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APPENDICES

SCHEDULE 15-2
DESIGN AND CONSTRUCTION REQUIREMENTS

PART 5
LMSF

ARTICLE 1 INTRODUCTION

1.1 Introduction

(a) This article outlines the guidelines and performance criteria that are necessary for DB Co to carry out the final design and construction for the various components and elements of the Moodie LMSF for the Project. The LMSF shall serve as the maintenance and storage facility for the City and shall house the Vehicles for the initial Confederation Line Extension of the Vehicle fleet. This Work requires coordination and interaction with other work by DB Co, including but not limited to the Mainline Track. DB Co shall design the LMSF to meet the Vehicle peak daily service requirements.

(i) Features of the Work shall include,

A. Construct all Track;

i. Furnish and install new turnouts, crossties, ballast, and necessary appurtenances.

ii. Install new rail throughout.

B. Retaining walls and miscellaneous concrete Structures;

C. Buildings as further defined below.

(b) This section summarizes the requirements that are otherwise detailed in the remaining Articles of this Part 5.

(i) Site Summary

A. The site is located on a parcel of land located between Highway 417 and Corkstown Road. The western site boundary is the ROW for the **[REDACTED]** and the eastern site boundary is the Moodie Drive/Highway 417 interchange. The development of the facility for Phase 1 shall not disturb the Trans Canada Trail, also located at the western boundary of the site.

B. This site currently is a greenfield site.

C. A neighbouring development to the north of LMSF Corkstown Road is Wesley Clover Parks recreational facility.

(c) Facility Summary

(i) The LMSF (Phase 1) shall be designed to maintain and store 24 Vehicles required by the City and shall protect for the future interim Vehicle storage capacity of 64 Vehicles (Phase 2) within the confines of the Lands and the ultimate build-out for storage capacity of 90 Vehicles (Phase 3) in the yard area. The specific timeline for the future expansion is unknown.

(ii) Phase 2 shall add capacity to the storage yard, augment the Phase 1 Vehicle Service & Maintenance Shop with two additional light maintenance shop Tracks, offices, welfare spaces, back shops, and storage; provide for MOW functions as described for Phase 1, and include a new Office Building as detailed below. Phase 2 shall be contained within the existing Land.

(iii) Phase 3 shall add capacity to the storage yard, augment the Phase 2 Vehicle Service & Maintenance Shop with one additional, stub-ended heavy maintenance shop Track, as detailed below. MOW functions as described for Phase 1 shall be provided

(iv) The LMSF will serve as the service center and light maintenance center for the portion of the Vehicle fleet prescribed above. 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. DB 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. DB Co shall design the site to protect for Phase 2 including future interim Storage Tracks within the Lands provided in Schedule 20 – Lands.

D. DB Co shall protect for Phase 3 inclusive of the additional final build-out of Storage Tracks an expanded administrative office and operator welfare building (LMSF Office Building) with associated parking.

i. The City acknowledges for implementation, Phase 3 may require the realignment of Corkstown Road and additional property not identified in Schedule 20.

E. The design shall incorporate space for snow storage for current and interim site development for Phase 2.

F. The site shall be secured at the perimeter with a minimum 2.4m high fence and gate system. Gates shall be motorized and shall be operable through the facility access control system. The fence along Corkstown Road shall be architectural and shall comprise of powder coated weld wire mesh or steel pickets. Other fenced areas, not readily visible to the public, may be

chain link. The security fence between the yard and Highway 417 shall be provided with a glare screen, where required, so that Vehicle headlights will not shine on Highway 417. The yard shall be designed so that snow cleared by Highway 417 does not fall into the yard. Intrusion detection shall be contiguous with the perimeter fence.

G. All structures crossing Stillwater Creek shall be designed and constructed to minimize the reduction of daylight at the creek level an along its banks. Crossing Track structures shall be open design. Only a single crossing shall be permitted for pedestrians and motorized service carts and this shall be limited to 3m in width. The pedestrian and motorized service cart Structure will be permitted to have a closed deck. The only other crossings permitted shall be for Tracks. DB Co shall design the crossing structures with particular attention given to the requirement that the creek shall receive the maximum amount of daylight. DB Co shall demonstrate that its design solution minimizes the impact of the development on the creek.

(v) DB Co shall design the site so that there shall be six or less parallel sets of Tracks for the initial site development.

(vi) LEED:

A. The Office Building shall be designed for LEED® "Certified" status.

B. DB Co shall register the LMSF with the GBC and provide documentation for all credits necessary for "Certified" status.

(vii) Accessibility:

A. Where applicable, DB 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.

(viii) The LMSF shall be designed in accordance with CPTED. For further clarity, the design of the LMSF shall be included in DB Co's independently contracted CPTED review and report, required under Schedule 15-2, Part 4, Clause 1.3(b).

(d) General Maintenance Philosophy: The LMSF design shall allow for flexibility in Vehicle maintenance procedures.

(i) The design and operation of the LMSF, 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 that they are paired as two car Trains within the storage yard;

B. The goal of the maintenance building is to return the Vehicles 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; and,

C. Heavy maintenance shall be performed at the MSF on Belfast Road.

(e) General LMSF Operations Philosophy

(i) The LMSF shall provide for maximum safety and flexibility in Train movements. Direct access from the mainline to the LMSF Tracks shall be provided. Track shall be designed free of single points of failure and shall limit the number of turnouts and other special Trackwork for the most heavily used portions of the yard (i.e. those associated with daily routines). Designs shall be free of single point of failures for each phase of the construction. However, in Phase 1, a failure at the east end of the storage yard that will allow access to the Mainline for half of the storage Tracks is not desirable, but is acceptable.

(ii) Double leads shall be provided off of the Mainline Track extending to the Yard Track ladder, and shall be accessible from either Mainline Track via a double or universal crossover arrangement that precedes the yard limits. One of the leads may pass through the S&I building and then through to the storage yard.

(iii) Positive mechanical protection shall be provided to ensure no stray Trains escape onto the Mainline and shall be under the control of the TOCC and interlocked with the Train Control System and signals governing movement across those Track segments. Runaway or stub-end Track shall be provided to ensure stray Trains safely traverse off the Yard Lead Tracks, through the diverging route of a turnout, preventing access to the Mainline. Positive mechanical control shall ensure stray Trains safely traverse onto runaway or stub-end Track from any proposed or future handover Track. Runaway or stub-end Track shall be equipped with a bumping post to ensure Vehicles are undamaged and able to return to service in the event of a stray Train escaping.

(iv) DB Co shall design and construct a parking facility (minimum 40 spaces) for the City within logical proximity of the Vehicle handoff platform and no fewer than 10 additional parking spaces at Vehicle maintenance building.

(v) At the location within the LMSF, where the Operator will take control of Trains, DB Co shall provide the following facilities:

A. An enclosed/heated office for the City supervisor who will be responsible for the handoff; and,

B. DB Co shall work with the City to define the specific functional requirements for the spaces outlined above.

C. One handoff platform shall be provided. The staging area for the handoff platform shall be a conditioned vestibule integrated into the LMSF Office Building, which provides a clear view and direct access to the Operator handoff platform.

D. MYCC windows shall have a full view of the Operator handoff platform, plus as wide a view of the yard as possible. Optimized and logical flow of the yard (handoff, daily servicing and storage) shall take precedence over this latter criterion.

E. Ancillary spaces such as fire sprinkler, mechanical, electrical rooms, equipment, etc. shall be provided as required to support the facility by DB Co. They may be placed as needed for functionality and as permitted by Code. Designs shall exhibit that they are not environmentally detrimental (visually intrusive or causing noise and vibration) to the community or to work areas.

(f) LMSF Operations Criteria

(i) Maximum LMSF design speed shall be 15km/hr.

1.2 LMSF Functions and Requirements

(a) At a minimum, DB Co shall design and construct the LMSF to accommodate the following:

(i) To satisfy all Operational scenarios of the Agreement;

(ii) All necessary functions to support the initial LRT line network while protecting for the future expansion of the facility. DB Co shall present designs that show how the future expansion will be accommodated without interruption of normal facility function;

(iii) Rooms and spaces within the facility as identified in the room Data sheets, in Appendix A of this Part 5, for use and occupation by City staff and Project Co;

(iv) Phase 2 and 3 level of design development shall be sufficient to illustrate the future build out can occur and how it would meet functional requirements (e.g. Operator access to handoff platform during construction or truck access to parts storage, expansion of Shop and Storage Yard/Building). DB Co shall clearly demonstrate its approach to phased build out throughout the submittal process. DB Co shall demonstrate that Phase 2 facilities will fit within the Lands identified for the LMSF, and that it can be constructed without interruption of transit operations. DB Co shall indicate the impact of the proposed Phase 3 concept on Corkstown Road, the Trans Canada Trail, and **[REDACTED]** mainline.

(v) Roadways and other paved areas, Utilities, signaling, communications, access control and other security features, and other miscellaneous features for a complete and operational facility; and,

(vi) Delivery and warehousing of parts, equipment and materials. Roadway circulation shall accommodate tractor-trailers with 16m trailers. Vehicles delivering parts and materials shall not foul Tracks when on or off loading.

(vii) The City recognizes that some demolition may be required to permit the Phase 2 and 3 expansions in order to optimize ultimate functionality. DB Co shall present designs that minimize impacts to operations during construction.

(viii) With the exception of persons performing maintenance of Vehicles on shop Tracks or cleaning Vehicles in the storage shed, at no time shall any staff be required to cross facility Tracks to access any area of any LMSF building or parking area.

(ix) S&I, light maintenance, and heavy repair Tracks shall be adjacent to one another. Movement between Tracks shall not be interfered with or blocked by storage, office, or other ancillary space.

(b) The LMSF is subject FLUDTA and design approval by the NCC under Section 12 of the National Capital Act.

(i) Refer to Schedule 15-2, Part 4, Clause 1.2 (l) for general requirements.

1.3 Administrative, Welfare and Training Functions

(a) The administrative and training functions for the LMSF facility shall be at the LMSF Office Building, providing easy and direct access from Corkstown 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 LMSF shall be conceived and designed to permit ready expansion to accommodate the staffing and functional requirements of interim and final LMSF build-out. The Phase 1 building shall not be required to be conceived as an integrated part of the interim and final building. Should DB Co opt to show the expansion of the LMSF Office Building as an addition to the initial building, it shall demonstrate how the spaces in the initial build out will be repurposed or expanded;

(iii) Public access shall be through a secure vestibule on the first floor. Direct public access to the shop, warehouse, and any other industrial areas shall not be permitted;

(iv) Administrative, training and welfare areas shall be isolated from the transmission of sound and vibration;

(v) 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;

(vi) Dispatcher shall, to the fullest extent possible, be positioned with a view of Operator staff;

(vii) The LMSF Office Building shall be sufficient to house the specified program for the initial LMSF build-out. It shall be positioned to be fully operational and not impinge upon the construction of a new LMSF Office Building size to house the Operator for subsequent interim and final build-out stages of the LMSF development.

(viii) DB Co shall submit designs that clearly indicate the future welfare expansion of the site can be constructed without impact or compromise to the operations of the LMSF as initially constructed and operated.

(b) Design shall protect for:

(i) A Phase 2 Office Building which shall be 934m^2 minimum area.

(ii) Handoff platforms shall be expanded to two during the Phase 2 expansion. Operators shall not be required to cross any Track to access a handoff platform.

1.4 Vehicle Storage and Future Expansion of LMSF

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

(b) Vehicle Storage Tracks shall be under roof, illuminated, and have full fire sprinkler coverage. Side walls shall be incorporated to the full extent possible without triggering the requirement for mechanical ventilation. The location of wall openings shall be subject to a microclimate analysis in order to reduce the impact of extreme weather conditions on the parked Vehicles. The storage shed shall be designed to accommodate storage of two-Vehicle Trains, but space for up to 4 single uncoupled Vehicles shall be accommodated (within the total shed Vehicle capacity).

(c) Initial yard storage capacity shall be 24 Vehicles

(d) Design shall protect for:

(i) Interim yard storage capacity of 64 Vehicles within the confines of the property;

(ii) Full build-out yard storage capacity of 90 Vehicles which may require the realignment of Corkstown Road northward. Other development shall be within the Lands;

(iii) System expansion to Kanata from the LMSF yard via a grade separated, two-Track expansion across the **[REDACTED]** with Storage Track geometry designed to be completely double ended at the completion of this expansion. The elevation of the **[REDACTED]** alignment shall remain as currently fixed. DB Co shall design and demonstrate that its design complies with this requirement for all phases, although it is not presently anticipated that this crossing will be completed before Phase 2 is constructed;

(iv) Phase 2: Two light maintenance (progressive maintenance) Tracks in a shop building expansion. See Clause 1.7 (f) and (g) of this Part 5. Phase 3: An additional third heavy repair Track in a shop building expansion. See Clause 1.7 (i) of this Part 5.

(v) DB Co shall present staged designs that show how these requirements will be accomplished; and,

(vi) Future expansion of Highway 417 to the north of the existing travelled lane limit of pavement including a 3.75m travel lane, 3m shoulder and provisions for required barriers between Highway 417 and the future system expansion to Kanata.

(e) At least one side of each Vehicle parked in the shed shall be accessible from a paved surface of adequate width and structural capacity to permit the passage of a 1255mm wide, 3,000mm long, 1,000 kg, motorized utility cart. Walkways shall permit turnaround of cart at each end. Pedestrian and road vehicle access to the Vehicle storage shed is required.

(f) CBTC sectionalization in the shed shall allow for all Tracks adjacent to an asphalt walkway to be closed to automatic Trains when a worker is on the walkway. The system shall allow for this to be done from the MYCC and locally using keyed CBTC Emergency stop switches. The number of zones may vary based on the DB Co design

(g) OCS shall also be sectionalized with separate feeders, one for the two north most Tracks, and one for the two south most Tracks.

(h) A heated and ventilated building shall be provided of approximately $15m^2$ and shall be constructed immediately adjacent or as a part of the Vehicle storage shed to provide convenient access for car cleaners for cleaning supplies and storage of materials. Provide standard office lighting levels, double, lockable swinging doors, a floor mounted janitorial sink with minimum 7.5L/min instantaneous hot water heater. Heavy duty industrial shelving, min 500 kg/m^2; 600mm deep, min. 75L/min; brace at floor and floor deck above.

1.5 Moodie Yard Operational Control Functions

(a) Facility shall provide for the day to day operations of the yard via UTO which shall be the primary method of positioning Vehicles for maintenance, inspection, storage, and revenue service handoff to the Operator.

(b) All routes within the Moodie LMSF yard limits shall be under operational control of the MYCC.

(c) All routes exiting the Moodie LMSF limits onto the Mainline Tracks shall be under operational control of the TOCC/BCC.

(d) The transfer of operational control between the MYCC and the TOCC/BCC for Trains entering and exiting the Moodie LMSF to/from the Mainline Tracks is to integrate an S&TCS to address the following:

(i) All switches located on the Mainline Tracks that provide access to the Moodie LMSF shall be under separate control by the TOCC/BCC though means of a signalized interlocking with wayside signals in addition to the on board cab signaling system.

(ii) All switches located within the Moodie LMSF shall be under separate control by the MYCC through means of signalized interlockings with wayside signals in addition to the on board cab signaling system.

(iii) Routing of all Vehicles between the mainline interlockings and the Moodie LMSF interlockings shall be established by direct data communications shared between the S&TCS GUI of the TOCC/BCC and the S&TCS GUI of the MYCC.

(iv) A Train Control transition zone shall be established to hold Vehicles entering or exiting the Moodie LMSF until the appropriate route is established. The signals of either interlocking shall be used to govern the Train movement through the entire route until the Train is fully under control of the TOCC/BCC or the MYCC.

(v) The length of the transition zone shall ideally be sufficient to accommodate the maximum anticipated length of a Train without having any part of the Train stopped over a switch. However, in the event that Track geometry design and available spacing cannot prevent the Train from sitting over a switch while stopped in the transition zone, a Train may be stopped over a yard switch provided that the following is adhered to:

A. The position indications of the yard switch(s), for both normal and reverse, are shared from the MYCC to the TOCC/BCC.

B. The position indications of the interlocking switch(s), for both normal and reverse, are shared from the TOCC/BCC to the MYCC.

C. The Track occupancy of the transitions zone area is shared with both the TOCC/BCC and the MYCC.

D. Safety precautions shall be taken to ensure that any switch cannot be thrown underneath the Train due to loss of shunting.

E. The Train shall never be stopped over a mainline switch under any circumstances.

(e) The overall design concept involving a Train stopped over a switch in the transition zone shall be submitted to the City prior to procurement and installation.

(f) The interface design for route establishments between the S&TCS of the mainline interlockings and the S&TCS of the Moodie LMSF interlockings shall be compliant with the operational procedures established between the City and Project Co.

(g) All elements of the S&TCS of the Moodie LMSF and the mainline interlocking, that require design adjustments for the operational control functions noted above, shall remain in compliance with the S&TCS as described under Schedule 15-2, Part 3 – Systems.

1.6 Crew Dispatch

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

(b) Crew dispatch areas shall be located proximate to and provide convenient access to Vehicle handoff platform. The handoff platform shall be a part of the Operator building. The Open Offices and the Operators' Day Room (aka Break Room) shall be immediately adjacent. One of the work stations in the Open Office area shall have an operable (sliding) window into the Operators' Day Room to facilitate dispatch of Operators. Additionally a stainless steel cabinet with doors on either side of the wall, measuring in area approximately 0.42m^2 and 200mm deep, shall be provided for storage and charging of Operator radios. Access control shall be provided on the Day Room side; locking shall not be required on the Open Office side. Stainless steel shelving and charging connections shall be provided for 24 radios.

(c) Functional areas include:

(i) Lobby;

(ii) Data and communications room;

(iii) MYCC;

(iv) Day room for the Operator;

(v) Welfare facilities for the Operator;

(vi) Management offices for the Operator;

(vii) Storage areas for the Operator; and,

(viii) Visitor's office area.

1.7 LMSF Vehicle Maintenance Service & Inspection Building

(a) It is of paramount importance that the LMSF in general shall be designed with safety as the preeminent design factor. In particular, because of the use of UTO within the Service & Inspection Building, industrial workflows and process shall consider that this can be a noisy environment and that optimizing sight lines and minimizing blind corners and safe crossing of potentially live Tracks is essential to the safety and wellbeing of facility employees. DB Co shall present designs that clearly indicate how potential work place hazards have been eliminated or mitigated;

(b) The LMSF S&I Facility shall comprise a single, double-ended S&I Track, welfare and office facilities for Project Co, materials storage and ancillary spaces to support the maintenance and daily servicing of the Vehicle fleet housed at the LMSF

(c) The S&I Facility shall include any and all light progressive maintenance (that does not require lifting Vehicles), including seat repairs, window replacement, flooring replacement, door repair, electronic component replacement, replacement of pantographs and AC units, and systems testing.

(d) The S&I Track shall be fully capable of and designed for UTO operation.

(e) High bay parts storage of not less than 7600mm vertically clear shall be provided for the activities performed on this Track and shall include a full inventory of the parts, supplies, and materials required to maintain the Vehicles. Mezzanine storage is not required for Phase 1. Areas by Phase shall be as follows:

(i) Phase 1: 90m^2.

(ii) Phases 2 & 3: 200m^2 on ground floor and 100m^2 on mezzanine (areas are not expanded in Phase 3).

(f) S&I Track shall provide ample space for the daily service and inspection of Trains which shall be conducted on a single Track of sufficient length to enclose the Train in a conditioned S&I space per the mechanical requirements specified herein.

(i) Inspection Track shall be direct fixation on a slab that slopes at 2% to a continuous floor drain centered on the gage of the Track, running the full length of the space. Bottom of rail shall be 40mm above finish floor to allow water and detritus to move freely to a gage centered trench drain. Crossing aisles, flush with TOR not less than 3.5m wide shall be provided at each end of the S&I Track. At least one side and both ends of the Vehicle shall be accessible by a forklift without repositioning the Vehicle.

(ii) Platforms at rooftop elevation shall be provided along one side of the Track for the length of the consist to provide access to and visual inspection of the Train rooftop and pantograph. Platform shall provide access to the Vehicle roof for the specified maintenance activities. Platform shall have guardrails that prohibit access to the Vehicle and OCS without the OCS being deenergized first. Fall protection shall be provided for the length of the consist.

(iii) A fail safe system (e.g. Kirk key) shall be employed to integrate OCS deenergization with locked vestibules that prohibit entering the platform if the OCS is not deenergized. This system shall be operable in a failsafe mode from both ends of the platform.

(iv) Lighting shall be provided as specified for Maintenance Facility occupancy and additional low level lighting shall be provided for undercarriage inspection.

(v) Compressed air hose and trouble light with duplex outlet shall be on 4 reel sets at 4m centres along each consist side and on each side of the Track. Length of hoses and cords shall be sufficient to reach all areas of potential service for a given level of shop floor.

(vi) The S&I Track shall be on and precede an automatic, drive-through trainwasher. It shall be isolated from the trainwasher by a high-speed bi-fold door and have positive pressure mechanically in comparison to the train washer space.

(vii) An automatic, drive-through trainwasher shall be positioned in a conditioned space on the same Track and immediately adjacent to and contiguous with the S&I space. The Train washer shall employ equipment that is designed for the specific purpose of washing Vehicles and which is capable of providing a spot free wash that does not damage the Vehicle, applied graphics including advertising, or components. Washer shall clean all sides of the Vehicle including the under carriage and trucks, rooftops and interstitial space between Vehicles.

(viii) A water reclamation system shall be employed that is compatible with the sustainability goals of the project. Final rinse water shall be stripped from the vehicle surface using high pressure air blowers or other acceptable means prior to exiting the wash enclosure. All effluent discharged from the system to the sanitary sewer shall be pretreated to comply with applicable codes and effluent quality standards. See Article 8 for additional requirements.

(ix) Provide level Track crossings (embedded Track) at both ends of the S&I bay to allow equipment movements from one side of the bay to the other.

(x) Shop doors shall be bi-fold due to OCS. Note that all maintenance shop Train doors shall be bi-fold as there shall be OCS on all Tracks.

(xi) DB Co shall work with the car washer manufacturer to determine the specific requirements for a car washer that meets the requirements of this Part 5 inclusive

of, but not limited to: room sizes, clearances, wash and drying equipment, utility connections, effluent discharge, and storage, for a fully functioning system.

(xii) A hot water pressure washing system shall be provided in the S&I bay and shall provide full Vehicle coverage for a Train. Pressure washing: three stations at each Vehicle; minimum overlap of coverage shall be 3m, at Vehicle ends, hose shall be capable of extending to the far corner of the Vehicle on opposite rail. Stations shall be located at 8.15m, 24.445m, and 40.74m.

(xiii) A 2-ton monorail crane shall be configured to facilitate movements of parts and equipment from the Vehicles and rooftop platform to the main floor at each end of the consist. The crane shall be interlocked with the OCS, such that the OCS cannot be energized unless the crane trolley is in the home position and the hook is fully retracted. The crane shall run the entire length of the S&I Track and shall be centred on the rail gage. The monorail crane shall extend fully over the crossing aisles at both ends of the S&I Track.

(xiv) Distribution of sand and windshield washer fluid and pressure washing wands sha1l be as follows (zero point for dimensions is coupler face of Vehicle when parked):

A. Pneumatic sanding with storage capacity of 45000kg/28000L of sand. Sand distribution shall be provided with dispensers aligned with all sand fill ports on a 2-Vehicle consist; 5.23m from either end and at the midpoint of the Vehicle; minimum 4m reach shall be possible as measured from the midpoint along the face of the Vehicle;

B. Washer fluid: 1m from each end of Vehicle. Washer fluid tank shall hold 2200L and shall be located in the Train wash equipment room providing same access as the wash chemical tanks. All tanks shall be accessible by facility roadway; and,

C. Road access to the sanding system silo and the Train washer chemical rooms shall be provided with sufficient width, design section and clearances to permit tractor and 12m trailers combos to access equipment.

(g) The design shall protect for the future Phase 2 construction of two light maintenance shop Tracks. They shall be double ended and have the capacity for two uncoupled Vehicles on each Track. Tracks shall each have independent stinger power. These Tracks shall have the following characteristics:

(i) Sufficient space shall be provided for maintenance and materials movement activities at all ends and sides of all Vehicles. Tracks shall have 5m of clear floor area, measured parallel with the Track.

(ii) The general arrangement of Track shall be on pedestal Track with a main pit elevation of 950mm below finished floor/TOR and gage pits with elevation an additional 800mm below that. Gage pits shall be long enough to permit access to

ends of vehicles for coupler work including meeting couplers between vehicles. Main pit shall be minimum 14,350mm wide. Tracks shall be on minimum 7,700mm centers. Provide forklift accessible ramps to all sides of Tracks. Forklift access shall also be provided at grade for the entire length of the pit area, providing access to the cross aisles at the far ends of the shop.

(iii) All pit floors shall be slabs that slope at 2% to a continuous floor drain centered on the gage of each Track, running the full length of the space.

(iv) Continuous rooftop maintenance platforms shall be provided at 2954mm above finished floor and shall run the full length of the shop on both sides of each car. Stair access shall be provided at each end and mid-points of all platforms (4); Kirk key or other failsafe means of deenergizing the OCS shall be provided and shall control all access points to individual upper platforms. Track upper platforms shall be fully segregated from each other (as one can remain energized while the other is not), and have a gate at the midpoint to isolate half of the platform.

(v) Code compliant fall protection shall be provided at all elevated platforms. Removable guardrail sections shall be provided as required, as well as gates dividing platforms east-west at midpoints required to mitigate fall hazard if a single Vehicle is in the bay. They shall be fabricated from aluminium of a grade suitable to withstand loading and the industrial environment.

(vi) Hotel power stingers shall be provided at the midpoint of each Vehicle. Jibs shall be a minimum of 2.5m clear over the walking surface of the platform and shall extend to the centerline of the Track. Stinger cable shall be capable of reaching the connection point on the Vehicle regardless of from what direction it enters the shop from. Stingers shall be interlocked with the OCS such that the OCS cannot be energized unless the stinger is disconnected and the jib is secured in the home position.

(vii) Monorail crane service shall be provided for the full length of the shop. The crane immediately adjacent to the mezzanine associated with the upper parts storage and equipment shops shall directly access back shops and storage at a second floor mezzanine long one side of the shop. The cranes shall be 2-ton and one shall be configured to facilitate movements of parts and equipment from the upper platform and to the mezzanine as noted above. The intention for the monorail crane accessing the mezzanine is to create horizontal work processes, i.e. storage of AC units and pantographs on mezzanine adjacent to Vehicle rooftop on light maintenance Track. Both shall also be capable of accessing parts and equipment from the main floor and service pit. All monorail cranes shall be interlocked with the OCS, such that the OCS cannot be energized unless the crane trolley is in the home position and the hook is fully retracted.

(viii) Compressed air and trouble light with duplex outlet shall be distributed via hose reel sets at each Vehicle truck. Hose reel sets on pit wall sides shall be recessed in

alcoves in the pit walls. Centre reel sets shall be supported from the overhead catwalk. Similarly compressed air and trouble light with duplex outlet shall be on reel sets at the quarter points of each Vehicle and on each sides of the Vehicles.

(ix) Pit lighting and other fixtures shall be recessed where possible or in plane with structural columns so that the available working width of the pits is maximized.

(x) Specific utilities shall be placed as follows (zero point for dimensions is nose of vehicle when parked):

A. At floor level:

i. 120V 20A every 20m, both sides, mounted to rail posts;

ii. Compressed air, every 25m, both sides, mounted to rail posts; and,

iii. Water, every 50m.

B. At upper platform level:

i. 120V 20A on both sides of platforms, every 20m;

ii. Compressed air paired with 120V (every 20m); and,

iii. Stinger power, two per Track, positioned as noted above.

(xi) Road access to the sanding system silo and the Train wash chemical rooms shall be provided with sufficient width, design section and clearances to permit tractor and 12m trailers combos to access equipment.

(h) Phase 1 non-shop functional areas shall include:

(i) Secure lobby;

(ii) Conference room;

(iii) First aid/safety equipment room;

(iv) Break room;

(v) Women’s locker room, shower and washroom;

(vi) Men’s locker room, shower and washroom;

(vii) Janitor’s closet;

(viii) Data and Communications (server) room;

(ix) Open office;

(x) Copy/office supply room; and,

(xi) Supervisors' offices (2).

(i) The design shall protect for the future Phase 3 construction of a dedicated heavy repair Track in a shop building expansion. The Track shall have capacity to work on two, decoupled Vehicles and provide enough separation between Vehicles to allow simultaneous work on the facing ends of the Vehicles. The provision for this LMSF Track shall be adjacent to, and in the same space, as the two light maintenance Tracks. Track shall be flat floor, may be stub ended, and shall be in close proximity to and directly accessible to parts storage without crossing other Tracks. Forklift access shall be provided to each side of the Track. Track shall be fitted with a 10-tonne overhead crane. The addition shall not impact major utility installation nor block access to them. It shall be located so as to have virtually no impact to ongoing LMSF operations during construction.

(j) Parking shall be provided for future phases as follows:

(i) 96 parking spaces for Phase 2; and,

(ii) 144 parking spaces for Phase 3.

1.8 Service and Inspection

(a) A Vehicle or Vehicle consist coming out of service shall be routed to the S&I Track constructed as described herein.

(b) Daily Activities:

(i) The operator will spot the consist at the appropriate point. The Train will generally remain energized during the daily activities. The primary daily activities shall consist of the following:

A. Walk-through of the consist to identify any issues related to damage or vandalism;

B. Adding sand to the sand boxes (as required based on consumption) – pneumatic sanding system with a filling hose at each sandbox fill point;

C. Checking window washer fluid and topping off as necessary; and,

D. Visual inspection of the Vehicle exterior and couplers.

(c) Additional Activities:

(i) The S&I Track shall be configured such that minor repairs and component change-outs can also be completed on the Track. At roof level, visual inspection of the Vehicle roof, including pantograph wear strip, by means of the roof-level platform

(key interlock system requires the OCS catenary to be de-energized before accessing the platform). The carbon wear strip on the pantograph can be replaced. The 2-ton monorail hoist and OCS shall be configured to enable **[REDACTED]** to perform change-out of an HVAC unit, the entire pantograph or remove other rooftop elements. Enabling fall protection system(s) shall be provided for rooftop work activities.

(ii) Basic car cleaning, and vandalism repairs, will occur later when the Vehicle is on a Storage Track.

(iii) Phase 1 undercar inspections, especially of the brakes, will require the Vehicle to be placed over a pit at another offsite facility, typically on a weekly basis.

(iv) For Phase 1 scheduled / preventive maintenance will occur at another offsite facility equipped for that work.

(v) Vehicle wash:

A. After S&I activities are complete, the Vehicle proceeds forward into the automatic washer.

B. Vehicle presence detectors shall sense the leading and trailing edges of the Vehicle, and automatically activate and deactivate the detergent application arch, brushes and rinse arches, and blowers, in the correct sequence. The Vehicle normally will pass through the washer at a low constant speed (approximately 3 km/hr). Excessive speed or stopping shall trigger an alert and eventually an automatic shutdown of the machine. Colored lights and digital speed display shall assist maintenance personnel in maintaining the optimum speed for detergent “dwell time” and brushing action.

C. There shall also be a “no wash” option that can be selected by the maintenance personnel.

D. After being washed, the Vehicle will typically be routed to the storage Tracks for cleaning and overnight storage, or into the shop for scheduled or unplanned repairs.

1.9 Room Data Sheets

(a) DB Co shall include within the LMSF, the rooms identified in the room data sheets provided in Appendix A. These sheets contain additional requirements for the design and construction of required rooms within the LMSF. All rooms included in Appendix A shall be included in Phase 1, unless otherwise noted.

1.10 LMSF Maintenance of Way Facility

(a) The LMSF MOW facility shall be at a minimum 435m^2 (minimum clear width of 10m measured perpendicular to Tracks) with an embedded Track of not less than 45m in length and shall be suitable for materials storage of all components associated with the maintenance of the Confederation Line East or West Extensions that must be stored in a weatherized, heated and ventilated enclosure. The MOW facility shall be designed and constructed as follows:

(i) Facility shall allow the passage of rail and hi-rail vehicles commonly used for MOW activities.

(ii) Rail shall be embedded type and shall be designed to 26 kPa minimum in areas of rail vehicle influence and minimum12 kPa loading elsewhere.

(iii) Electrical, lighting and mechanical systems shall be as specified for LMSF facility except that the space shall only be heated and ventilated. Air conditioning shall not be required. Fire suppression system shall be as per Code.

(iv) A diesel fuel storage tank adjacent to the MOW Storage Track and accessible to delivery trucks, with a capacity no less than 2400L, shall be provided in order to fuel rail borne MOW equipment. Fuel dispensing and spill protection shall be provided.

(v) A suitable exhaust extraction system shall be provided to permit diesel equipment to be operated inside the MOW.

(vi) Provide single occupancy, universal washroom if location of MOW facility on property so dictates.

(vii) Provide cold and hot water source and enameled cast iron wall or floor mounted janitorial sink. Faucet shall be industrial grade and able to accept a water hose fitting.

(viii) Provide continuous grated trench drain 1.675mm from centerline of the MOW Track on the shop/storage side of the Track.

(ix) Provide120V 20A duplex outlets every 10m on walls parallel to Tracks. Provide 2x 240V connection evenly spaced on one wall parallel to track, and 1x 575V 3-phase connection along the same wall.

(x) Provide compressed air: two on each wall parallel to Track, evenly spaced, wall mounted. Hose reels shall be provided and have sufficient length and capacity to service all point of Vehicles stored on enclosed MOW Track.

(b) MOW facility is required in all phases (Phases 1 – 3).

(c) Provide an exterior laydown area for Track, bulk materials, other Track material, etc. of not less than 1,000m2. Area shall be accessible by road and rail, shall have a compacted gravel surface and shall be secure (fenced) from public access.

1.11 LMSF Operation

(a) The LMSF shall be able to operate as either CBTC or non-CBTC territory.

(b) DB Co shall design and implement a solution for S&TCS in the LMSF that provides:

(i) Control of power switches and interlockings from the MYCC control panel.

(ii) A display on the MYCC panel of all Trains on all Tracks and the order of the Vehicles in them.

A. The level of detail shall be selectable.

(iii) Standard signal system interlocking protection such as route locking, approach locking, detector locking, etc.

(iv) Signals at all interlockings to allow safe movement of Trains without functioning onboard CBTC systems.

(v) Yard speed limit enforcement for CBTC equipped Trains.

(vi) The Design of the yard S&TCS shall allow for coupling and uncoupling of Trains on any Tracks between interlockings.

(c) The design of the LMSF shall be based on UTO

(i) The MYCC shall not control the signals and switches in the interlockings entering or leaving the yard. These shall be controlled by the TOCC, BCC and the CBTC system.

A. CBTC transponders and wireless APs shall be installed throughout the yard including Yard Track leads approaching the interlockings interfacing with the mainline.

B. Trains which are not registered and initialized with the CBTC system shall not be permitted to leave the LMSF yard without a manual override.

C. Track design shall provide adequate clearances for UTO operation. Geometry shall not require Vehicles to stop or be stored on turnouts as part of the normal operational scenario.

(d) Moodie Yard TPSS(s)

(i) TPSS(s) shall be provided in the LMSF yard to provide DC power to support the operation of the yard. The TPSS(s) shall be sized to satisfy all traction loading for

Train movements to Storage Tracks, storage, Yard Lead operation and Train movements into and out of the shop.

(ii) Yard TPSS and TPSS Equipment shall be of the same arrangement and design and manufacturer as the mainline TPSS.

(iii) Yard Traction Power positive circuits and negative rail returns shall be electrically isolated from the mainline Traction Power positive circuits and mainline negative rail returns.

(iv) Yard Traction Power positive circuits and negative rail returns shall be electrically isolated from the shop Traction Power positive circuits and shop negative rail returns.

(v) Yard Traction Power ductwork and cabling shall be installed to the respective demark maintenance hole system provided.

(vi) Yard TPSS shall have sufficient quantity and size DC circuit breakers to service the sectionalizing requirements and provide sufficient quantity and size circuit breakers for growth of the yard to the ultimate build out.

(vii) Yard TPSS shall be controlled and monitored through TPSS SCADA by TOCC, BCC and MYCC.

(viii) Yard negative rail system shall be electrically continuous through and be directly connected to the Yard TPSS negative return.

(e) Moodie Shop TPSS

(i) TPSS shall be provided in the LMSF shop to provide DC power to support the operation and sectionalization of the shop Tracks. The TPSS(s) shall be sized to satisfy the traction loading for Train movements to, into and out of each Track, and Train loads during repair, testing and maintenance through an auxiliary quick connect system to interface with the Vehicle auxiliary power receptacle.

(ii) Shop TPSS and TPSS Equipment shall be of the same design and manufacturer as the mainline TPSS and shall provide an interlocked contactor system for circuiting each Track and respective auxiliary quick connect distribution system.

(iii) Shop Traction Power system to each Track contact wire shall be through an isolation switch, wall-mounted for manual operation, and be interlocked for Safety through any crane, lifting jacking or maintenance device (wheel truing) or other device that may cause serious injury or damage if Traction Power remains energized.

(iv) Shop Traction Power system shall be interlocked throughout the shop through a resettable visual and audible Emergency trip system reporting directly to the MYCC and resettable only by the MYCC.

(v) Shop TPSS shall be provided with a SCADA system reportable and controllably only through the MYCC through the MSF BMS SCADA.

(vi) Shop negative rail system shall be continuous throughout and grounded.

(f) Moodie Mainline TPSS

(i) Refer to Schedule 15-2, Part 3, Article 13 – Traction Power System.

(g) Moodie AC Service

(i) DB Co shall design, furnish, install, test and commission a 44kV switch yard, including 72kV switchgear, stepdown transformers, a 15kV substation and all auxiliary systems to service the Moodie LMSF power facility. DB Co shall develop the site plan for the switchyard, and 15kV substation. The switchyard and 15kV substation shall be located at the Moodie LMSF.

(ii) The 44kV switch yard shall be supplied by two **[REDACTED]** supply feeders. The feeders shall be equipped with a pole mounted line side tie switch. The tie switch shall be owned by **[REDACTED]**, controlled by **[REDACTED]** and maintained by **[REDACTED]**. The switch yard shall consist of two 72kv incoming line circuit breakers equipped with line side and load side disconnects, two 44kV to 13.2kV 9MVA stepdown transformers and all required auxiliary systems. The line side load break disconnect switches shall serve as the demarcation point between **[REDACTED]** and DB Co. Each stepdown transformer supplies a bus feeder circuit breaker located in the 15kV substation. The switchyard and its equipment shall be owned by the city, controlled by **[REDACTED]**. and maintained by DB Co.

(iii) The 15kV substation shall be a prefabricated enclosure housing 15kv switchgear consisting of two line circuit breakers, two 15kV busses with bus tie, four feeder circuit breakers and all auxiliary systems. Refer to Schedule 15-2, Part 3, Article 13- Traction Power System, for details of the 15kV substation construction. **[REDACTED]**'s revenue metering shall be provided through CT's and PT's on the two incoming feeder breakers in the 15kV substation. The revenue metering CT's and PT's shall be owned by **[REDACTED]**, monitored by **[REDACTED]** through SCADA and maintained by **[REDACTED]**. The 15kV substation shall be owned by the City, controlled by DB Co and maintained by Project Co.

(iv) The switchyard shall be serviced by two **[REDACTED]**, 3-phase 4-wire 44kV feeders. The assigned **[REDACTED]** feeders have a maximum capacity of 9MVA each. One 44kV **[REDACTED]** feeder shall be in service at all times. At the discretion of **[REDACTED]**, the load from one feeder can be switched to the alternate feeder through a normally open tie switch connected between the two incoming feeders. The bus tie switch shall be owned by **[REDACTED]**, controlled by **[REDACTED]** and maintained by **[REDACTED]**. 9MVA shall be the maximum power limit for the Moodie LMSF Facility.

(v) Each incoming 44kV feeder shall have an overhead disconnect switch as part of the load break gang operated or cluster mount switches, owned by the City, controlled by **[REDACTED]** and maintained by Project Co;

(h) DB Co shall ensure that the following control requirements are met:

(i) The TPSS shall be designed for unattended operation with remote supervision and control from all control centres through the SCADA system.

(ii) Local control shall be provided for all elements of the TPSS through a HMI and computer based TPSS control unit (PLC). Remote control shall be disabled when in local control. Local control shall be enabled by means of a "local/remote" switch. This switch shall enable and disable local control of the entire TPSS excepting circuit breaker trip functions. All TPSS indication and alarms shall be provided to the HMI.

(iii) HMI located in each TPSS shall be the local TPSS status screen annunciator. The HMI/PLC shall provide all information to SCADA at the TOCC, BCC, MYCC and BYCC. This includes alarms, equipment status and real-time metering values. The default screen shall be a representation of the TPSS single line indicating the current status.

(i) DB Co shall ensure that the following SCADA requirements are met:

(i) Moodie LMSF power facility shall be provided with a SCADA monitored and controlled reporting directly to TOCC, BCC, MYCC and BYCC.

(ii) DB Co shall provide a system where all metering is monitored and logged by the SCADA system.

(iii) The LMSF power facility shall be provided with a SCADA RTU that shall interface with the SCADA systems specified in Schedule 15-2, Part 3, Article 8 – SCADA System, for the purposes of transmitting the information and control to TOCC, BCC, MYCC and BYCC.

(iv) The following status and control points, at a minimum, shall be incorporated into the LMSF power facility SCADA system functionality:

A. AC switchgear – Status and control:

i. Protective devices – Status; and,

ii. Lockout device – Status.

B. Loss of utility power – Status;

C. Transformer:

i. Winding over temperature – Status.

D. LMSF power facility Local Control Enabled – Status;

E. Loss of Station auxiliary power – Status;

F. Intrusion detection – Status; and,

G. Fire alarm:

i. Trouble – Status;

ii. Power Supply – Status; and,

iii. Alarm – Status.

H. Loss of control power – Status;

I. Battery charger trouble/failure – Status;

J. Climate Control – Status;

K. LMSF power facility air temperature – Status;

L. Emergency trip activated – Status; and,

M. Mass trip control – Status.

(v) 25% additional status and control point spare capacity shall be provided at the LMSF power facility.

(vi) Communication between the local SCADA system, the TOCC, BCC, MYCC and BYCC shall be redundant via the CTS.

(j) DB Co shall ensure that the following climate control requirement is met:

(i) The LMSF power facility 15kV substation shall include a climate control system which shall maintain indoor temperature and humidity to allow for PLC and SCADA equipment operational performance to be maintained throughout all expected external temperature variations. The climate control system shall be designed to continuously maintain the temperature within the LMSF power facility and provide status to the SCADA system.

(ii) Moodie's AC service provides AC power to Moodie's mainline TPSS, Station, LMSF TPSS and LMSF facility;

A. Moodie's mainline TPSS: 13.2 kV, 3 phase, 4 wire.

B. Moodie's Station: 13.2 kV, 3 phase, 4 wire to Station stepdown transformer.

C. Moodie's LMSF TPSS: 13.2 kV, 3 phase, 4 wire.

D. Moodie's LMSF facility: 13.2 kV, 3 phase, 4 wire to facility stepdown transformer.

(iii) Feeder protection schemes will be provided by electrical interlocking.

1.12 LMSF Coordination

(a) DB Co shall provide the City access to and storage space within the LMSF in accordance with the requirements of Clause 5.2(m) of Schedule 15-2, Part 1 – General Requirements.

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 LMSF 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 LMSF 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.

(c) General Architecture

(i) The location of the LMSF Facility is considered a Scenic Entry Route in accordance with the City of Ottawa Official plan and a Capital Arrival Route in accordance with the NCC Greenbelt Master Plan.

(ii) DB Co shall consider the location of the LMSF in the design of the architecture of the site while confirming to the specific requirements of these documents.

(iii) The landscaping for the site shall use landscaping features to provide visual abatement of the Moodie LMSF from adjacent communities and uses, particularly in the vicinity of the Wesley Clover Facility and take into consideration views to and from the Capital Arrival perspective.

2.2 Signage

(a) General Requirements:

(i) Shall comply with Schedule 15-2, Part 4, Article 7 – Wayfinding and Signage 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) DB Co shall perform a code analysis with respect to the OBC.

(b) Provide a complete code analysis for the LMSF, 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 Vehicle 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 LMSF.

(ii) Design and construction shall conform with the below mentioned codes with any amendments from City 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 Commentaires (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 Schedule 15-2, Part 2, Article 7 – Geotechnical Design Criteria and Requirements.

(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, equipment load, crane loads, 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 Schedule 15-2, Part 2, Article 7 – Geotechnical Design Criteria and Requirements, 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, DB 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 Schedule 15-2, Part 2, Article 9 – 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) DB 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) HVAC equipment shall be screened so as to not be visible from Corkstown Road and the MUP.

(b) Reference Documents

(i) 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:

A. Ontario Regulation 350/06 OBC;

B. NBCC;

C. ODA;

D. AODA;

E. CSA Codes and Standard;

F. Model National Energy Code of Canada for Buildings;

G. ULC;

H. NFC;

i. NFPA 70

ii. NFPA 90

iii. NFPA 91

iv. NFPA 130

I. ASHRAE Handbooks and Standards; and

J. SMACNA.

(c) Design Criteria and Parameters

(i) The design of HVAC systems shall conform to the requirements of this Article, and all the applicable codes and standards.

(ii) Noise Criteria

A. 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 5-4.1

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

(iii) Vibration Requirements

A. 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:

i. Provide vibration isolators to mechanical Equipment and components; and

ii. Provide seismic restraints for mechanical Equipment or components including ductwork and piping.

(iv) Design Conditions

A. The design conditions shall be based on ASHRAE Handbook Fundamentals.

(v) Design Parameters

A. The design parameter shall be based on ASHRAE standards 55, 62.1, 90.1 and 189.1

(vi) Duct Sizing Criteria

A. 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.

(d) 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.

(e) HVAC Controls

(i) Design and Performance Requirements

A. All building controllers, application controllers and all input/output devises shall use industry standard protocols.

(f) 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) DB 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) DB 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) 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.

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 LMSF.

(b) DB 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) **[REDACTED]** Standards.

5.3 Basis for Design

(a) Calculations:

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

(ii) Light levels in lux:

Offices Meeting & Training Rooms	500
Corridors	200
Kitchens	500
Maintenance Facility	750
Parking Lots	35
Utility Rooms	300
Wash, Shower & Locker Rooms	200
Stairways	200

(b) An illumination plan shall be completed.

(i) EA compliant Lighting Treatment Plan, in accordance with municipal standards, shall be prepared during the pre-construction phase. This plan shall include lighting fixtures and illumination along the various sections of the corridor. A lighting audit of the preferred lighting design plan may be conducted to confirm clear sight lines and appropriate illumination. City of Ottawa policy regarding lighting of connections to LRT stations shall be followed. Consideration shall also be given to the use of wavelengths safe for wildlife.

(ii) The MTO requires illumination plans as part of the development package of any construction within permit control. The MTO requires that there be no light spillover from the development onto the ROW. However, since this development is within the right of way, light shall not spill over onto the existing and future widened Highway 417 travel lanes.

5.4 Functional Requirements

(a) Electrical Service

(i) The LMSF will receive its service feeder from **[REDACTED]**. DB 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 **[REDACTED]** and in accordance to **[REDACTED]** 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 **[REDACTED]** 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 **[REDACTED]** 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 **[REDACTED]**.

(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. Requirements for the installation of additional fibre along the Confederation Line for the use of the City is included in Schedule 15-2, Part 3 – Systems.

(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 post indicator 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. The system shall be integrated with system wide fire alarm system.

(h) Emergency and Standby Power System

(i) The critical loads of the electrical system shall be designated as an Emergency system as defined in CSA C282 and shall meet IEEE standard 446.

(i) Emergency and Standby Power Sources

(i) The Emergency generator connections shall be able to assume the entire load of the Facility during critical events including 25% spare capacity for future growth. The Emergency generator shall comply with local noise and emissions requirement and the required approvals shall be obtained by the DB Co from Governmental Authorities.

(ii) The Emergency generator shall be designed in correlation with the UPS system to ensure the quality required for the MYCC.

(iii) Transient voltage surge suppression shall be provided for the generator output.

(iv) Provide manual synchronization means beyond the automatic synchronization control for the back-up generator.

(v) All UPS systems shall be of the online, double conversion type, and shall be equipped with automatic static bypass switches, as well as an external manual maintenance bypass.

(vi) Emergency power feeders shall be rated for 2 hours either through the use of fire-rated cables/wiring or embedment in concrete.

(vii) Non-life safety loads shall automatically and instantaneously be shed in the event of generator overload.

(viii) Generator, fire pumps and main life safety switchboards shall not be located below grade.

(ix) The Emergency generator shall be diesel generator compliant with the requirements of CSA C282.

(x) Standby fixed mounted engine generator shall be installed in a conditioned indoor space (heated and ventilated) or outdoors, a completely enclosed weatherproof/sound attenuated housing to protect the generator from adverse weather conditions and reduce sound levels for surrounding residential neighbourhoods shall be provided. The generator shall be mounted on spring isolators with a floating floor, or equivalent means, to minimize the transmission of vibration. Enclosure shall have critical grade silencing suitable for residential installation. DB Co design shall follow NEMA/IEC enclosure/environmental protection standards.

(xi) The Emergency power generator shall be located in the area easily accessible for maintenance and refuelling.

(xii) Provide 120V/20A GFCI outlets around back-up diesel generators from UPS to provide power in the event of a concurrent generator and utility failure.

(xiii) Automatic transfer switches serving life safety loads shall be equipped with means of bypass to both sources

(xiv) When second Utility power source is selected, Emergency lighting, fire alarm and other Emergency equipment loads shall be connected to a UPS or battery system as required for loads classified as “emergency level 1”.

(xv) BACS – The BACS system within the LMSF shall provide supervisory control of the shop Traction Power System, LMSF electrical and mechanical systems, and communications subsystems. It shall be compatible with the SCADA system and supervision from the MYCC.

(j) Automatic Transfer Switches/Load Bank

(i) Multiple ATS shall be provided to transfer loads between the normal power system and the emergency power system. Loads shall be assigned to the ATS in accordance with CSA C282. Provide a load bank to allow exercising the generator under load without interruption of the building emergency loads. The load bank shall be sized at 100% of the maximum generator rating and shall have a step load capability in increments of 25%, 50%, 75% and 100% of the load bank rating.

(k) Emergency Loads

(i) The crane and other Vehicle maintenance facility equipment do not require full generator support for continued operation, but a method to lower the cranes need to be identified whether it is mechanical, hydraulic pressure release, or control voltage which may require Emergency power.

(l) UPS System

(i) Loads which cannot tolerate more than a ¼ cycle interruption shall be provided with internal or dedicated battery backup and/or connected to a central UPS or inverter system. These loads shall include, but are not limited to:

A. Fire alarm systems (inverter);

B. CCTV systems (UPS);

C. Yard control systems (inverter);

D. Telecommunications equipment (UPS);

E. ETEL (UPS);

F. AC/DC switchgear controls (inverter);

G. Emergency lighting and signage (inverter);

H. BMS PLC (UPS); and,

I. Access control (UPS).

(ii) The building UPS/inverter systems shall be sized to serve the anticipated demand load plus spare capacity of 25%. The UPS/inverter batteries shall be sized to carry the maximum UPS rated load for a period of 90 minutes. DB Co shall submit calculations which support the proposed size of the UPS/inverters and batteries. The UPS/inverter input shall be fed from the generator or the secondary utility feed for continued operation following the rated load period of 90 minutes.

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 LMSF connection Tracks and the beginning of the Yard Tracks.

(d) Grade

(i) The maximum grade on Storage Tracks shall be 0.3%.

(e) Horizontal curves shall not be less than 35m radius and vertical curves not less than 30m length crest and sag on the LMSF Tracks.

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) Track at handoff platform(s) shall be level or of sag geometry aligned to prevent unintended movement of Vehicles when stationed at the platform for operator access.

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.

(iii) The rail length shall be 23.8m, which will be used to establish the CWR.

(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 (25mm minimum clear) 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. Rail shall be isolated from asphalt.

(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.

(vi) Rails embedded in concrete require gauge flangeways and field side rail wear relief.

(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.

(f) Direct Fixation Track

(i) DF Track shall be utilized in the car wash area of the shop building.

(ii) Rails shall be fastened to a concrete pedestal (plinth), leaving the rail fully exposed and isolated for stray current protection 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 shall not be used.

(iii) Rail Lengths

A. All rail shall be CWR.

B. Rail length to be provided is 23.8m, which will be used to establish the CWR.

(c) Restraining Rails

(i) DB 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. Restraining rail is not required on Tracks within yards operating at or below yard speed.

(ii) Restraining rail shall be electrically isolated from running rail in order to maintain broken rail protection.

(d) Rail Joints

(i) DB 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) DB 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.

(iv) Rail shall be isolated from all Pavement.

(f) Switch Clearing Device

(i) Switch clearing devices shall be supplied and installed by DB Co at Special Trackwork locations. DB Co shall provide conduits and junction boxes and other supporting Infrastructure for these devices.

(ii) DB Co shall provide switch clearing devices that are proven in railway industry and meet accepted industry standards and do not compromise safety.

(iii) Additional separate controlled heating that can melt snow in the critical switch areas shall be provided. Switch heaters shall be gas fired.

(g) Switch Machines and other Turnout Appliances

(i) Switch machines and other associated Equipment shall be provided and installed by DB Co.

(ii) DB 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) Switch machines shall be positively drained.

(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. DB 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), DB 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 DB Co. Special Trackwork assemblages include all materials necessary for construction.

(ii) All Special Trackwork joints shall be butt welded in-field except where DB 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.

(vi) Turnouts and switch machines shall be drained.

(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 PA SYSTEM

7.1 General Requirements

(a) DB Co shall ensure that the communication systems and PA system for the LMSF provide support to the City and Project Co operations. The communications systems for the LMSF shall include the following:

(i) CTS;

(ii) MYCC;

(iii) Yard/shop PA system;

(iv) CCTV;

(v) Telephone system;

(vi) IT Infrastructure System;

(vii) SCADA which includes;

A. Traction Power SCADA; and,

B. LMSF BMS.

(viii) Intrusion Access Control; and

(ix) Train-to-wayside wireless communications.

7.2 Operational Description

(a) CTS Interface – DB Co shall provide an interface to the CTS, which provides hi-speed fiber optic communications transmission for the various communications subsystems at the LMSF, including CCTV, PA, telephone, IAC, train-to-wayside communications, BMS, and SCADA systems.

(i) DB Co shall provide dual redundant hi-speed network nodes located at the main control room in the LMSF for sending and receiving voice and data information to the TOCC, BCC, BYCC and MYCC.

(ii) All backup for the system servers shall be located at the BCC at 805 Belfast MSF. DB Co shall provide data connectivity to the City's IT service for connectivity to the BCC at the Belfast MSF. Data connectivity between the TOCC at 875 Belfast and the BCC at 805 Belfast already exists.

(b) LMSF PA System – The LMSF shall be equipped with a PA loudspeaker system that shall allow personnel at the MYCC to make announcements throughout the facility concerning Train movements, maintenance, and repair operations in the yard shop. The

system shall operate within local regulations and applicable laws with respect to ambient noise.

(c) CCTV – CCTV cameras shall be deployed strategically throughout the LMSF to provide visual images of the LMSF to be viewed at TOCC, BCC, BYCC and MYCC. The CCTV system shall use video analytics and/or intrusion detection systems to detect if people or objects have made unauthorized entry into the LMSF Tracks including the yard wye and road crossings into the facility. The CCTV system shall be capable of monitoring Train movements throughout the yard. Additionally DB Co shall furnish and install two local CCTV PTZ cameras to inspect the Train roof/pantograph, with a CCTV workstation at floor level of the S&I Track. The final locations and arrangement shall be determined by the City.

(d) Telephone System – DB Co shall provide maintenance telephones and administration telephones for all the offices and equipment rooms, including the MYCC, TPSS, signal equipment rooms, and electrical equipment rooms. DB Co shall provide an interface to the Existing Confederation Line PBX for the management and routing of the telephone extensions.

(e) IT Infrastructure – An IT infrastructure shall be provided to support the daily office operations of the City and Project Co including desktop workstations, printing equipment, and teleconferencing equipment.

(f) SCADA – The SCADA systems required for the LMSF includes the following subsystems:

(i) Traction Power – The Traction Power SCADA shall be an on-line, real-time, interactive system operated by TOCC, BCC, BYCC and MYCC 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.

(g) LMSF BMS – The BMS system within the LMSF shall provide supervisory control of the shop Traction Power System, LMSF electrical and mechanical systems, and communications subsystems. It shall be compatible with the Confederation Line SCADA system and supervision from the TOCC, BCC, BYCC and MYCC.

(h) Voice/Data Radio System – The City and DB Co shall utilize the existing and planned Public Safety Service Radio System for its operations. DB Co shall procure from the Radio Supplier and install the dispatch workstations required in the MYCC. DB Co shall work with the Radio System Supplier to determine quantity and functionality required to efficiently operate and maintain the system. One full Voice/Data Radio System touchscreen radio console shall be procured and installed in the MYCC.

(i) IAC – The IAC system shall control access and provide for detection of intrusion into entrance points of the LMSF. Intrusion sensor activation shall sound an audible alarm

locally and trigger an alarm notification for unauthorized entry or tampering to the TOCC, BCC (when active), BYCC and MYCC.

(j) 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 LMSF. 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 LMSF CTS shall utilize the same network topology as the main Confederation Line CTS.

(ii) The CTS shall provide hi-speed dual redundant fiber optic data connectivity to the TPSSs within the LMSF, MYCC, TOCC, BCC and main LMSF communications room.

(b) MYCC

(i) The functions within the MYCC for operation and control of the LMSF shall include CCTV, IAC, PA, SCADA, Voice/Data Radio System Radio System and BMS monitoring of the electrical substation, sump pumps, pump systems, ventilation systems, car wash, cranes, lifts, wheel trueing, shop TPSS, 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 MYCC shall have access to maintenance monitoring, reporting and scheduling, defect reporting, vehicle scheduling, rostering of drivers, and status of in service fleet.

(ii) Three wall mounted displays shall be provided which are capable of displaying various CBTC and SCADA displays as required by MYCC staff.

(iii) The MYCC shall contain two workstations capable of administration of all LMSF 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. 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.

(iv) The MYCC shall contain three 40" wall mounted displays capable of administration of all LMSF communications systems. Functions shall vary based upon the responsibility and access rights of the person who is accessing the displays at any given time.

(c) Yard/Shop PA System

(i) Announcements shall be addressed to single and multiple zones within the LMSF. 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 LMSF 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 MYCC of all major system components such as preamplifiers, power amplifiers, supervision detectors, and power supplies.

(d) CCTV

(i) The CCTV system camera views shall comply with any Applicable Law.

(ii) The CCTV system cameras within the LMSF shall be capable of being controlled from the MYCC, TOCC, BCC (when active) or BYCC.

(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 LMSF exterior and perimeter;

B. Entrances and exits to LMSF 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 LMSF 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 MYCC, TOCC, BCC (when active) or BYCC 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 Existing Confederation Line's 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.

(e) Telephone System

(i) The telephone system, at a minimum, shall provide maintenance telephones located in communications rooms, electrical equipment TPSSs, signal equipment rooms, and the MYCC.

(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 Existing Confederation Line's telephone system. The Existing Confederation Line's PBX shall provide call routing and processing for all telephones in the LMSF.

(f) SCADA System

(i) The SCADA systems within the LMSF shall be capable of being controlled from the MYCC, BYCC, TOCC or BCC (when active).

(ii) The SCADA system shall facilitate the transmission of indications and alarms from the RTUs to the TOCC, BCC or MYCC as described previously via the CTS. Transmissions shall include:

A. Traction Power alarms, indications, and control signals.

B.

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 TOCC, BCC, MYCC and BYCC to permit the monitoring of device actions.

(g) Radio Communications

(i) The radio communications system shall provide full radio coverage of the LMSF, indoors and outside to support operations, maintenance, security and management personnel. A dispatch console with connectivity to the City's Radio Control Centre shall be installed in the MYCC.

(h) Cellular System

(i) A cellular system shall provide full cellular coverage of the LMSF, indoors and outside.

(i) Intrusion Access Control System

(i) The IAC systems within the LMSF shall be capable of being monitored from the MYCC, BYCC, TOCC and BCC (when active).

(ii) The system shall provide controlled access and detect intrusion of the following:

A. TPSS;

B. Signal equipment rooms;

C. MYCC;

D. CER;

E. External doors, entrances and exits of the LMSF; and

F. 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 DB Co to approved City staff for entry into the LMSF, CIHs, TPSS, and vent plants.

B. Access cards shall be provided by the City to Project Co staff for entry into private station areas, the TOCC and BCC (when active).

(iv) The IAC system which is interfaced with the CCTV system shall provide staff within the TOCC, BCC, BYCC and MYCC 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 Vehicles with a wireless data connection at the LMSF 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 Vehicle systems.

(k) Systems Infrastructure Interface

(i) Each communications system element has a requirement for both power supply and data transmission. DB 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. DB 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) DB Co shall provide all equipment, accessories, materials, etc., and building systems required for the maintenance requirements of the Vehicles.

(b) DB Co shall supply and install equipment as listed in Schedule 36 – Interface Agreement, Appendix 2.

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.