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**SCHEDULE 15-2  
DESIGN AND CONSTRUCTION**

**PART 6  
DESIGN AND CONSTRUCTION REQUIREMENTS - MSF**

**ARTICLE 1 INTRODUCTION**

**1.1 Introduction**

- (a) This article outlines the guidelines and performance criteria that are necessary for Project Co to carry out the final Design and Construction for the various components and elements of the MSF for the OLRT Project. The MSF shall serve as the maintenance and storage facility for the City and Project Co and shall house the OLRT Vehicle fleet. This Work requires coordination and interaction with other work by Project Co, including but not limited to the mainline Track. Project Co shall Design the MSF to meet the LRV peak daily service requirements.
- (i) Features of the Work shall include, but not be limited to, final Design, financing, Construction, testing and acceptance, operation and maintenance of the following:
- A. Obtain necessary Construction Permits;
  - B. Complete mobilization and demobilization;
  - C. Install and maintain storm water pollution prevention features;
  - D. Construct all Track;
    - i. Furnish and install new turnouts, crossties, ballast, and necessary appurtenances.
    - ii. Install new rail within buildings and/or where embedded; second-hand rail, meeting the criteria stipulated in Part 6 Article 6 – Trackwork, may be used elsewhere.
  - E. Retaining walls and miscellaneous concrete Structures;
  - F. Buildings as further defined in 1.1(c); and
  - G. Emergency Planning
    - i. Project Co shall be responsible for the preparation, submission and maintenance (including revisions as necessary) of fire safety plan(s), for approval by the authority having jurisdiction, pursuant

to Ontario Fire Code, Section 2.8 Emergency Planning, where applicable.

- (ii) Project Co shall not be permitted to install fuel storage tanks at the MSF with the exception of fuel tanks servicing stand by power generation equipment only.
- (b) This section summarizes the requirements that are otherwise detailed in the remaining Articles of this Part 6.
- (i) Site Summary
    - A. The site is located on a parcel just east of the crossing of Belfast Road to the south and west; to the north is the VIA right of way, which defines the northern property line. The eastern site boundary is a light industrial property (occupied by Pepsi Cola).
    - B. The site zoning is compatible with the proposed use and activities associated with the MSF.
    - C. This site currently houses a series of privately owned commercial properties and a maintenance facility for the City.
    - D. A neighbouring development to the north of the VIA Rail right of way is composed largely of three storey, multifamily residential units. A combination of sound walls, landscaping berms and other noise mitigation measures shall be employed to provide acoustic and visual screening of the MSF.
- (c) Facility Summary
- (i) The MSF shall be designed to maintain and store all vehicles required by Project Co to meet the requirements outlined in Part 1 Article 2 – Operational Performance Requirements.
  - (ii) The MSF will serve as the service center and heavy maintenance center for the entire LRT network. Any Design for the initial build out shall take into consideration, be compatible with and protect for any future expansion or build-out requirements.
    - A. Project Co shall plan, design and construct facilities as required to perform all necessary operations and maintenance activities required by the Project Agreement.
    - B. Buildings may be designed to take advantage of the pre-engineered delivery method.
    - C. Space shall be assigned on the site to protect for a future two-bay paint shop building.

- (iii) LEED:
  - A. The administration building and the maintenance building shall be designed for LEED® “Certified” status.
  - B. Project Co shall register the MSF with the GBC and provide documentation for all credits necessary for “Certified” status.
- (iv) Accessibility:
  - A. Where applicable, Project Co shall ensure the project site and facilities are designed to be universally accessible including satisfying the requirements of Transport Canada, AODA and applicable City Guidelines and CSA Standards. The application of Design guidelines and criteria, standards and practices shall accommodate the needs of persons with physical, sensory, and mental disabilities.
- (d) General Maintenance Philosophy: The MSF Design shall allow for flexibility in LRV maintenance procedures.
  - (i) The MSF site, or alternative location determined by the threat and vulnerability analysis, shall house the BCC for the OLRT System.
  - (ii) The Design and operation of the MSF, shall be based on the following concepts:
    - A. To ensure that the required number of Vehicles needed for specified levels of service are available for revenue service, clean, sanded and in good mechanical order; and
    - B. The goal of the maintenance shop is to return the LRV to “ready for revenue service” status as quickly as possible. Therefore, maintenance procedures shall focus on exchanging good components (from shop stores) for defective components.
- (e) General MSF Operations Philosophy
  - (i) The MSF shall provide for maximum safety and flexibility in Train movements. Direct access from the mainline to the MSF Tracks shall be provided.
  - (ii) Project Co shall Design and construct a parking facility (minimum 50 spaces) for the City within logical proximity of the vehicle hand-off area from Project Co to the City.
    - A. Should the City be required to cross Tracks in the maintenance yard to access any areas required to maintain operations, Project Co shall provide all necessary safety appurtenances and training to provide the City with a safe crossing environment.

- (iii) At the location within the MSF, where Project Co will handover LRT trains to the Driver, Project Co shall provide the following facilities:
  - A. A heated and enclosed shelter for waiting Drivers;
  - B. An enclosed/heated office for the City supervisor who will be responsible for the handover; and
  - C. Project Co will work with the City to define the specific functional requirements for the spaces outlined above.
- (f) MSF Operations Criteria
  - (i) Maximum MSF speed shall be 15km/hr.

## **1.2 MSF Functions and Requirements**

- (a) At a minimum, Project Co shall design and construct the MSF to accommodate the following:
  - (i) To satisfy all Operational scenarios of the Agreement;
  - (ii) All necessary functions to support the initial LRT line and several functions for the entire planned network;
  - (iii) Rooms and spaces within the facility as identified in the room Data sheets for use and occupation by City staff; and
  - (iv) Roadways and other paved areas, Utilities, signaling, communications, access control and other security features, and other miscellaneous features for a complete and operational facility.

## **1.3 Administrative, Welfare and Training Functions**

- (a) The administrative and training functions for the MSF facility shall be at the maintenance of equipment building, providing easy and direct access from Belfast Road to the public, employees, and visitors. It shall include the following areas and features:
  - (i) Access: entrance to/exit from the site shall be easily recognizable and shall not require passing through “industrial” areas of the site;
  - (ii) These areas of the MSF shall be conceived and designed to permit ready expansion to accommodate the staffing and functional requirements of full system build-out;
  - (iii) A ground floor lobby shall be provided to educate the public on the sustainable principals employed by the facility Design and the features of the rest of the OLRT System;

- (iv) Public access shall be through a secure reception area on the first floor. Direct public access to the shop, warehouse, and any other industrial areas shall not be permitted;
- (v) Administrative, training and welfare areas shall be isolated from the transmission of sound and vibration;
- (vi) Administrative and management shall be provided with offices or open office cubicles in accordance with the standards established by Interior Planning Standards, City of Ottawa, Real Property and Assets Management. Finishes shall also be consistent with these standards;
- (vii) Management shall, to the fullest extent possible, be positioned with a view of maintenance and Equipment operations; and
- (viii) Training areas shall be provided for all staff and protect for the future installation of driver training equipment.

#### **1.4 LRV Storage**

- (a) The LRV Storage Tracks shall be provided with storage capacity of sufficient size to accommodate the operational performance requirements.

#### **1.5 BCC Functions**

- (a) Facility shall provide for the day to day operations of the yard and:
  - (i) BCC shall provide for a back-up operations and dispatch area capable of performing all of the operations of the primary TSCC located at. Not less than two dispatcher stations shall be provided and each shall be outfitted to provide for normal operations of the LRT System by the City; and
  - (ii) Shall be designed to be post disaster survivable following the Essential Services Code requirements for structural, mechanical, and electrical systems. Additionally provide for:
    - A. Triple redundant HVAC systems on mission critical Equipment including the control center and related data systems rooms; and
    - B. All mission critical systems shall be on full emergency back-up electrical power, to be provided by a fixed emergency generator system. The back-up power system shall be supported by UPS systems capable of maintaining mission critical systems for not less than two hours.

#### **1.6 Crew Dispatch**

- (a) Crew dispatch areas shall be under control of the LRT Driver and shall be independently controllable from Project Co areas.

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- (b) Areas shall be maintained by Project Co and shall be operational and available to operations personnel and LRT drivers at all times as required to support system operations.
- (c) Crew dispatch areas shall be located proximate to and provide convenient access to LRT hand-off area.
- (d) The design and operation of the MSF shall facilitate pedestrian movement to and from Belfast Road.
- (e) Functional areas include:
  - (i) Dispatcher's area;
  - (ii) Day room for LRT Driver;
  - (iii) Welfare facilities for the LRT Driver;
  - (iv) Management offices for the LRT Driver; and
  - (v) Storage areas for the LRT Driver.

**1.7 Room Data Sheets**

- (a) Project Co shall include within the MSF, the rooms identified in the room data sheets provided in Appendix F. These sheets contain additional requirements for the design and construction of required rooms within the MSF.

**ARTICLE 2 ARCHITECTURAL DESIGN CRITERIA**

**2.1 Introduction**

(a) General Requirements

(i) Reference Documents

A. The Design and Construction of the architectural requirements of the MSF shall comply with the criteria contained in this Article, and all standards, regulations, policies, Applicable Law, guidelines or practices applicable to the Project, including but not limited to each of the following Reference Documents. In the event of a conflict between criteria, commitments or requirements contained within one document when compared with another, the more stringent shall apply:

- i. OBC;
- ii. NBC;
- iii. CGSB;
- iv. ASTM;
- v. ODA;
- vi. AODA;
- vii. The Ontario Heritage Act;
- viii. OHSA;
- ix. CSA Standards;
- x. ULC;
- xi. MNECB;
- xii. ASHRAE;
- xiii. NFPA, including but not limited to NFPA 130;
- xiv. NCC Regulations when applicable;
- xv. Others:
  - 1. the City standards;
  - 2. City of Ottawa Bylaws;

- 3. City of Ottawa Standards;
  - 4. City of Ottawa Guidelines;
  - 5. APTA Transit Standards; and
  - xvi. Ontario Fire Code
  - xvii. Canada GBC – LEED® Program.
- (ii) Scope of Construction Work
- A. Materials employed in the construction of exterior façades shall be consistent with City standards.
  - B. The MSF shall be designed and constructed as a campus with a common aesthetic throughout all Structures.
- (b) Materials
- (i) All materials used in the construction of the interior and exterior of facility shall be of any code compliant material suitable for the appropriate type and durability of facility or otherwise indicated in the Project Agreement.

**2.2 Signage**

- (a) General Requirements:
- (i) Shall comply with Part 5 Article 6 – Wayfinding and Signage of this Schedule 15-2 and the City of Ottawa Visual Identity Standards Manual.
  - (ii) Site signage including illuminated entry monument, roadway and rail signage and wayfinding signage for visitors and delivery vehicles.
  - (iii) Building signage identifying address and facility for each building and as required to identify Track numbers at each rail door. Provide emergency contact information and hours of operation (as relates to public access) at main entry doors.
  - (iv) Interior signage identifying all departments and rooms: offices, workstations, breakrooms, washrooms, shop functions, etc. Provide meeting room agenda, staff directory, and daily events holders.
  - (v) Regulatory signage for accessibility, Safety, and hazardous materials.
  - (vi) Provide a fire safety plan(s) for the facility as approved by the AHJ.

**2.3 Building Code Analysis**

- (a) Project Co shall perform a code analysis with respect to the OBC.
- (b) Provide a complete code analysis for the MSF, in accordance with Schedule 10 – Review Procedure, addressing the following minimum requirements:
  - (i) Building Size, Use and Occupancy:
    - A. Building area and number of storeys; and
    - B. Mezzanines.
  - (ii) Structural Design:
    - A. Approach to compliance for structural Design.
  - (iii) Occupant Load:
    - A. Occupant load factors and Design occupant loads; and
    - B. Occupant load calculation;
  - (iv) Construction Requirements:
    - A. Construction classification and Construction requirements; and
    - B. Interior finishes.
  - (v) Interconnected Floor Spaces:
    - A. Description of interconnected floor spaces; and
    - B. Special protection for interconnected floor spaces.
  - (vi) Spatial Separation:
    - A. Spatial separation and exposure protection.
  - (vii) Fire Department Access:
    - A. Fire Department access route;
    - B. Fire Department access openings;
    - C. Water supply for firefighting; and
    - D. Hydrants and Fire Department connections.

- (viii) Fire Separations and Compartmentalization:
  - A. Required fire separations;
  - B. Voluntary fire separations; and
  - C. Fire resistance rating of assemblies and fire protection ratings of closures.
- (ix) Egress and Exiting:
  - A. Exiting concept including number and location of exits;
  - B. Travel distance;
  - C. Exit capacity;
  - D. Egress widths including, vertical egress widths and horizontal egress widths;
  - E. Egress time to protected route or exterior; and
  - F. Door hardware.
- (x) Fire Protection Systems, Emergency Power and Communication Systems:
  - A. Fire alarm system and devices;
  - B. Standpipe system;
  - C. Sprinkler system: All buildings shall be sprinklered, including any LRV storage building, except where special extinguishing agents are required in sensitive areas\rooms;
  - D. Voluntary systems;
  - E. Emergency lighting and exit signage;
  - F. Emergency power; and
  - G. Communication Systems.
- (xi) Ventilation:
  - A. Emergency ventilation.
- (xii) Washrooms:
  - A. Number of washroom fixtures; and

- B. Location of gender specific toilet rooms.
- (xiii) Barrier Free Design:
  - A. Provide analysis consisting of description of Barrier Free Design requirements to meet the following to provide the most accommodating environment:
    - i. Barrier Free Access in accordance with the AODA Accessible Built Environment Standard.
  - B. Protection of a barrier-free path of travel.

**ARTICLE 3            STRUCTURAL DESIGN CRITERIA**

**3.1    General Structural Design Criteria**

(a)    General Requirements

- (i)    This Structural Design Criteria presents the basic structural Design guidelines, codes, and standards references that must be followed throughout the structural Design process of the entire MSF.
- (ii)   Design and Construction shall conform with the below mentioned codes with any amendments from City of Ottawa codes.
- (iii)   Wood and wood products shall not be used for structural members.

(b)    Reference Documents

- (i)    The Design and Construction of structural Work shall comply with the criteria contained in this Article, and all standards, regulations, policies, Applicable Law, guidelines or practices applicable to the Project, including but not limited to each of the following Reference Documents. In the event of a conflict between criteria, commitments or requirements contained within one document when compared with another, the more stringent shall apply:

- A.    OBC;
- B.    NBC;
- C.    User’s Guide – NBC: Structural Commentaries (Part 4);
- D.    CSA;
- E.    CAN/CSA S6-06 including Supplement No. 1;
- F.    CAN/CSA S6 Package – Canadian Highway Design Code and CHBDC;
- G.    AREMA Manual for Railway Engineering;
- H.    CAN/CSA A23.1/A23.2;
- I.    CAN/CSA A23.3;
- J.    CAN/CSA G40.20-04/G40.21-04;
- K.    CAN/CSA O86;
- L.    CAN/CSA S16;
- M.    CAN/CSA S304.1; and

- N. ASTM International.
- (c) Structural Loads
  - (i) Dead Loads
    - A. Dead Load shall include all actual weight of materials used and shall not be less than minimum requirements by OBC and NBC and any amendments by the City.
  - (ii) Live Loads
    - A. Vertical and horizontal live loads shall be as described in the above Reference Documents based on occupancy and use of area. Any Equipment loads such as Bridge crane, jib crane, fork lift etc. shall be considered as live load.
  - (iii) Environmental Loads:
    - A. Snow, wind, ice and seismic loads shall be as described in the relevant Reference Documents, using the Importance Category of “Normal” with the building code and “Other” within CHBDC.
  - (iv) Lateral Earth Pressure Loads
    - A. All underground Structures including retaining walls and pits shall be designed for lateral earth pressure including surcharge. Lateral earth pressure and surcharge shall be as described in relevant Reference Documents and as may be prescribed in Part 1 Article 12 – Geotechnical/Foundation Design Criteria.
- (d) Load Combinations
  - (i) Load Combinations shall be in accordance with the applicable building codes for the Facility Buildings and foundations and shall include any possible load combinations (dead load, live load, cranes load, impact load, snow load, wind load, seismic load and lateral earth pressure).
- (e) Design Considerations for Structures above Ground
  - (i) Seismic requirements shall be as per OBC and NBCC.
- (f) Design Considerations for Foundations
  - (i) Foundations for Structures shall be designed such that their displacements (SLS), as defined in the Reference Documents identified in this article and as may be prescribed in Part 1 Article 12 – Geotechnical/Foundation Design Criteria, are

compatible with the structural Design, function, and structure performance requirements, and clearance envelope requirements over their Design Life.

- (ii) Where there is a potential for new Construction to adversely impact any Adjacent Structures, Project Co shall prepare and implement an appropriate instrumentation and monitoring plan for the existing Structure to confirm that the new Construction will not adversely impact the Existing Adjacent Structures, as prescribed in Part 1 Article 20 – Protection of Existing Adjacent Structures.

### **3.2 Materials**

#### **(a) Concrete**

- (i) Design of concrete Structures shall be in accordance with CAN/CSA A23.3 and CAN/CSA S6.
- (ii) Design of prestressed and precast concrete Structures shall be in accordance with CAN/CSA A23 and CAN/CSA A251-00.
- (iii) Structures supporting Train loads, including ground-supported slabs, shall meet CHBDC standards for fatigue.
- (iv) For durability Design within CAN/CSA A23.1, concrete shall be considered class C-1. Concrete supporting Train loads shall be class C-XL. Exterior slabs-on-grade may be class C-2.
- (v) All concrete exposed to freezing and thawing cycles shall be air entrained.
- (vi) All non-prestressed reinforcement and testing methods shall conform to the following standards:
  - A. CSA; and
    - i. CAN/CSA G30.18-M92
    - ii. CAN/CSA W186-M1990
  - B. ASTM International.
    - i. ASTM A82/A82M
    - ii. ASTM A182/A185M
    - iii. ASTM A496/A496M
    - iv. ASTM A497/A497M
    - v. ASTM A775/A775M

- (vii) All concrete materials, testing methods, and Construction practices for plain and reinforced concrete shall conform to the following standards:
  - A. CSA; and
    - i. CAN/CSA A23.1/A23.2
    - ii. CAN/CSA A3000 (Consists of A3001, A3002, A3003, A3004, A3005)
  - B. ASTM International.
    - i. ASTM C260
    - ii. ASTM C494/C494M
    - iii. ASTM C1017/C1017M
- (viii) Concrete reinforcement shall conform to CAN/CSA G30.18 M, and welded wire mesh shall conform to CAN/CSA G30.5.
- (ix) Weldable reinforcing steel: CAN/CSA G30.18-M.
- (x) All bent reinforcing bars shall meet the bend test requirements of CAN/CSA G30.18.
- (xi) Joints
  - A. Construction joints
    - i. Waterstop shall be provided for the entire joint between units including invert slab, external walls and roof slab for Structures partially or completely underground. Wall construction joints above invert slab and below roof level shall have a horizontal water seal only.
- (b) Masonry
  - (i) Design of masonry Structures shall be in accordance with CAN/CSA S304.1 and CAN/CSA S6, where they are applicable.
  - (ii) Masonry Structures shall be designed to resist all applied vertical and lateral loads as required by the OBC (and the NBC where applicable). This requirement applies to load-bearing and no- load-bearing masonry.

- (iii) All concrete materials, testing methods, and Construction practices for reinforced and unreinforced masonry shall conform to the following standards:
  - A. CSA
    - i. CAN/CSA A23.1/A23.2
    - ii. CAN/CSA A179
    - iii. CAN/CSA A370
    - iv. CAN/CSA A371
  - (iv) All masonry walls shall have galvanized horizontal reinforcing.
- (c) Steel
  - (i) Design of cold formed steel Structures shall be in accordance with CAN/CSA S136.
  - (ii) All steel materials shall confirm to the following standards:
    - A. CSA; and
      - i. CAN/CSA G40.20/G40.21.
      - ii. Beam connections, columns, base plates, beams, purlins, girts and sag rods: CAN/CSA G40.20/G40.21-M.
      - iii. Welding materials: CAN/CSA W59-M, and certified by the Canadian Welding Bureau.
    - B. High strength bolts: ASTM A325M, Type 1. Nuts: ASTM A563. Washers: ASTM F436.
  - (iii) Protection of Steelwork
    - A. The minimum thickness of concrete when used as an encasement for steelwork shall be 60mm.
  - (iv) Protective Coatings
    - A. Structural steel members and connections shall be protected against corrosion.

- B. Acceptable methods of protection are painting and hot dip galvanizing as follows:
  - i. Bolts, nuts and washers used with galvanized Structures shall also be galvanized in accordance with CAN/CSA G164-M92 (R2003).
  - ii. Protection shall be restored when severe damage to the galvanized coating has occurred during welding or as a result of rough handling or abrasion.
  - iii. Methods of painting shall be in accordance with CISC/CPMA.
  
- (d) Metal Deck
  - (i) Design and Performance Requirements
    - A. Design steel deck to CAN/CSA S16, Update No. 1.
    - B. Formed steel sheet: CSSBI 101 M, Grade A and ASTM A653/A653M.
  
- (e) Metal Studs
  - (i) This section applies to all light gauge metal work
    - A. Include Design, manufacture, supply, installation, inspection and testing of load bearing metal studs as described in these performance specifications and summarized in the following elements of the work:
      - i. Load bearing metal studs shall be capable of carrying live, dead, and imposed loads.
  
  - (ii) Design and Performance Requirements
    - A. Design load-bearing metal studs based on Limit States Design principles using factored loads and resistances. Loads and load factors to be in accordance with the OBC. Resistances and resistance factors to be determined in accordance with the OBC and CAN/CSA S136-M.

**ARTICLE 4 MECHANICAL DESIGN CRITERIA**

**4.1 HVAC**

(a) General HVAC Requirements

(i) Project Co shall provide complete design and construction of HVAC systems for all facilities as required by and in accordance with all referenced codes and standards and where required in the Project Agreement.

(ii) Reference Documents

A. Project Co shall comply with all applicable municipal, provincial, federal and foreign, codes, standards, regulations and best practices, and with manufacturers' requirements and recommendations.

B. The Design and Construction of the mechanical systems shall comply with the criteria contained in this Article, and all standards, regulations, policies, Applicable Law, guidelines or practices applicable to the Project, including but not limited to each of the following Reference Documents. In the event of a conflict between criteria, commitments or requirements contained within one document when compared with another, the more stringent shall apply:

i. Ontario Regulation 350/06 OBC;

ii. NBCC;

iii. ODA;

iv. AODA;

v. CSA Codes and Standard;

vi. Model National Energy Code of Canada for Buildings;

vii. ULC;

viii. NFC;

1. NFPA 70

2. NFPA 90

3. NFPA 91

4. NFPA 130

ix. ASHRAE Handbooks and Standards; and

- x. SMACNA.
- (iii) Design Criteria and Parameters
  - A. The Design of HVAC systems shall conform to the requirements of this Article, and all the applicable codes and standards.
  - B. Noise Criteria
    - i. Mechanical Equipment and systems shall be designed so that the maximum transmitted by the systems do not exceed Ontario health and safety codes, ASHRAE Standards, or the following noise criteria.

**Table 6-4.1**

Noise Level Criteria		
Area	Noise Criterion	Equivalent Air-Weighted Sound Level dB(A)
Office and Staff Break Room	NC-40	49
Conference Room	NC-35	44
Toilet Room and Janitor’s Closet	NC-45	53
Communication Room	NC-50	58
Equipment Room	NC-60	67
Shop Areas	NC-60	67

- C. Vibration Requirements
  - i. All HVAC Equipment shall be designed and installed to eliminate or to reduce the transmission of vibration and noise to any part of the building as follows:
    - 1. Provide vibration isolators to mechanical Equipment and components; and
    - 2. Provide seismic restraints for mechanical Equipment or components including ductwork and piping.
- D. Design Conditions
  - i. The Design conditions shall be based on ASHRAE Handbook Fundamentals.
- E. Design Parameters
  - i. The Design parameter shall be based on ASHRAE standards 55, 62.1, 90.1 and 189.1

- F. Duct Sizing Criteria
  - i. Use equal pressure method to size ducts serving air conditioning system, heating and ventilation system, and normal building exhaust system. Use velocity method for any other system that may require it due to system requirement or noise control or as indicated in the individual system.
  
- (b) HVAC Equipment and Systems
  - (i) General Requirement
  - (ii) Design and Performance Requirements
    - A. Equipment
      - i. Select HVAC Equipment containing no CFC refrigerant
      - ii. Select HVAC Equipment utilizing refrigerant that will not contribute to ozone depletion and global climate change, such as Refrigerant 410A.
      - iii. All HVAC Equipment shall be isolated from the building and anchored for seismic restraint.
    - B. System:
      - i. Design high efficiency HVAC system to meet or exceed ASHRAE 90.1-2007.
      - ii. System ventilation Design shall meet ASHRAE 62.1-2007 for indoor air quality.
  - (iii) Material and Product
    - A. All Equipment shall be certified to be installed in Canada and meet the requirements of MNECB.
  
- (c) HVAC Controls
  - (i) Design and Performance Requirements
    - A. All building controllers, application controllers and all input/output devices shall use industry standard protocols.
  
- (d) Testing and Balancing
  - (i) Performance Requirements

- A. Provide testing, adjusting and balancing by an agency certified by an agency certified by the AABC or NEBB.

**4.2 Plumbing and Fire Protection**

- (a) Project Co shall provide complete design and construction of plumbing and fire protection systems for all facilities as required by and in accordance with all referenced codes and standards and where required in the Project Agreement.

- (b) Reference Documents

- (i) Project Co shall comply with all, applicable, municipal, provincial, and federal codes, standards, regulations and best practices.

- A. Ontario Regulation 350/06
- B. Ontario Mechanical Code
- C. CSA Codes and Standard
- D. NFPA 70
- E. Ontario Regulation 213/07

- (c) Plumbing Fixture

- (i) General Requirement

- A. Provide Design, approvals, supply of materials, installation, inspection and testing of works associated with the plumbing fixtures as described in these performance specifications and summarized in the following elements of the Work.

- i. Urinal: Waterless type urinals are prohibited.

- (ii) Design and Performance Requirements

- A. Fixtures and fittings, where applicable, shall be in accordance with requirements of CSA B45 Series.

- (d) Fire Protection System

- (i) Design of the fire protection systems shall conform to the latest edition of the following applicable codes and standards:

- A. Ontario Regulation 350/06 OBC;
- B. Ontario Fire Code (latest issue);

- C. Ontario Mechanical Code;
  - D. CSA Codes and Standard;
  - E. NFC: NFPA 13;
  - F. NFPA 14.
    - i. Provide dry standpipe systems in areas subject to freezing temperature. Provide pressure gauge at top of each standpipe riser. Siamese fire department connection for standpipe shall match connection for sprinkler systems;
  - G. NFPA 20 and
  - H. NFPA 2001.
- (ii) Design and Performance Requirements
- A. BCC:
    - i. Provide clean agent for the BCC area to protect the electronic Equipment. Also provide Class III wet standpipe system to comply with the requirements of NFPA 14 as a back-up system.
- (iii) Fire Protection Specialties
- A. Design and performance requirements: All fire extinguishers shall be pressurized (stored pressure) rechargeable type, in accordance with NFPA 10, and ULC listed and labeled for the class of fires for which they are specified.
    - i. The clean agent fire suppression system is to utilize Inergen gas and be in accordance with requirements of NFPA 2001.
    - ii. The clean agent fire suppression system supplier shall, as a minimum, provide 24-hour Emergency service, 7 days per week and be able to respond to an Emergency situation with 2 hours of receiving the call.

**ARTICLE 5 ELECTRICAL DESIGN CRITERIA**

**5.1 Introduction**

- (a) This article presents the basic electrical Design guidelines, codes, and standards references that shall be followed throughout the electrical Design process of the MSF.
- (b) Project Co shall provide complete design and construction of electrical and communication systems for all facilities as required by and in accordance with all referenced codes and standards and where required in the Project Agreement.

**5.2 Reference Documents**

- (a) The Design and Construction of electrical Work shall comply with the criteria contained in this Article, and all standards, regulations, policies, Applicable Law, guidelines or practices applicable to the Project, including but not limited to each of the following Reference Documents. In the event of a conflict between criteria, commitments or requirements contained within one document when compared with another, the more stringent shall apply:
  - (i) OBC;
  - (ii) NBCC;
  - (iii) Ontario Regulation 164/99, Current Edition;
  - (iv) CEC, Part I, 21st Ed: Safety Standard for Electrical Installations;
  - (v) ANSI;
  - (vi) ULC;
  - (vii) NEMA;
  - (viii) CSA;
  - (ix) IESNA, Lighting Handbook;
  - (x) ASHRAE 90.1;
  - (xi) City of Ottawa Standards;
  - (xii) NFPA 130;
  - (xiii) ASME A17.1;
  - (xiv) IEEE; and
  - (xv) Hydro Ottawa Standards.

**5.3 Basis for Design**

- (a) Calculations:
  - (i) Lighting-level calculations shall be completed for all interior and exterior spaces occupied by staff.

**5.4 Functional Requirements**

- (a) Electrical Service
  - (i) The MSF will receive its service feeder from Hydro Ottawa. Project Co shall determine whether to receive medium voltage power from the Utility and distribute around the site at this level to pad mounted transformers at the various load points.
  - (ii) Primary switching rooms for incoming service shall be:
    - A. designed in partnership with HOL and in accordance to HOL Specification GCS0002: Primary Voltage Service Specification;
    - B. at grade or within five (5) meters below grade with two walls on the outside to allow ease of access for HOL incoming feeders and designed for a three (3) hour fire envelope;
    - C. a minimum of 5.5m wide, 9.5m long and a ceiling height of 3.2m; and
    - D. coordinated with HOL in terms of switchgear location and placement within the rooms.
  - (iii) Emergency ventilation or fire suppression Equipment shall be provided a reliable power source or combination of sources. On-site power generation shall be provided as the backup source for these loads. All power sources shall be as approved by the Authority Having Jurisdiction and in conformance with the applicable code.
- (b) Metering
  - (i) Customer-owned metering shall be provided.
  - (ii) Utility revenue metering shall be provided as required by Hydro Ottawa.
- (c) Duct banks, Maintenance Holes and Handholes
  - (i) Duct banks and maintenance holes shall be designed in accordance with the seismic criteria defined for this Project. Duct banks shall be designed to include spare capacity after completion of installation to protect for future growth and expansion. Ducts shall be sloped to maintenance holes to provide adequate

drainage. Concrete encasement shall be provided where required by applicable code. In addition, space is to be provisioned for a 24 way fibre to be installed for a separate highways IT network in coordination with the City Highways Department. All ducts to be roped.

- (ii) Maintenance holes and/or handholes shall be sufficiently sized and provided where access to or installation of cable is necessary.
- (d) Electrical Rooms
  - (i) Electrical rooms shall have sufficient space to house all Equipment. Adequate space shall consider minimum working clearances, conduit entry points and routing, Equipment removal / replacement and ventilation requirements.
- (e) Grounding and Bonding
  - (i) The electrical distribution system shall be solidly grounded.
  - (ii) An applicable code compliant grounding electrode system shall be provided.
  - (iii) All non-current-carrying metal enclosures and all alternating current Equipment shall be securely connected to the grounding system.
  - (iv) Avoid natural gas piping and pipe connected to an active cathodic protection system.
- (f) Lighting
  - (i) Emergency fixtures, exit lights and essential signs shall be independently wired from the emergency lighting panel. Emergency lighting shall be automatically energized upon failure of commercial power. Emergency lighting for stairs and passageways shall be designed to accommodate egress.
- (g) Fire Alarm
  - (i) The fire alarm system shall be analog addressable, non-coded with a general alarm sounding and strobe lights activated in the building when alarm conditions are initiated. Visual and audible alarms shall be initiated at the fire alarm control panel in each building. The central fire alarm control panel shall have the capability to receive alarm, supervisory and trouble signals from all buildings. Sprinkler systems and PIV valves will be monitored by the fire alarm system, with water flow initiating a general alarm. The panel shall be provided with a dialer for calls of alarm and trouble conditions. A remote annunciator shall be placed in the lobby at the fire department's designated show-up location to aid in their locating the fire.

**ARTICLE 6 TRACKWORK**

**6.1 Order of Precedence**

(a) General

(i) The Design and Construction of trackwork shall comply with the criteria contained in this Article, and all standards, regulations, policies, Applicable Law, guidelines or practices applicable to the Project, including but not limited to each of the following Reference Documents. In the event of a conflict between the criteria, commitments or requirements contained within one document when compared with another, the more stringent shall apply:

A. AREMA Track Standards, unless otherwise approved, or approved equivalent; and

B. The criteria in TCRP Report 57 may be used as a source for proposed alternative requirements.

**6.2 General Requirements**

(a) The scope of the trackwork includes all Works related to the Design and Construction of a complete light rail yard for the maintenance and storage facility as specified herein. This includes, but is not limited to, the Design, supply, installation, and testing of yard Tracks and any and all related incidentals.

(b) The scope of the special trackwork consists of all Works related to the complete Construction of special trackwork as described in these Output Specifications. This includes, but is not limited to, the Design, supply, and installation of special trackwork, including all turnouts, adjoining trackwork, fastening components, and all other Track materials.

(c) The limits of the yard begin at the points of switches for the yard special trackwork that designate the end of the MSF connection Tracks and the beginning of the yard Tracks.

(d) Grade

(i) The maximum grade on yard storage tracks shall be 0.3%.

**6.3 Operational Requirements**

(a) Yard Tracks designed to hold or store full-length Trains clear of other Tracks and Structures shall accommodate the maximum Train consist between clear points, defined as the location where Track centres between two diverging Tracks from a given turnout are exactly 4m.

(b) Unless site constraints provide insufficient space, storage Tracks shall be double-ended.

## **6.4 Track Types**

### **(a) General**

- (i) The Track Structure shall be built to 1435mm Track gauge.
- (ii) The running rails of all Track, including special trackwork, shall be electrically isolated from the ground.

### **(b) Ballasted Track**

- (i) Yard ballasted Track shall utilize timber or precast concrete crossties with a resilient rail fastening system.
- (ii) Crushed stone or other material shall conform to AREMA ballast specifications.
- (iii) The particle size requirements shall conform to AREMA requirements in relation to the crushed stone ballast, class number 4A.
- (iv) Minimum depth of ballast below the bottom of ties under the running rail shall be 225mm. Shoulder ballast shall extend a minimum of 300 mm beyond the ends of ties before sloping at 2:1 to the sub-ballast.
- (v) Ballast shall be well drained and shall not contact the running rails for mitigation of stray current and loss of shunting or calibration with signal systems.

### **(c) Asphalt Concrete Paved Track**

- (i) Paved yard Track shall be utilized for grade crossings with site roadways, service aisles, cart paths.
- (ii) Compacted asphalt shall be placed to embed the rails to top-of-rail elevation. Gaps shall be left on the inside of the rails for wheel flange ways.

### **(d) Embedded Track**

- (i) Embedded yard Track shall, except for gaps formed for wheel flange ways, consist of the rails fully embedded in concrete to top-of-rail elevation.
- (ii) The embedment concrete and base slab concrete shall be designed to support and hold the rails in place to the correct Alignment, profile, and Track gauge.
- (iii) Embedded Track shall be utilized in the shop buildings and aprons immediately outside of buildings.
- (iv) Embedded Track Design shall include provisions for providing resiliency and electrical isolation between the rail and concrete slab.

- (v) Embedded Track shall be drained.
- (e) Pedestal Track
  - (i) Pedestal Track shall be utilized in pit areas of the shop building.
  - (ii) Rails shall be supported on short steel columns and fastened with crane rail clamps.

## **6.5 Track Materials**

- (a) General
  - (i) Materials identified in the following sections shall be used for all Track Construction.
- (b) Rail/115 lb RE
  - (i) Supply rail that meets:
    - A. AREMA Volume 1, Chapter 4, Part 2; and
    - B. ASTM A1.
  - (ii) Second-hand Rail
    - A. Second-hand, or relay, rail may be used in the yard except for rail switches and inside the buildings.
    - B. Project Co shall perform ultrasonic or other appropriate inspections to ensure second-hand rail is free from mechanical and internal defects.
  - (iii) Rail Lengths
    - A. All rail shall be CWR.
- (c) Restraining Rails
  - (i) Project Co shall install restraining rails against the gauge side of the low rail for all mainline horizontal curves with a radius of 145m or less.
  - (ii) Restraining rail must be electrically isolated from running rail in order to maintain broken rail protection.
- (d) Rail Joints
  - (i) Project Co shall supply insulated glued joints for 115lb RE rail manufactured to AREMA standards.

- (ii) Rail joints must be electrically tested prior to and after placement in Track.
- (e) Rail Bonding
  - (i) Project Co shall supply and install rail bonds that meet AREMA specifications in Volume 3, Chapter 33, Parts 7 and 12.
  - (ii) Rails shall be welded in continuous lengths and bolted joints must be electrically bonded.
  - (iii) At locations requiring insulated joints, the traction power direct current continuity of negative rails must be maintained by use of impedance bonds.
- (f) Switch Clearing Device
  - (i) Switch clearing devices shall be supplied and installed by Project Co at special trackwork locations. Project Co shall provide conduits and junction boxes and other supporting Infrastructure for these devices.
  - (ii) Project Co shall provide switch clearing devices that are proven in railway industry and meet accepted industry standards and do not compromise safety.
- (g) Switch Machines and other Turnout Appliances
  - (i) Switch machines and other associated Equipment shall be provided and installed by Project Co.
  - (ii) Project Co shall allow for the location of trackside terminal boxes, which shall be located near the switch machine. Terminal boxes shall not be located within a position that would restrict the ability of maintenance personnel to maintain or manually throw the switch.
  - (iii) Additional separate controlled heating that can melt snow in the critical switch areas shall be provided.
- (h) End-of-Track Devices (Bumping Posts)
  - (i) These devices shall be mounted near the end of Track on stub-end storage Tracks. The end-of-Track device shall meet the following requirements:
    - A. It shall be capable of stopping an unoccupied Train travelling at 10km/h;
    - B. It shall be suitable for permanent exterior exposure;
    - C. It shall engage the vehicle symmetrically about the coupler at bumper height;

- D. It shall have a cushioned face and not produce any damage to a vehicle at vehicle speeds less than 5 km/h. Project Co shall coordinate the Design of the stopping device to ensure engagement to the car is adequate to prevent damage; and
  - E. Upon approval(s), Project Co shall procure and install the approved end-of-Track devices as part of the Works.
- (ii) Rail-mounted wheels stops shall be used at the ends of shop Tracks to impede the travel of any car beyond the end of the Track(s).

**6.6 Special Trackwork**

(a) General

- (i) All special trackwork shall be supplied and installed by Project Co. Special trackwork assemblages include all materials necessary for Construction.
- (ii) All special trackwork joints shall be butt welded in-field except where Project Co can demonstrate that space does not permit. At these locations thermite welds performed in accordance with manufacturer's weld procedures are acceptable. Compromise welds shall be considered part of the mainline Track conditions and installation. No holes, for temporary joint installation, or otherwise, shall be permitted within 150mm of the weld location.
- (iii) All turnouts shall utilize curved switch points.
- (iv) Special trackwork components shall be based on AREMA specifications for turnout Construction.
- (v) All components shall be designed so that the specified tolerances can be maintained throughout the operating life of the special trackwork with minimal maintenance.

(b) Types of Special Trackwork

(i) Turnouts

- A. Provide minimum #6 turnouts within the yard.
- B. All yard turnouts shall be power operated.

**6.7 Track Construction Tolerances**

- (a) Verification of the Track installation shall include a Trackstar Geometry Test (or equivalent).

- (b) Clearances shall be verified by laser measurement using an L-Kopia vehicle (or equivalent).

**ARTICLE 7 COMMUNICATION AND PUBLIC ADDRESS SYSTEM**

**7.1 General Requirements**

- (a) The communication systems and PA system for the MSF shall provide support to Project Co operations. The communications systems for the MSF shall include the following:
  - (i) CTS interface;
  - (ii) BCC;
  - (iii) YCC;
  - (iv) Yard/shop PA system;
  - (v) CCTV;
  - (vi) Telephone system;
  - (vii) IT Infrastructure System;
  - (viii) SCADA which includes:
    - A. Traction Power SCADA;
    - B. Train Control SCADA; and
    - C. MSF BMS.
  - (ix) Intrusion Access Control; and
  - (x) Train-to-wayside wireless communications.

**7.2 Operational Description**

- (a) CTS Interface – Project Co shall provide an interface to the CTS, which provides hi-speed fiber optic communications transmission for the various communications subsystems at the MSF, including CCTV, PA, telephone, IAC, train-to-wayside communications, BMS, and SCADA systems.
  - (i) Project Co shall provide dual redundant hi-speed network nodes located at the main control room in the MSF for sending and receiving voice and data information to the TSCC.
  - (ii) All backup for the system servers shall be located at. Project Co shall provide data connectivity to the City’s IT service for connectivity to. Data connectivity between the TSCC at already exists.
- (b) [REDACTED]

- (c) MSF PA System – The MSF shall be equipped with a PA loudspeaker system that shall allow personnel at the YCC to make announcements throughout the facility concerning Train parking, maintenance, and repair operations in the yard shop. The system shall operate within local regulations and applicable laws with respect to ambient noise.
- (d) CCTV – CCTV cameras shall be deployed strategically throughout the MSF to provide visual images of the MSF to be viewed at TSCC, BCC and YCC. The CCTV system shall use video analytics and/or intrusion detection systems to detect if people or objects have made unauthorized entry into the MSF Tracks including the yard wye and road crossings into the facility. The CCTV system shall be capable of monitoring Train movements throughout the yard.
- (e) Telephone System – Project Co shall provide maintenance telephones and administration telephones for all the offices and equipment rooms, including the BCC, YCC, TPS, CIHs, and electrical equipment rooms. Project Co shall provide an interface to the existing City PBX for the management and routing of the telephone extensions.
- (f) IT Infrastructure – An IT infrastructure shall be provided to support the daily office operations of Project Co including desktop workstations, printing equipment, and teleconferencing equipment.
- (g) SCADA – The SCADA systems required for the MSF includes the following subsystems:
  - (i) Traction Power – The Traction Power SCADA shall be an on-line, real-time, interactive system operated by TSCC and YCC personnel at the maintenance console to monitor and control power distribution and equipment. The shop traction power system shall include the shop TPSS, traction interlock systems, traction emergency trip systems, shop traction power switch status and shop stinger system monitoring and control.
  - (ii) Train Control – The Train Control system shall have a separate monitoring system.
- (h) MSF BMS – The BMS system within the MSF shall provide supervisory control of the shop Traction Power System, MSF electrical and mechanical systems, and communications subsystems. It shall be compatible with the OLRT SCADA system and supervision from the YCC.
- (i) Radio Communications – The City and Project Co shall utilize the existing and planned Public Safety Service Radio System for its operations. Project Co shall obtain from the Radio Supplier, dispatch workstations which shall be installed in the YCC and BCC. Project Co shall work with the Radio System Supplier to determine quantity and functionality required to efficiently operate and maintain the LRT System.
- (j) IAC – The IAC system shall control access and provide for detection of intrusion into entrance points of the MSF. Intrusion sensor activation shall sound an audible alarm

locally and trigger an alarm notification for unauthorized entry or tampering to the YCC and TSCC.

- (k) Train-to-wayside wireless System – A Train-to-wayside wireless system enabling wireless transmission of data from one device to a receptor within a limited range shall be provided in the MSF. This system shall support the transfer of Train diagnostics, passenger counts, and the transfer of recorded video between the Trains and the data servers located within a secure data room.

### **7.3 Performance Requirements**

- (a) CTS

- (i) The MSF CTS shall utilize the same network topology as the main OLRT CTS.
- (ii) The CTS shall provide hi-speed dual redundant fiber optic data connectivity to the CIHs and TPSSs within the MSF, YCC, TSCC, and main MSF communications room.

- (b) [REDACTED]

- (c) YCC

- (i) The functions within the YCC for operation and control of the MSF shall include CCTV, IAC, PA, and BMS monitoring of the electrical substation, sump pumps, pump systems, ventilation systems, car wash, cranes, lifts, wheel trueing, shop traction power substation, emergency trip system, traction power interlock system, shop traction power switch position, yard Train Control system controlling all yard track switch movements, monitoring of all yard Track switch movements, monitoring of vehicles in yard, monitoring of vehicles within the yard and up to the yard lead demark for turn over to mainline operations. In addition, the YCC shall have access to maintenance monitoring, reporting and scheduling, defect reporting, vehicle scheduling, rostering of drivers, and status of in service fleet.
- (ii) The YCC shall contain at least one workstation capable of administration of all MSF communications systems. Functions shall vary based upon the responsibility and access rights of the person who is logged on at that workstation at any given time.

- A. At a minimum, workstations shall include visual displays, keyboards, telephones, headset connection and headset, microphone, printer, and portable radio station.
  - B. The workstations shall have a yard GUI installed which shall provide a graphic representation of the track layouts and switch positions, power status, vehicle location and identification, CCTV images of the yard, logs of maintenance, SCADA status, report generation daily logs, and security status.
- (d) Yard/Shop PA System
- (i) Announcements shall be addressed to single and multiple zones within the MSF. Separate zones with separate amplifying channels and speaker systems shall be accessible individually or in combination. Zones shall be defined by operational needs and announcement sound levels shall be within applicable codes and standards.
  - (ii) The MSF PA system shall maintain a uniformly distributed sound level not less than 60dB plus or minus 30 degrees off axis, 1 meter above the floor, at Vehicle ambient noise level.
  - (iii) Automatic gain adjustment of the PA system shall be provided based upon ambient noise levels captured by ambient noise sensors. The system shall adjust volume and clarity in proportion to the increase in noise level from a preset quiet level.
  - (iv) The PA system shall be fully supervised with failure annunciation at the YCC of all major system components such as preamplifiers, power amplifiers, supervision detectors, and power supplies.
- (e) CCTV
- (i) The CCTV system camera views shall comply with any Applicable Law.
  - (ii) The CCTV system cameras within the MSF shall be capable of being controlled from the YCC, TSCC, or BCC (when active).
  - (iii) The system shall include both fixed and PTZ cameras. Cameras shall be rated for the environment installed, including day/night capabilities, heater/blower, appropriate housing, etc.
  - (iv) Camera locations shall be strategically selected to view the following, ensuring the views are clear, unobstructed, and not impaired by Structures, signage, foliage, intense lights, or any other obstacles:
    - A. All areas of the MSF exterior and perimeter;

- B. Entrances and exits to MSF buildings and access controlled locations;
  - C. Entrances to yard wye, access roads and pedestrian access through perimeter fence; and
  - D. All maintenance activities that require safety and security.
- (v) The CCTV system shall have video analytics and/or intrusion detection systems to detect if there has been unauthorized entry into the MSF Track areas within the perimeter fence.
  - (vi) The CCTV system shall interface to the IAC system. The CCTV system shall be capable of automatically displaying the best view of an access control device at YCC, TSCC, or BCC (when active) automatically either via fixed camera or PTZ preset, upon activation of an IAC system. The system shall be capable of overriding the automatic panning if necessary.
  - (vii) All CCTV video shall be recorded and stored digitally for a minimum of 30 days. The system shall automatically archive all alarm events automatically detected to the TSCC head-end storage system.
  - (viii) The system shall capture, record, store, download, view (playback), and allow monitoring of all CCTV cameras. The system shall be capable of providing simultaneous viewing, recording, and playback.
  - (ix) The resolution and clarity of captured images shall be maintained under a range of lighting conditions from darkness (>10 lux) through bright sunlight while ensuring optimal picture quality.
  - (x) The system shall safeguard and maintain authenticity of the video images using security techniques such as digital image watermarking or encryption and shall be able to demonstrate a chain of custody for data that will be used as evidence in a court of law.
  - (xi) All cameras shall have a camera identity displayed so that image loss can be detected.
  - (xii) The system shall be capable of configuring recording rate and resolution individually for each camera locally or remotely.
  - (xiii) The system shall store all recorded images in an industry accepted standard authenticated format. At a minimum, the system shall be capable to support MPEG4 and H.264 video formats.
- (f) Telephone System

- (i) The telephone system, at a minimum, shall provide maintenance telephones located in communications rooms, electrical equipment TPSSs, CIHs, the BCC, and YCC.
  - (ii) The system shall provide clear and intelligible communication suitable for the environment the telephones are installed in.
  - (iii) The telephone system shall be fully compatible with the main OLRT telephone system. The PBX at the TSCC shall provide call routing and processing for all telephones in the MSF.
- (g) SCADA System
- (i) The SCADA systems within the MSF shall be capable of being controlled from the YCC, TSCC or BCC (when active).
  - (ii) The SCADA system shall facilitate the transmission of indications and alarms from the RTUs to the TSCC or YCC as described previously via the CTS. Transmissions shall include:
    - A. Traction Power alarms, indications, and control signals.
    - B. Train Control alarms, indications, and control signals.
    - C. Facility power alarms, indications, and control signals.
    - D. Communications Systems alarms, indications, and control signals.
    - E. Lighting controls, auxiliary equipment monitoring such as HVAC and electrical equipment.
  - (iii) Indications transmitted from the RTUs to the processors shall be processed to provide monitoring information to all required subsystems, generate commands to be transmitted back to the RTUs, provide information for displays and alarm processing at the control consoles, and store information and historical data for future processing.
  - (iv) For each remote location, the SCADA system shall display the following items on the SCADA monitoring workstations:
    - A. Current system and subsystem status
    - B. Control panel status
    - C. Remote control RTU functions
    - D. Alarm handling and fault resets

- E. Historical event logging
- (v) RTUs shall operate in a full-duplex mode in which each continuously scans and reports the status of indicators and commands.
- (vi) Each RTU shall be designed to interface to the CTS. The RTU shall have electrical isolation between the system inputs/outputs and the CTS units.
- (vii) Each remote, monitored location shall contain a local human-machine interface for local alarm annunciation and system local control.
- (viii) Emergency conditions shall immediately be displayed within 3 seconds on the operating displays in TSCC to permit the monitoring of device actions.
- (h) Radio Communications
  - (i) The radio communications in MSF shall support operations, maintenance, security and management personnel. A dispatch console with connectivity to the City's switching site shall be installed in the BCC and YCC.
- (i) Intrusion Access Control System
  - (i) The IAC systems within the MSF shall be capable of being monitored from the YCC, TSCC and BCC (when active).
  - (ii) The system shall provide controlled access and detect intrusion of the following:
    - A. TPSS;
    - B. CIH;
    - C. YCC;
    - D. BCC;
    - E. MCR;
    - F. External doors, entrances and exits of the MSF; and
    - G. Yard perimeter and access gates including the yard wye.
  - (iii) All cardholders shall have access based on facility, card reader, time, and day. The system shall allow Project Co or the City to define access levels and apply them to any or all cardholders. Access authorization shall be denied by credential holder, time of day, group of staff, shift, and any additional characteristics that are identified by the system controller database.

- A. Access cards shall be provided by Project Co to approved City staff for entry into the MSF, CIHs, TPSS, and vent plants.
- B. Access cards shall be provided by the City to Project Co staff for entry into private station areas and the TSCC.
- (iv) The IAC system which is interfaced with the CCTV system shall provide staff within the TSCC, BCC and YCC with the display of video of the nearest CCTV camera providing coverage of that area, upon activation of an IAC alarm.
- (j) Train-to-Wayside Wireless System
  - (i) The Train-to-wayside wireless system shall provide all LRVs with a wireless data connection at the MSF for the data transfer of Train diagnostics, passenger counts and recorded video from the NVR.
  - (ii) The Train-to-wayside wireless system shall be an extension of the CTS. A LAN connection shall be provided between the wireless access points and the nearest communications room in order to connect to the CTS WAN.
  - (iii) The system shall provide the latest wireless technology standards with backwards compatibility of established standards as needed. The system shall be fully compatible with the LRV systems.
- (k) Systems Infrastructure Interface
  - (i) Each communications system element has a requirement for both power supply and data transmission. Project Co shall supply and connect the power requirements necessary for each communications device to operate properly in accordance with appropriate codes to each device location in a raceway system. Project Co shall supply and connect the data transmission requirements necessary for each communications device to operate properly to each device in a raceway system.

**ARTICLE 8           VEHICLE SERVICE EQUIPMENT**

**8.1    Overview**

- (a) Project Co shall provide all equipment, accessories, materials, etc, and building systems to meet the maintenance requirements of the Project Agreement.
  - (i) Project Co’s maintenance responsibilities related to the Vehicles and the right of way are detailed in Schedule 15-3 – Maintenance and Rehabilitation Requirements. Project Co shall provide the required major equipment and appurtenances to comply with these requirements
- (b) Minor Equipment and Appurtenances
  - (i) Project Co’s maintenance responsibilities related to the Vehicles and the right of way are detailed in Schedule 15-3 – Maintenance and Rehabilitation Requirements. Project Co shall provide the required minor Equipment and appurtenances to comply with these requirements.

**8.2    Baseline Requirements for Industrial Equipment**

- (a) This section sets forth baseline requirements that apply to all Vehicle service Equipment defined herein.
- (b) General Requirements
  - (i) Equipment shall be manufactured, installed and operated in accordance with all industrial and safety standards (or portions thereof) that apply to the Work, including but not limited to:
    - A. CCOHS;
      - i. OHSA
    - B. CSA;
      - i. CSA Standard C22.2 No 94
      - ii. CSA Standard C390-10
      - iii. CSA W47.1
      - iv. CSA W59
    - C. CEAA;
    - D. CGSB;
    - E. CISC;

- F. CWB;
- G. NBCC;
- H. NFCC;
- I. NPCC;
- J. OBC; and
- K. OESC (Ontario Regulation 164/99).

(ii) Labeling

- A. Manufacturer shall securely attach in a prominent location on each major item of Equipment a noncorrosive, indelible nameplate showing manufacturer's name, address, model number, serial number, and pertinent utility or operating data.
- B. All electrical Equipment and materials shall be new and shall have attached labels attesting to CSA or Electrical Safety Authority approval, in categories for which standards have been set by that agency and labeled as such in the manufacturer's plant.