTV) systems provide a method to remotely monitor and assess areas identified either as secure, public, or controlled access. GO utilizes Closed Circuit Television systems at stations, terminals, and other locations to monitor train, bus arrivals, and departures, observe customer flow, and to conduct surveillance related to the protection of its corporate assets.

5.3.4.2 The level of CCTV system design and installation at each station or facility depends upon the unique conditions of each site and in accordance with GO corporate needs. Monitoring and recording requirements are determined by the stakeholders.

5.3.4.3 All the CCTV cameras at various GO locations can be viewed by the following user groups:

a) Rail Operations and Bus Operations;
b) Station Services;
c) ~~GO Transit Safety~~Customer Protection Services;
~~c)~~d) ~~Corporate Security~~Metrolinx Security Personnel.

5.3.4.4 The CCTV systems are divided into two significant groups, Operational systems, and Access Control and Intrusion Detection Systems ~~Security Systems~~. Coordination with Lighting and Signage System installation:

a) For new facilities, Lighting and Video Systems shall be designed concurrently;
b) For existing facility that already have lighting, the Video System must be designed to work with the existing lighting or upgrades may be needed for the existing lighting, privacy concerns of viewing and recording video images, work rule concerns of viewing and recording video images, and/or legal implications of video surveillance.

The corporate standard system for archiving recorded video must be used. This includes, but it is not limited to, the following factors:

a) Legal requirements;
b) Secure and controlled storage area.

5.3.4.5 Design Plans shall comprise of:

a) CCTV Block Diagram, line and riser diagrams;
b) CCTV coverage zones and locations;
c) Power support for systems, including Emergency and UPS power;

5.3.4.6
d) Communication support for systems;
e) Temperature control for systems.

Operational ~~system~~System

5.3.4.7.1 This system supplies operational assistance to various GO Transit departments by providing and recording real time images.

5.3.4.7

~~Security system~~ Access Control and Intrusion Detection System~~System~~ Function

5.3.4.8 5.3.4.8.1 The CCTV system provides real time video feed and records images, used to deter unauthorized entry, assist in ongoing or live incident responses and provide a record of events for Metrolinx Security Personnel~~Corporate Security~~ investigations. ~~This system also provides and records images in real time, and it is used to deter the entry of unauthorized personnel, and provide record for System Safety investigations.~~

5.3.4.8.2 The video information derived from the cameras of the Operational, ~~and~~ Access Control and Intrusion Detection Systems ~~Security systems~~ are recorded on local servers.

5.3.4.8.3 The CCTV system shall have a minimum 72 hour recording cycle.

5.3.4.8.4 Metrolinx Security Personnel ~~Corporate Security~~ will evaluate and direct retention cycles at each station or facility. Metrolinx standard is to provide 100% CCTV coverage by fixed cameras.

5.3.4.8.5 PTZ cameras are to be located to assist in ongoing or live investigational concerns and must be located in areas giving general overview of all GO properties.~~are strategically located in areas of ongoing concerns~~.

5.3.4.9

~~5.3.4.8.1~~5.3.4.8.6 All other areas that require CCTV coverage are to be designed with the Metrolinx project groups.~~records on a 72 hour cycle.~~

5.3.4.10 Local Monitoring

5.3.4.9.1 All cameras, including pan/tilt/zoom (PTZ) at each site are viewed locally on a dedicated video monitor and manipulated by means of a keyboard, mouse, and/or joystick.

Remote Monitoring

5.3.4.10.1 The systems are connected via GO Transit network, which allows remote and local access to all cameras on all systems. The current method of transmission of video images is operating on MPLS circuits and Metrolinx~~.~~ IT WAN Infrastructure. Various CCTV system viewing, and monitoring rights are granted through administrative privileges as set out by GO System Safety.

5.3.4.10.2 ~~IT WAN Infrastructure. Various CCTV system viewing and monitoring rights are granted through administrative privileges as set out by GO System Safety~~.

CCTV Head End System

5.3.4.11.1 The CCTV Head End System is located in the Main Communications Room of each Metrolinx facility. Refer to the I&IT Station Telecommunication~~s~~ and ~~Electronic~~ Systems ~~document~~ Standards for detailed specifications.

5.3.4.11 Components

5.3.4.12.1 The equipment required for either the Operational or the Security CCTV system generally includes, but is not limited to the following:

5.3.4.12

a) Colour Monitors–24” or 32” display monitor inside station service area, 32” or 50” at Transit Safety Dispatch, wall or ceiling mounted each site is dependent on local requirements and conditions;
b) This will include all hardware required for the installation;
c) Outdoor grade platform monitors to assist CSA to ensure doorways are clear of passengers;
d) CSA screens are ~~Typically~~ typically used on curved platforms with obscured vision and installed on mini-platform on dedicated 3.0 m pole;
e) Cameras–Fixed or Pan/Tilt/Zoom, refer to Metrolinx I&IT Telecommunication and System Standards for details on approved camera specifications and models~~high sensitivity (0.08fc) and other new technology compatible and approved with the corporate standard system~~;
f) Camera Housings–weatherproof (outdoor), moisture and dust-proof, maintain the ambient temperature within the housing in the camera operating temperature range of ~~–10~~-40°C to +50°C. All cameras in ~~non-conditioned~~damp, wet, and outdoor spaces shall have heaters and ventilation capabilities to reduce moisture and condensation and mitigate excessive heating;
g) A sunscreen is fitted to protect the camera from direct sunlight;
h) Indoor housings are either high impact polycarbonate or epoxy coated steel, dust-proof, with top mount assembly, suitable for cameras with fixed focal length and shall include a smoked dome cover.~~;~~

5.3.4.13

i) Lenses–Fixed with auto-Iris. Aspherical lenses are used on platforms to suit lighting conditions.

Design/Installation Criteria

5.3.4.~~14~~13.1 CCTV system implementation is part of the overall facility design. The level of design and installation at each station, facility, or wayside layover will depend upon the unique conditions of each site and in accordance with GO corporate needs. Monitoring and recording requirements will be determined by the user groups.

Data and Power Transmission

5.3.4.14.1 Must be included in the overall system wiring and power design, and includes the following:

a) Cable Systems (wire and fiber optic);
   1) CAT6A F/FTP~~Twisted Pair~~;
   2) Coaxial Cable (for existing analog cameras only);

3) Fiber Optic ~~- preferred medium of data transmission~~ (Single Mode Fiber).

b) Transmission Architecture;

1) Metrolinx Network.

~~c) Transmission Distance;~~

~~1) Repeaters;~~

~~2) Signal Boosters;~~

~~3) Equalization.~~

~~d) Environmental;~~

~~1) Temperature extremes (high and low);~~

~~2) Weather (rain, snow, icing, flooding, etc.);~~

~~3) Physical (topographic conditions);~~

~~4) Lightning and Transients (electrical grounding).~~

Installation: CCTV Cabling Requirements:

5.3.4.15

a) All cables shall be run in a neat and orderly fashion in a conduit system;

b) CCTV cables shall be designated at both ends as per design requirements provided in Metrolinx Specification 26 05 21 Electrical Conductors and Cables~~Section 0: Electrical~~;

c) All cables that run from cameras to terminating equipment shall be single length (splices in these cables are not allowed);

d) Sufficient slack (minimum 1.0 m) shall be left in case it is necessary to re-terminate the cable, and cables shall be coiled and concealed from view;

e) Emergency power–all systems and components shall be powered via a single source from the emergency power panel within the communication room;

~~e)~~f) PoE extenders are not permitted.

5.3.4.16

CCTV Conduit~~s~~ Requirements:

a) Conduits shall be designated with “CCTV” at terminating ends, and CCTV conduits shall not be shared with any other system;

b) Wiring shall be run in conduit. Cables located in ~~non-conditioned~~damp, wet, and outdoor spaces shall be run in epoxy coated rigid galvanized steel (RGSEC); Cables located in ~~conditioned~~dry, indoor, HVAC controlled spaces shall be installed in RGS. The use of flex conduit greater than 1 m is not allowed. The use of EMT is not allowed. ~~Outdoor cable shall be run in epoxy coated rigid galvanized steel; indoor cable may be R.G.S. or E.M.T. depending on the location~~;

5.3.4.17

c) All underground ~~buried~~ conduits shall be rigid PVC;

d) Conduit breaks prior to entry in to a building shall be incorporated in the design. ~~-~~ For detailed design~~,~~ requirements refer to Metrolinx Standard Specification 26 05 34 Raceway for Electrical Systems;~~Section 0: Electrical~~.

Connections Requirements:

a) All copper connections shall be copper-to-copper compression type with insulating covers.

b) Poles with cameras shall have one-meter slack cable in raceway.

c) Fish cord in all CCTV raceways shall be installed for future use.

d) Splices are not allowed.

Hand Wells Requirements:

a) Dedicated hand wells, located away from doors and main traffic areas, shall be provided for CCTV, separate from power.

b) Where installed in public areas, all enclosures, cover-plates, outlet plates, access panels, and hand wells shall be provided with keyed temper-proof hardware.

5.3.4.18 c) Drainage shall be considered for all hand wells.

CCTV Camera Placement

5.3.4.19.1 Placement shall include the following considerations:

a) Mount cameras at 6 m height to prevent damage and provide good field of view;

5.3.4.19 b) 6 m dedicated poles are to be used for normal mounting;

c) ~~If higher installation is required, f~~Firm mounting masts shall be used to prevent motion;

d) Utilize and include existing physical characteristics and infrastructure using CPTED principles;

e) Civil structures–roads, building, windows, important rooms, etc. existing barriers and fencing, terrain and ground contours;

f) Use of lens, zoom, and terrain conditions when setting and selecting camera locations;

g) Be aware of rising and setting sun when setting camera alignment to avoid the flare and blinding effects on the camera;

~~g)~~h) Fish eye lenses for 180° or 360° views are not allowed. Multiple cameras shall be used.

~~h)~~i) Mount cameras inside secure areas and provide tamper protection assume all cameras are subject to tamper;

~~i)~~j) Outdoor, cold, hazardous conditions, etc. ~~-~~Provide appropriate camera housings for worst-case environmental conditions. Heating and ventilation shall be provided for all ~~non-conditioned~~damp, wet, and outdoor spaces;

~~j)~~k) Existing lighting; existing power; existing data and communication networks;

~~k)~~l) Existing environmental controls;

~~l)~~m) Impact considerations on neighbouring properties;

~~m)~~n) At a minimum, an illumination of 2 foot-candles throughout assessment area shall be maintained.

5.3.4.19.2 Table CCTV Coverage Type (Image Quality) provides image resolution for CCTV Camera Placement Tables below 50 thru 55.

Table 50: CCTV Coverage Type (Image Quality)

Requirement	Pixels / Meter
Identification	250
Recognition	125
Monitor	75

Table 51: CCTV Camera Placement - Parking

Parking Lots – At GO Stations				
Area	***Fixed***	***PTZ***	***Coverage Type (Image Quality)***	***Comment***
Entrances ~~To~~ to Specific Lots	X		Identify	Identify driver and plate
Exits from Specific Lots	X		Identify	Read plate, monitor traffic flow
General Area Coverage	X		Monitor	Provide coverage, aid in investigation, customer security, deter crime. General coverage shall be provided through the use of multiple strategically placed cameras on dedicated poles for each lot area. The goal is to achieve 100% coverage if possible.
Main Entry drive Feeding to Multiple Lots	X		Identify	Capture plate number, driver identification, monitor traffic flow.
Main Exit Leaving	X		Identify	Read plate, monitor traffic flow, aid in investigations
Immediate Area		X	Monitor	Pan Tilt Zoom (PTZ) cameras within or adjacent to lot in order to facilitate operational needs / safety inquiries / security investigations / incident response / etc. Positioning shall be in a manner that a PTZ camera is able to zoom in and view any immediate area. Multiple strategically located PTZ cameras through the parking lot perimeter areas shall be coordinated to allow viewing of all parking lots for the entire station during investigation only. PTZ cameras shall not be considered as part of the typical coverage areas under surveillance.
Parking Lots - At GO Facilities - Park and Ride				
Entrances ~~To~~ to Specific Lots	X		Identify	Identify driver and plate
Exits from Specific Lots	X		Identify	Read plate, monitor traffic flow

General Area Coverage	X	X	Monitor	Provide coverage, aid in investigation, customer security, deter crime. PTZ cameras on as-needed basis. Higher crime rates will dictate the usage of additional cameras.
Bike Shelters	X		Recognize	Monitor and recognize all who enter the shelter providing investigational information, customer reassurance
Parking Structures				
Area	***Fixed***	***PTZ***	***Coverage Type (Image Quality)***	***Comment***
Entrances ~~To~~ to Structure	X		Identify	Identify driver and plate dedicated to entry lane.
Exits from structure	X		Identify	Read plate, monitor traffic flow. Dedicated to exit lane
General Area Coverage	X		Monitor	Provide coverage, aid in investigation, customer security, deter crime. Each drive and parking lane shall have at least one dedicated camera at each end looking in to provide a more complete coverage area.
Pedestrian Entry	X		Identify	Identify all who enter through a controlled entry point.
Pedestrian Exit	X		Identify	Identify everyone who exits through a controlled entry point.
Stairs	X		Monitor	From top looking down maximum view, use 2 cameras ~~if~~ with U-shaped stairs to view the entire length of the stairs. The i~~.~~ ~~I~~ntent is to aid in customer claims of slip and fall, decrease likelihood of vagrancy, vandalism and violence.
Stair Vestibules	X		Monitor	Coverage of the entire vestibule to promote safety and for investigational purposes.
~~Elevators~~Elevator Interior	X		Recognize	Passenger security, investigation purposes, emergency situations, confined space monitoring. Dedicated inside elevator viewing maximum area with emphasis on the emergency call button.

Elevator ~~Vestibules~~Door	X		Monitor	Dedicated to view vestibule outside elevator~~,~~ ~~viewing 2 -way call for assistance button~~ and ability to view maximum area inside the elevator. When multiple elevators exist side by side it may be necessary to share coverage with 2 cameras
Elevator Lobby/Waiting Area	X		Monitor	Dedicated to view vestibule outside elevator, viewing 2-way call for assistance button and ability to view entire waiting area. If required, more than 1 camera shall be used to achieve as close to 100% coverage as possible.
Service Rooms	X		Monitor	Monitor door - can share camera with other service rooms if sharing a common entry area.
Perimeter	X	X	Monitor	Strategically place fixed cameras on each side monitoring entire exterior perimeter walls. One PTZ to monitor and investigate on each side of perimeter.
2 Way Call devices	X		Recognize	Each 2 way call device shall have a dedicated fixed camera monitoring the device.
General NOTE: 1		X	Monitor	Each parking level drive lane shall have PTZ camera capable of viewing immediate floor level for investigation, monitoring. More than one PTZ is required to facilitate coverage of structures with multiple drive lanes. PTZ camera shall not be used in place of fixed monitoring
General NOTE: 2		X	Monitor	One on each exterior side of structure to monitor general area, provide live monitoring, and aid in investigation. If obstructions such as stairs are hindering view, then a second camera shall be dedicated to facilitate complete coverage.

Table 52: CCTV Camera Placement – Stations Exterior and Interior

Station Interior				
Stairs / Escalator	X		Monitor	From top looking down - maximum view if long stairs use 2 cameras.
Stair Vestibules	X		Monitor	Dedicated camera to cover vestibules not covered by stair cameras
Elevators Cab Interior	X		Recognize	Passenger security, investigation purposes, emergency situation, confined space monitoring. Dedicated inside elevator viewing - maximum area with emphasis on the emergency call button.
Elevator ~~Vestibules~~Door	X		Monitor	Dedicated to view vestibule outside elevator~~,~~ ~~viewing 2-way call for assistance button~~ and ability to view maximum area inside the elevator. When multiple elevators exist side by side it may be necessary to share coverage with 2 cameras.
Elevator Lobby/Waiting Area	X		Monitor	Dedicated to view vestibule outside elevator, viewing 2-way call for assistance button and ability to view entire waiting area. Possibly more than one camera shall be used to achieve as close to 100% as possible.
Station Lobby	X	X	Monitor	Coverage of entire lobby with fixed camera, 1 PTZ for live monitoring and investigation centrally located.
Station Entry Points (pedestrian)	X		Identify	Identify any person who enters through any controlled entry point (pedestrian entry points).
Station Exit Points	X		Identify	Identify everyone who exits through a controlled entry point.
Customer Service Desk Interior	X		Identify	Fixed dedicated camera for each service counter attendant, camera placed to view customer face over the shoulder of service attendant. Provide fixed camera dedicated to view door entry to customer service area (from inside area)
Customer Service Desk Exterior	X		Monitor	Camera shall view the side of the service counter, providing a profile view of anyone at service counter.

Rail Platforms				
Area	***Fixed***	***PTZ***	***Coverage Type (Image Quality)***	***Comment***
Service Rooms	X		Monitor	Monitor door - can share camera with other service rooms if on same side of building
Stairs / Escalator	X		Monitor	From top looking down maximum view, if long stairs use 2 cameras to view the entire length.
Stair Vestibules	X		Monitor	Dedicated camera to cover vestibules not covered by stair cameras
Elevators	X		Recognize	Dedicated to view ~~interior elevator~~elevator cab interior, viewing 2-way emergency call for assistance button.
Elevator Vestibules	X		Monitor	Dedicated to view vestibule outside elevator, viewing 2-way call for assistance button and ability to view maximum area inside the elevator.
Elevator Lobby/Waiting Area	X		Monitor	Dedicated to view vestibule outside elevator, viewing 2-way call for assistance button and ability to view entire waiting area. Possibly more than one camera shall be used to achieve as close to 100% as possible.
Platform Ends Both -Rail operations		X		Looking down track to monitor rail traffic and switches (Operational)
Platform Ends Both - Platform Monitoring	X		Monitor	Monitoring platform, looking in towards customer waiting areas on platform.
Mini Platform	X		Identify	Coverage from both sides, capture 2-way call button.
General Platform Area	X		Monitor	Coverage with fixed cameras 100%.
Platform Shelters	X		Recognize	Interior. Dedicated fixed cameras.

Elevator Vestibules	X		Monitor	Dedicated to view inside the elevator as much as possible and view the vestibule outside elevator, viewing 2-way call for assistance button and ability to view entire waiting area. Possibly more than one camera shall be used to achieve as close to 100% as possible.
Service Rooms	X		Monitor	Monitor door - can share camera with other service rooms if on same side of building
Loading Docks	X	X	Monitor	Coverage of entire loading dock, monitor any access control, point from loading dock to building
Loading Dock Man Door	X			Coverage of 2-way call device for access to building.
Bus Routes Internal	X		Monitor	General coverage
Bus Routes External	X		Monitor	General coverage
Bus Parking, Internal and External	X		Monitor	General coverage
Fueling/Fuel Storage	X	X	Monitor and Recognize	Dedicated 100% coverage by Fixed type camera, one additional PTZ camera for area overview and live incident monitoring
Service Roads To/From Fueling and Fuel Storage Areas	X		Monitor	Dedicated 100% coverage by Fixed type cameras
Supplementary Coverage		X		PTZ camera(s) installed at locations which will provide direct line of sight to areas such as parking lot, gates, building entrances / exits, property perimeter.
Rail – Maintenance and Storage Facility/Layover				
Area	***Fixed***	***PTZ***	***Coverage Type (Image Quality)***	***Comment***
Vehicle Gate (“main gate”)	X	X	Recognize	Dedicated camera for vehicles, facial and plate recognition. 1 PTZ for investigation, live monitoring.

Pedestrian Gate (“man gate”)	X	X	Recognize	Dedicated camera for pedestrian gate, facial recognition at control point. 1 PTZ for investigation, live monitoring. Note: If vehicular gate and pedestrian gate have sufficient proximity, 1 PTZ may be used for both.
Car Parking, Employees	X		Monitor	100% General coverage including coverage for Metrolinx support/service vehicles. Supplementary PTZ as required in the general area for live investigation.
Car Parking, Guests	X		Monitor	100% General coverage. Supplementary PTZ as required in the general area for live investigation.
Building Exterior	X		Monitor	View of entire sides, No hiding spots, bind spots. If obstruction exists add camera.
Building Entry Points - Vehicles	X		Recognize	Identify driver and plate
Building Entry Points - Pedestrian	X		Recognize	All pedestrian entrances shall have dedicated cameras
Area	***Fixed***	***PTZ***	***Coverage Type (Image Quality)***	***Comment***
Property Perimeter	X	X	Monitor	Strategically place Fixed cameras monitoring entire perimeter 100%. One PTZ to monitor and investigate on each side of perimeter. 100% coverage using fixed cameras at each train entrance into a rail maintenance or layover yard, leading to its rest position. PTZ cameras shall be strategically located for ongoing investigations.
Service Rooms	X		Monitor	Monitor door - can share camera with other service rooms if on same side of building
Lost & Found	X		Recognize	Entry to Lost and Found room and/or closet

Loading Docks	X	X	Monitor	Coverage of entire loading dock inside and out; monitor any access control point from loading dock to building. Camera(s) installed at locations which will provide monitoring of offloading areas (Sand, Fuel, DEF, Toilet servicing chemicals, holding tanks, etc..)
Loading Areas & Doors	X		Recognize	Coverage of 2-way call device for access to building. Note: All 2-way call devices at doors shall have coverage.
Fueling/Fuel Storage Areas	X	X	Monitor	Dedicated fixed coverage of the entire area with 1 PTZ camera for general overview and incident monitoring. The views must be completely unobstructed at the point of fueling/refueling and fuel storage area(s).
Roads Leading to Fueling/Fuel Storage Areas	X		Monitor	If not already covered by other dedicated site CCTV cameras, provide dedicated, unobstructed, fixed camera coverage of the entire area
Rail Equipment	X	X	Recognize	Monitor length of parked train at each end looking in. One PTZ central location to monitor Rail movement between tracks Fixed camera to monitor wayside power cabinets as well as the connection point to the trains.
Equipment	X		Recognize	Fixed cameras to monitor the entire area around major pieces of shop equipment including but not limited to: - drop tables, - car & body hoist systems, - wheel truing machines Note: Additional critical shop equipment to be identified by the applicable business unit during the planning stages of a project

Area	*Fixed*	*PTZ*	*Coverage Type (Image Quality)*	*Comment*
Supplementary Coverage		X	Monitor	PTZ camera(s) installed at locations which will provide direct line of sight to areas such as parking lot, gates, building entrances / exits, property perimeter. ~~High mast~~ PTZ to be used to supplement 100% fixed camera coverage for investigative purposes. Locations to be coordinated with Metrolinx Security Personnel~~corporate security~~ and operational business unit. Note: pole placement shall not interfere w/ operations.
Wash Equipment Rooms	X		Recognize	Provide 100% coverage using fixed cameras
Warehouse / Forklift areas	X		Monitor	Fixed cameras to monitor forklift activities throughout stores and along travel paths.
Wash bays	X		Recognize	Provide 100% coverage dedicated to the wash process, using fixed cameras
Maintenance Bays	X		Monitor	Fixed cameras to monitor all rolling stock movements into or exiting the maintenance bays. 100% coverage via fixed cameras. Interior and exterior as required.
Progressive Maintenance Bays	X	X	Monitor	Fixed cameras to monitor: Derails & blue flags outside of the maintenance bays, Fixed cameras to monitor train consist, entry into the building, Fixed camera coverage (100%) to monitor activities for the full length of the PM facility. PTZ placed in a supplemental fashion for investigation purposes.
Rail Maintenance Facilities	X	X	TBD	Additional coverage shall be provided according to requirements identified by Metrolinx during asset/infrastructure design
Note: Site specific CCTV requirements will be identified and incorporated for each project during the design stage.				

5.3.5 Public Address System

Public Address Systems (PA) are provided at bus terminals and rail stations for direct communication to passengers. These systems are used by Station Operations and Rail Operations and predominantly include rail and bus platforms, bus loops, passenger waiting areas, tunnels/stairways, and shelters. ~~Announcements are made from a wall-mounted touch-tone DTMF paging phone located in the Station Service Area. This phone is compatible with the zone selection equipment in the Communication Control enclosure.~~

5.3.5.1 Coverage–Local

5.3.5.2.1 A system of speakers divided into zones enable announcements from the service counter throughout the station or to specific areas, e.g., tunnels or platforms. Under normal working conditions, pages are made using the all call feature to all areas.

5.3.5.2 Remote

5.3.5.3.1 Rail Station PA Systems can be accessed through existing VOIP interface to enable announcements to be made by Rail Operations at Union Station. This allows GO Operations personnel to access rail stations PA systems to make announcements.

5.3.5.3

Paging

5.3.5.4 5.3.5.4.1 Paging is presently conducted manually throughout the Rail System PA Network. The PA system is designed to utilize a IP-based infrastructure for both live and pre-recorded announcements at all bus and rail locations from a central control location. ~~However, both Union Bus and Rail Stations have the capability of automatically making pre-recorded announcements. An IP Ethernet link between these stations also allows access to either system. Replacement or new systems at bus and rail stations will contain provision for connection for any future system wide IP network~~.

5.3.5.5 References

5.3.5.5.1 The design and installation of the PA System will comply with the following:

a) Innovation & Information Technology Telecommunication~~s~~ & Systems ~~Document~~Standards;

5.3.5.6 b) Universal Design Standard.

Controller

5.3.5.7 5.3.5.6.1 The controller provides, through a system processor, audio input to the various groups of speakers, referred to as zones. ~~This is accomplished by means of Zone Drivers and Zone Relay Cards. It also interfaces with the Red and Local Paging Phones~~

Dual Tone Multi Frequency (DTMF) Existing Systems

5.3.5.8 5.3.5.7.1 If required by GO Transit to phase out, disconnect, and remove an existing system, the Consultant shall specify that the Contractor turn over all removed and unused equipment to GO Transit. The process of phasing in the new system shall not cause any undue disruption to the services of the existing system.

System Requirements

5.3.5.8.1 The PA System generally consists of zone-grouped speakers strategically located in or at GO Transit facilities, buildings, tunnels, stairwell entrances, elevator vestibules, rail platforms, PUDO Areas, and Bus Loops, and a System Controller located in the Communications Room of the facility.

5.3.5.8.2 For Station and Terminal Facilities - The System shall accept local inputs from local phones and DTMF paging phone in the Service Area and a remote input from GO Transit ~~'RED' phone system (Bell Canada SST System)~~.

Emergency Power

5.3.5.9.1 PA System equipment and auxiliary equipment shall be supplied from the emergency power panel located inside the station communication room.

5.3.5.9

Prioritized Paging

5.3.5.10.1 The PA system shall be user configurable to provide prioritized paging announcements when announcements are generated simultaneously from different inputs. Initial configuration shall establish to the following priority level:

5.3.5.10

a) Highest Priority - GO Operations ~~'Red' Phone, Local 'Red' Phone~~;

b) Lowest Priority Requirements:

1) Other Paging telephones including Service Area;

~~2) The system shall provide for a separate 600 ohm audio input whose priority access level in the system is also user configurable;~~

~~3) The PA system shall interface with a maximum of seven and minimum of four PA paging phone inputs and up to three 600 ohm audio circuits. All three audio inputs shall provide independent audio adjustment of the incoming signal. A common audio adjustment shall also be provided for the PA paging phone inputs. Signal levels for the local paging and remote paging shall be separate inputs requiring individual adjustments. The equipment provided shall be capable of adjusting all audio inputs over a range of -30db to +6db;~~

~~4) A solid state controller shall provide the switching and signaling required for priority calls, selective zone paging, zone "group" paging, all call, background music mute, paging alert tones and emergency override;~~

~~5) On site user configurable, prioritized paging access for audio inputs shall be provided. The PA system shall interface with the GO Transit 'RED' phone system to allow both 'RED' phone paging from Union Station and local 'RED' phone paging from the service counter. The local 'RED' phone paging facility shall automatically provide service counter paging speaker override whenever the local 'RED' phone system is used.~~

5.3.5.11

c) Group zone

1) Selection codes shall be configurable through the system configuration menu;

2) The operation of VOIP phone shall automatically select independent user- defined 'group' zones.

Audio Power, Coverage and Quality

5.3.5.11.1 The amplifier capacity of the system shall be determined by the number of speakers required to achieve the design criteria: three amplifiers minimum, as follows.

5.3.5.11.2 A minimum of two amplifiers shall be provided for the Platform area in order to maintain continuous system functionality. The amplifiers shall operate independently of each other. Each amplifier shall be powered from a chassis that is powered from a separate circuit.~~The first amplifier shall not be used to feed an audio signal to the second amplifier.~~

5.3.5.11.3 A third amplifier shall be provided to cover the PUDO area, Station building, tunnels, stairwell entrances, elevator vestibules, and if required, a third platform or bus platform.

5.3.5.11.4 The method of cable installation and speaker mounting on the rail platforms shall be arranged such that, not more than a 6dB drop shall be experienced whenever one ~~amplifier~~ chassis fails.

5.3.5.11.5 Platform speakers shall be arranged in such a way as to maintain 50% coverage on each platform upon failure of a ~~single amplifier~~PA chassis.

5.3.5.11.6 For all areas, which require coverage, the PA system shall maintain a uniformly distributed sound pressure level measured at 1.5 m above floor level. The minimum sound pressure level at station platforms shall be 10dB above the measured ambient noise level to a maximum of 82dBA at day

5.3.5.11.7 Time hours and a maximum of 76 dBA at night time hours. The speech quality of the system shall be high and messages shall be clean and intelligible. There shall be no unwanted noise or spurious audio signals (20dB or less) emanating from the system.

5.3.5.11.8 A real time clock shall be used to provide the timing signals for volume adjustment. The real time clock shall run continuously even when power is removed and it shall maintain full date and time with automatic spring and fall Canadian daylight-saving time adjustments.

5.3.5.11.9 The PA system shall be designed to minimize unwanted noise at nearby residences in compliance with applicable noise control bylaws, shall these be less than the maximum values specified above, without however, reducing the effectiveness as an emergency voice communication system.

5.3.5.12 Components

5.3.5.12.1 PA System Controller Rack

~~5.3.5.12.1.1~~ Refer to Metrolinx I&IT Telecommunication and Systems Standards for rack type.~~The PA System Controller shall be housed in a clear width 483mm (19") 35U rack enclosure having external dimensions of (559mm W X 635mm D X 1,500mm H) (22"W x 25"D x approx. 60" H)~~

5.3.5.12.2 Quick Disconnect Terminal Requirements:

a) All speaker cabling entering the communication enclosure shall be individually connected to a “quick” disconnect terminal

b) The quick disconnect facility shall allow individual outgoing zone cables to be quickly disconnected from the controller without the use of a screwdriver

c) The rail shall be marked to identify each respective zone/cable and incoming cables shall be tie-wrapped to rigid internal cable bars to prevent undue movement

d) The termination rail also provides individual earth (ground) terminals to allow the screen of each zone cable to be grounded

e) A laminated termination rail diagram, in addition to a control riser and/or single line block diagram shall be mounted on the inside of the rear door and a copy of such drawings shall also be included in the system manual.

Surge Protection

5.3.5.13.1 An independent transient voltage suppression and surge protection device shall be provided meeting UL 1449 TVSS rating power source located at the bottom of the enclosure. All required control system power supplies shall be installed on a "quick disconnect" DIN rail. All public address components shall be fed from a UPS panel. Provide redundant UPS power circuit to racks.

5.3.5.13

Limiter Circuits

5.3.5.14.1 The enclosure shall incorporate all the required driver assemblies suitably wired to their respective control circuits and terminal rail connections.

5.3.5.14

Voltage Adjustment

5.3.5.15.1 The System Controller shall provide for automatic volume adjustment for configurable Day/Night time periods using an integrated real time clock in addition to automatic daylight saving time adjustment. The automatic volume adjustment shall be available for all input channels via the system controller.

5.3.5.15

PCB Cards (Printed Circuit Board Cards)

5.3.5.16

5.3.5.16.1 The System Controller shall include a 483mm (19") card frame shelf, with suitable backplate assembly to receive the following plug-in PCB cards:

a) Amplifier;
b) Processor Control card c/w Real Time Clock Chip;
c) Zone Switch Card;
d) Zone Switch;
e) Paging Phone Interface;
f) Zone Driver Cards (quantity as required);
g) Zone Relay Cards (quantity as required);
~~5.3.5.17~~ ~~h) Power Supply;~~
i) Back Plate.

Zone Cards

~~5.3.5.17.1 Each Zone Card shall provide independent audio level adjustment, all audio inputs shall have independent level control in order to adjust incoming signal~~

~~5.3.5.17.2 Any audio channel shall be capable of automatically being connected to any combination of zones for broadcast of PA messages~~

~~5.3.5.17.3 "Power On" and "Status" LED indicators shall be provided on the front panel of the Display Card in addition to a processor reset button. All system processor modules shall be interchangeable~~

~~5.3.5.17.4 All PA system components shall be protected by electrical current limiting and thermal overload devices.~~

Amplifiers

5.3.5.18.1 Amplifiers in the PA rack shall provide input for telephone and microphones

5.3.5.18.2 Amplifiers shall have automatic voice limiter circuit to compensate for varying voice levels and paging styles

5.3.5.18 5.3.5.18.3 Amplifiers shall include RFI filtering, input/output overload protection, and open short circuit protection

Speakers–Outdoor Pole-Mounted

5.3.5.19.1 Mounting Requirements:

5.3.5.19 a) Speakers shall be outdoor weatherproof types mounted on lighting poles in such a manner as to eliminate the necessity of drilling the lighting poles (by stainless steel banding) and to provide resistance to vandalism;

b) Speakers shall be resistant to the environment and provide for the direct entry of any connected PA cable;

c) Speakers shall use an NPT threaded gland entry with liquid tight cable gland and be coupled to the pole gland plate using liquid tight flexible conduit;

d) No exposed PA cable is allowed. Refer to GO Standard Electrical Drawings.

5.3.5.19.2 Height Requirement:

5.3.5.19.2.1 The mounting height for speakers on light standards shall be generally 4m above grade.

5.3.5.19.3 5.3.5.16.2 Audio Coverage Requirement

5.3.5.19.3.1 5.3.5.16.2.1 The number of speakers required to achieve the required audio coverage will depend on the location, the location's acoustic properties, background noise levels, the mounting height and the ability to meet the output levels as defined in the DRM. The distance between speakers and the number of speakers required to achieve the specified audio coverage will depend upon the station's inherent acoustic properties and the locations of the light standards and shelters on the platform.

5.3.5.19.4 5.3.5.16.3 Temperature Requirement:

5.3.5.19.4.1 5.3.5.16.3.1 The operating temperature shall be between -30 ºC to 70 ºC

5.3.5.19.5 Features Requirements:

5.3.5.20 a) Line voltage 70V and maximum wattage 15W RMS continuous;

b) Full adjustment in both the vertical and horizontal plane;

c) Speaker Format shall be dual cone phenolic impregnated resin manufactured with 70V multi tap transformer and a sealed back for extra protection and audibility.

Speakers–Indoor

5.3.5.20.1 Surface and Recessed Types Requirements:

a) Speakers shall be dual cone, treated paper design with a built in 70V multi tap transformer;

b) A steel baffle or suspended ceiling tile support bridge and back box shall be provided for either flush or surface mounting applications to suit the location;

c) The speaker's back box shall be supported independently of the grid in a ceiling tile application;

d) The finish shall match location colour or as required by GO Transit;

e) Speakers in public areas shall be flush mounted or camouflaged whenever possible;

f) The Consultant shall co-ordinate flush or surface mounted locations with the architect.

5.3.5.20.2 Volume Control in Waiting Areas

5.3.5.20.2.1 Flush mounted speakers shall incorporate an integral volume control accessible from the front baffle plate that shall provide attenuation of 20 dBA at any wattage tap.

5.3.5.20.3 Temperature

5.3.5.20.3.1 Operating temperature range shall be within 0°C to 50°C.

5.3.5.20.4 Features

5.3.5.20.4.1 Line voltage 70V and maximum wattage 10W RMS continuous

Speakers–Shelter and Tunnel

5.3.5.21.1 5.3.5.17.1 Housing

5.3.5.21.1.1 5.3.5.17.1.1 Speakers shall have a vandal resistant diecast housing complete with stainless steel tamper-resistant "TORX" screws to prevent unauthorized access (Phillips or Robertson screws are not acceptable).

5.3.5.21.2 5.3.5.17.2 Output and Power

5.3.5.21.2.1 5.3.5.17.2.1 Speakers shall be designed for maximum output at a minimum power loss and shall be installed in accordance with manufacturer's recommendations.

5.3.5.21.3 5.3.5.17.3 Format Requirements:

a) Speakers shall be sealed dual cone construction and manufactured of phenolic impregnated resin;

b) Speakers shall incorporate a sealed back for extra protection and audibility. They shall be white in colour or finished as required by GO Transit.

5.3.5.21.4 5.3.5.17.4 Brackets

5.3.5.21.4.1 5.3.5.17.4.1 When used in exposed areas or inside tunnels, a stainless steel speaker-mounting bracket must be used.

5.3.5.22 5.3.5.18 5.3.5.21.5 5.3.5.17.5 Features Requirements:

a) Line voltage 70V and maximum wattage 8W RMS continuous;

b) Operating temperature range of -30°C to +50°C.

Installation

5.3.5.22.1 5.3.5.18.1 PA Cabling Requirements:

a) All cables shall be run in a neat and orderly fashion in a conduit system;

b) PA cables shall be designated at both ends as per information supplied on tender;

c) All cables that run from speakers to terminating equipment shall be single length (splices in these cables are not allowed–that is: no splices in conduits or below grade);
d) Sufficient slack (1 meter) shall be left in case it is necessary to re-terminate the cable;
e) Emergency power–all systems and components shall be powered via a single source from the emergency power panel.

~~5.3.5.22.2~~5.3.5.18.2 PA Cabling Specifications Requirements:

a) AWG: 14;
b) Stranding: 41 x 30;
c) Conductor: TC, 2 conductors;
d) Insulation: 0.02" Polyolefin;
e) Capacitance: 30 pF/ft. (conductor to conductor);
f) 58 pf/ft. (1 cond. and other cond. connected to shield);
g) Shield: Delfoil Aluminum/Polyester;
h) Jacket: Blue or White Polyvinylchloride (depending on application);
i) Nom. Cable OD: 0.302";
j) Voltage: 600;
k) Temp: 80°C;
l) Weight: 56 lbs/mft;
m) CSA: AWM, CMG;
n) UL: CM;
o) Flame Test: FT4;
p) Application: 70V PA Speaker Applications.

~~5.3.5.22.3~~5.3.5.18.3 PA Conduit~~s~~ Requirements:

a) Conduits shall be designated with “PA” at terminating ends;
b) Wiring shall be run in conduit;
c) Refer to Sections: 5.2.10.2 Conduits and 5.3.4.16 Conduits Requirements~~Outdoor cable shall be run in epoxy coated galvanized rigid steel; indoor cable may be R.G.S. or E.M.T. depending on the location~~;
d) All underground conduits shall be Rigid PVC.

~~5.3.5.22.4~~5.3.5.18.4 Connections Requirements:

a) All speakers connected in a single zone shall be run in a single line configuration;
b) All splices or connections shall be copper-to-copper compression type with insulating covers;

5.3.6.1

c) Poles with speakers shall have one metre slack cable in raceway;
d) Fish cord in all PA raceways shall be installed for future use.

5.3.6 Telephone Network

The main telephone switch shall consist of trunk lines ~~supplied as either individual or T1 circuits~~ to allow for local and/or long distance calling. The network is to be capable of interfacing with 4-digit dialing as well as integrating with the voice mail system. In addition, analog lines are provided at all locations for redundancy and for emergency systems.

Telephone switches at remote sites such as Middlefield or Wolfdale shall be linked to the main switch at Head Office to permit 4-digit dialing between all sites.

All systems are to be provided with backup power supplies from Uninterruptible Power Sources at each location ~~and where available~~ by generator power.

5.3.6.2 The network shall be capable of permitting paging to be performed through the local telephone system at all stations.

5.3.6.3 Provision shall be made for local caller I.D., call hold, call waiting, transfer, and conferencing.

5.3.6.4 Individual telephones shall be speaker type, capable of accepting multiple lines and speed dialing.

5.3.6.5

5.3.6.6 Conduits and power for the telephone network shall be provided at each trunk switch location.

5.3.6.7

5.3.7 Talk-Thru System

The talk-thru system provides instant ~~2~~ two-way voice communication between the public and station attendants through the glass divider at the station service counter.

5.3.7.1

5.3.7.2 The talk-thru unit provides hands free and effective duplex communication between the station operator and the passengers. The voice switching function is automatically biased in the direction from the passenger to the operator. Noise cancelling and omnidirectional microphones will be mounted on the passenger and service attendant sides respectively, of the booth glass divider. Two rotary encoded controllers will be provided to adjust the volume of each microphone. The operator's boom microphone will automatically override the passenger microphone when activated. Provision will be made for inter speech pause time. Refer to I&IT Telecomunication and Systems Standards - Service counter point to point two way talk system requirements for further details. Components:

a) Microphone Override Pushbutton;
b) Power On/Off L.E.D. Switch;
c) Noise Cancelling Microphone;
d) Seller's Mike-Off Switch;
e) Wiring–Conduits and 120 volt A/C source power outlets for each voice link assembly.

~~5.3.8.1~~5.3.7.3 Refer to Metrolinx I&IT Telecommunication and Systems Standards – Service counter point to point two way talk system requirements for details.

~~5.3.8~~ Access Control and Intrusion Detection Systems ~~Security Systems~~

~~5.3.8.2~~5.3.7.4 Security at GO Transit Rail and Bus Stations is managed by integrated access control and alarm systems. These systems are supplied and installed, as well as monitored by Metrolinx Vendor of ~~Chubb~~ Access Control and Intrusion Detection Systems ~~Security Systems~~ on a 24-hour basis.

Access Control

~~5.3.8.2.1~~5.3.7.4.1 Entry into the station sets off the time-delay actuated intrusion alarm, which is disarmed by entering an accepted.

5.3.8.2.25.3.7.4.2 I.D. code in the system keypad- The alarm control panel will continue to monitor all connected functions except the intrusion alarm sensors. When the premises are exited, re-entering the accepted I.D. code will reactivate the intrusion alarm. Designated employees are provided with individual I.D. codes to permit access into the premises. Time and date are recorded at central monitoring stations at the East and West Region facilities.

Building Alarms

5.3.8.3.15.3.7.5.1 Actuation of any equipment failure or fire alarm devices will cause a digital signal to be transmitted to the Metrolinx Vendor of ~~Chubb~~ ~~Security~~ Access Control and Intruder Detection central alarm monitoring location, as well as the local keypad. Activation of a hold up pushbutton will cause a silent signal to be transmitted to the Metrolinx Vendor~~Chubb~~ central monitoring location, indicating where the alarm originated.

5.3.8.35.3.7.5

5.3.8.3.25.3.7.5.2 Stations and facilities operations personnel shall be consulted prior to final design.

Alarm Systems

5.3.8.4.15.3.7.6.1 Devices are strategically located throughout the buildings to detect and alarm the following conditions:

5.3.8.45.3.7.6

a) Intrusion;
b) Smoke;
c) Low Temperature;
d) High Temperature;
e) Hold Up (manually operated by the Station Attendant);
f) Sump Pump Failure;
g) Inverter and UPS Failure;
h) Low Voltage (station main power supply).

5.3.8.55.3.7.7

General Features

5.3.8.5.15.3.7.7.1 The complete station alarm system shall include, but not be limited to, the following components:

a) Metrolinx Vendor ~~Chubb~~ ~~AFX~~ Control Panel;
b) ~~AFX~~ User Interface;
~~b)~~c) Access control devices shall be open architecture;
~~c)~~d) Signal Transmitter and Receivers;
~~d)~~e) Audible Signal Device;
~~e)~~f) Hold-Up Alarm Buttons;
~~f)~~g) Intrusion Detectors, IR, PIR and ultrasonic;
~~g)~~h) Smoke Detection Devices;
~~h)~~i) Low and High Temperature Sensors;
~~i)~~j) Inverter System–Trouble and AC Output Sensors;
~~j)~~k) Smoke Detector By-Pass Switch;
~~k)~~l) Central Commercial Monitoring Services.

5.3.8.65.3.7.8

Alarm Monitoring Equipment

~~5.3.8.6.1~~5.3.7.8.1 ~~Chubb~~ Metrolinx Vendor ~~alarm~~ Alarm Control Panel - The system controls are housed in a surface wall-mounted EEMAC cabinet either with a hinged lockable door and gasket or a secured by screws for tamper protection. A tamper switch is included to provide an alarm in the case of tamper for the latter protection.

~~5.3.8.6.2~~5.3.7.8.2 The alarm control panel is microprocessor controlled for monitoring 8 to 128 zones including the following:

a) Fire alarm detection with smoke detectors;
b) Intrusion alarm with dual microwave and infrared motion detectors;
c) Hold up alarm from high collar pushbuttons;
d) AC power failure, voltage sensor relays;
e) Low station temperature alarm;
f) Inverter system–trouble and AC failure output sensors;
g) Alarm system trouble/low battery condition;
h) Annunciation time delay devices for voltage sensors and thermostats.

~~5.3.8.6.3~~5.3.7.8.3 System Test momentary contact push-buttons are provided to test the alarm control functions including alarm output and telephone transmission. A manual “System Reset” push-button is provided to reset each alarm function at the keypad after the initiation devices have been set. An “Alarm Signal Silence” push-button in the alarm control panel is provided at the keypad to silence the audible alarm signals. An 8,192 event memory is either retrievable on site or from a remote PC located at a central facility. The system shall be subdivided from 2 to 16 areas that can carry up to 4,000 programmable codes, with 50 levels of authority. The system shall have false alarm prevention zones. All zones to be displayed on a liquid crystal display.

~~5.3.8.7~~5.3.7.9 Power Supply

~~5.3.8.7.1~~5.3.7.9.1 A 12 volt DC power supply for all system supervision, control and alarm functions shall be provided in the alarm control panel as an integral part of the system, complete with sealed gel type batteries and solid state charging equipment through 120 volt, 1 phase, 60 Hz normal power supply and step down transformer.

~~5.3.8.7.2~~5.3.7.9.2 The battery capacity will be sufficient to operate supervisory conditions for a minimum of 12 hours, including audible alarm signals and auto-dialer and at the end of this period to energize all alarm devices simultaneously for a period of 5 minutes continuously.

~~5.3.8.7.3~~5.3.7.9.3 The automatic charger shall be capable of restoring 90% of dead battery capacity within 12 hours. Discharge protection shall be provided to disconnect the charger when the voltage drops below 60%. The system shall report locally on the display loss of power and battery failure.

~~5.3.8.8~~5.3.7.10

~~5.3.8.9~~5.3.7.11 Audible Signal Device

~~5.3.8.8.1~~5.3.7.10.1 The audible signal device shall be a vibrating horn with 110dB rating for intrusion and fire, operating at 12 volt DC.

User Interface

AC Failure Output Alarm Set

~~5.3.8.17.1~~5.3.7.19.1 No AC Output: This alarm shall trigger upon the absence of AC output for any reason.

Smoke Detector Bypass Switch

~~5.3.8.17.2 5.3.8.18.1~~5.3.7.20.1 A smoke detector bypass pushbutton switch, a double contact shunt switch, shall be provided to indicate to central monitoring that the detector is in the by-pass mode.

System Functional Performance

~~5.3.8.18~~5.3.7.20

~~5.3.8.19.1~~5.3.7.21.1 Actuation of any intrusion alarm-initiating device will cause the system local alarm panel to operate as follows:

~~5.3.8.19~~5.3.7.21

a) To transmit a signal, depending on the location and type of alarm, to a central alarm monitoring location and to annunciate on the local keypad;

b) An audible alarm signal in the station will sound continuously for 5 minutes and then be automatically silenced.

~~5.3.8.19.2~~5.3.7.21.2 Actuation of any fire alarm initiating devices will cause the system local panel to operate as follows:

a) To transmit a digital signal, depending on the location and type of alarm, to a central alarm monitoring location and to annunciate on the local keypad;

b) Actuation of a hold-up push-button will cause the alarm control panel to transmit a silent alarm to a central alarm monitoring location, identifying to the operator the station where the alarm originated and the type of alarm.

~~5.3.8.19.3~~5.3.7.21.3 Actuation of a thermostat for low temperature, AC power failure, inverter system trouble, or Access Control and Intrusion Detection System ~~security system~~ trouble, will cause the alarm panel to:

a) Transmit a digital signal, depending on the location and type of alarm, to a central monitoring location and to annunciate on the local keypad after the pre-set time delay has expired;

~~5.3.8.20~~5.3.7.22 b) An audible signal in the keypad will sound continuously for 5 minutes and be automatically silenced.

Sequence of Operation

~~5.3.8.20.1~~5.3.7.22.1 The following is a typical procedure for entry into and exit from a station:

a) Entry – The designated door is unlocked and the time delay intrusion alarm is immediately activated;

b) The alarm is disarmed by key-in at the keypad located in the station before expiry of the time delay;

c) If the code is accepted, the intrusion alarm is disarmed and the alarm control panel will continue to monitor all the connected functions except the intrusion alarm sensors;

d) Exit – The exit code is entered in the keypad and the system will respond by initiating the time delayed intrusion alarm;

e) The station must be exited and the door locked before the end of the time delay;

f) The system will respond at the end of the time delay by arming all of the intrusion sensors.

Table 56: Heating, Ventilation and Air Conditioning

Room	C Winter Min.	C Summer Max	Energy Source
Passenger Waiting Room (including vending/ concessions)	18	25	HVAC
Station Attendant	22	22	HVAC
Staff Room	22	22	HVAC
Dispatcher Room	22	22	HVAC
Office Room	22	22	HVAC
Communications ~~Room~~room	15	22	HVAC (Note 1)
Hub ~~Room~~room	15	22	HVAC (Note 1)
Mini ~~Hub~~-Hub ~~Room~~room	15	22	HVAC (Note 1)
Electronics Workshop	22	22	HVAC
Washroom	22	N/A	Ventilation & Heating
Janitor Room	18	N/A	Ventilation & Heating
Battery Room	18	N/A	Ventilation, Heating & Gas Monitoring
Electrical Room	15	25	HVAC (Note 1)
Elevator Control Room	15	25	HVAC (Note 1)
Mechanical Room	18	N/A	Ventilation & Heating
Sump Pump Room	18	N/A	Ventilation & Heating
Maintenance Room	18	25	HVAC
Boiler Room	18	N/A	Ventilation, Heating & Gas Monitoring
Elevator Hoistway	15	25	HVAC (Note 2)
Workshop	22	22	HVAC
Storage Room	20	22	HVAC

Station Secondary Entrance, Tunnel, aAnd Pedestrian Bridge	N/A	N/A	Ventilation
Hydro Vault	N/A	N/A	
Shelter	N/A	N/A	Note 3

Notes:

1. For HVAC system detail requirement refer to service rooms requirements in section 5.2.243.
2. For HVAC system detail requirement refer to Elevators in section 5.5.5.
3. For HVAC system detail requirement refer to GO-Shelter standard drawing and specification.

Stations

5.4.2.2.1 Heating and Air Conditioning of the waiting area and the service area shall be achieved by energy efficient, premium quality air handling unit c/w outdoor condensing unit, or roof top unit depending on different projects, Equipment shall be accessible for operations and maintenance.

5.4.2.2

5.4.2.2.2 The service area will have a VAV box controlled by a thermostat, while the main thermostat shall be located in the maintenance room and interlocked with the waiting area temperature sensor.

5.4.2.2.3 Communication room and Electrical room shall have a dedicated split Heat Pump A/C unit, fan-forced heater as redundancy, and emergency cooling for each room, for detail refer to service room requirements in section 5.2.23.

5.4.2.2.4 Depending on area, washrooms shall be ventilated by Energy Recovery Ventilators or exhaust fans, and shall be heated by radiant heating (if available in the building) or by electric baseboard heating.

5.4.2.2.5 HVAC system shall be provided for Elevator hoistway. For detail, refer to Elevators in section 5.5.5.

5.4.2.3

Facilities

5.4.2.3.1 Radiant floor heating shall be the main heating system in the entire facility.

5.4.2.3.2 Office area shall be heated and air conditioned by energy efficient, premium quality rooftop packaged gas heating/electric cooling units.

5.4.2.3.3 Storage area and repair area shall be ventilated by heavy-duty industrial Air Handling Unit c/w heat recovery unit.

5.4.2.3.4 This system shall be controlled by thermostats and gas monitoring system.

5.4.2.3.5 To minimize infiltration through open overhead doors in rail facilities, heavy-duty industrial air curtains shall be installed above overhead doors.

5.5.4.1.1 The Two Way communication device is a customer service amenity, which assists customers with inquiries at rail station site to provide an enhanced customer service amenity at our platforms, elevators, parking structures, universal washrooms and maintenance facilities.

5.5.4.1.2 Two Way Communication Devices shall be placed at the following locations at a typical GO Rail station site:

a) At each elevator lobby on site including tunnels, pedestrian bridges and parking structures (new device technology to address current technical and operational issues);
b) In the vicinity of the Mini platform (to replace existing Bell telephones);
c) In all universal washrooms;
d) Secure entrance points for GO Operational Facilities;
e) In each elevator cab;
f) At each Carpool/Park and Ride site;

5.5.4.1.3 The Call flow shall be made to service attendant with call backup available 24/7 by Transit Safety.

5.5.4.1.4 Refer GO Standard Specifications for detailed two way communication device requirements.

5.5.5 Elevators

5.5.5.1 The requirements do not constitute a project specification. Each project shall have its own specification based upon the GO Master Elevator Performance Specification.

5.5.5.2 Variance requests shall be supported by an explanation of the reason for the deviation and detailed information on the proposed alternative.

5.5.5.3 Important: Refer to Metrolinx Standard Elevator Performance Specification 22 01 52 for details.

5.5.5.4 Configuration requirements are:

a) GO Transit elevators shall be Machine-Room-Less (MRL) elevator type;
b) Generator standby power shall be provided to permit continued operation of the elevator(s);
c) All electric elevators shall be provided with their own back-up battery power system;
d) All elevators shall be provided with battery powered emergency lighting;
e) All serviceable equipment, not directly connected to elevator operation, shall be serviceable from the exterior of the shaft.

5.5.5.5 Communications requirements are:

a) All elevators shall have CCTV camera mounted inside elevator cab;
b) Camera mounted in vestibules and lobbies shall view inside and outside of each elevator at each level ~~where possible~~;
c) All elevators shall have a two-way emergency call system.
d) All elevator banks shall have a two-way call device located beside each elevator bank on all floors serviced by the elevators
~~c)~~e) All elevators shall have an internally located Emergency Call system. The Emergency Call shall meet all Metrolinx Elevator Performance Specifications providing Emergency Call system 8 hour window of operation.

Heating requirements are:

a) Fan forced heater with built-in thermostat;
b) Heat Pump with hyper heating capability down to -25°C, ducted type and located outside the hoistway.

5.5.5.6 Air Conditioning requirements are:

a) Air conditioning via Heat Pump type A/C unit with low ambient cooling;
b) All elevators shafts shall be provided with heating and air conditioning systems.

5.5.5.7 Floor Grille

5.5.5.8.1 Constructed from stainless steel and shall be designed for cleanout by one person, unaided.

5.5.5.8 Elevator Numbering Convention

5.5.5.9
a) Elevators north of the tracks shall be assigned numbers first (if not applicable, east side of track shall be first);
b) Elevators serving platforms shall be numbered in a sequence following platform numbers being served (i.e. platform one first, followed by subsequent platforms);
c) Elevator groups serving a parking structure to be numbered in one sequence.

6 Heavy Rail

For Heavy Rail, the reference should be made to the GO Transit Track Standards and GO Transit Track Standard Plans.

7 Information technology; Telecommunication & Systems

For all IT Telecommunication and Systems requirements refer to the I&IT ~~Standard~~ Telecommunication and Systems ~~document~~Standards.

8 Appendix A – LEED Mandatory Credits

8.1 How to Use the GO LEED Mandatory Credit Checklist

8.1.1 Mandatory credits have been established for each building type to ensure that credits that are important to GO Transit's goals of energy efficiency and reduced operating and maintenance costs are targeted, integrated into the design early and achieved.