

Region of Waterloo  
Stage 1 Light Rail Transit Project

Design and Construction Performance Output Specifications  
Article 16  
Operations, Maintenance, and Storage Facility (OMSF)

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**ARTICLE 16 OPERATIONS, MAINTENANCE AND STORAGE FACILITIES (OMSF)**

**16.1 Introduction**

- (a) This Article establishes the overall requirements for the planning, design and construction of the Operations, Maintenance, and Storage Facility for the System (OMSF). The requirements are broad in scope, to accommodate variations in Project Co's design to address Project Co's approach to the operations and maintenance of the completed LRT Project. The purpose of this Article is to provide design guidelines for the OMSF. Project Co's solutions for the OMSF shall expand on these guidelines. Project Co shall prepare a Basis of Design Report – OMSF which explains Project Co's approach to the design of the OMSF in greater detail and in a site specific manner. The presentation of specific requirements or functions within this Article must not be construed to limit or modify in any way Project Co's responsibility to provide a holistic, comprehensive, and fully functional solutions for all OMSF components and functions. The Basis of Design Report – OMSF shall address every aspect of the OMSF design requirements cited in this Article. The rationale for all deviations or variances from any requirement cited this Article must be fully described in the Basis of Design Report – OMSF.
- (b) As part of the Basis of Design Report, Project Co shall prepare a Code Analysis covering the OMSF. This shall include comparative identification of requirements where more than one code applies.
- (c) The Operations, Maintenance and Storage Facility shall have all of the necessary structures, equipment, tools, spare parts, storage areas and other ancillary areas required to support Project Co's maintenance and operations requirements. Project Co must provide a wheel truing machine at the OMSF site.
- (d) The Region will provide to Project Co a limited number of spare parts for the LRV and a list of all spare parts and other consumable items as recommended by the Rail Car Supplier. The initial spare parts inventory is currently being negotiated with the Rail Car Supplier and the complete inventory will be made available to Project Co through Addendum. In addition to the initial spare parts and consumable items, the Region will providing Project Co with the required special tools and bench test equipment required for specialized maintenance, repair and testing activities. This list of special tools and bench test equipment will be made available to Project Co through Addendum. Project Co must, however, provide required hand tools and shop equipment required to perform its maintenance and rehabilitation obligations as set forth in Schedule 15-3. Project Co shall be responsible for maintaining the level of spares parts to ensure that vehicle availability is not impacted due to a lack of spare parts or consumables.
- (e) The OMSF shall also include a Central Control Facility (CCF) which shall be equipped, as required, to provide all of the necessary operations such as train control, traffic management, security, yard operations and communications. The CCF shall meet the requirements of an Operations Control Center defined in NFPA 130.
- (f) The site for the OMSF is depicted on the drawings. The layout for the OMSF, shown on functional plans and other documents prepared by the Region was prepared for planning purposes and is not intended to represent the Region's preference for the layout of the OMSF. Project Co shall develop the most efficient layout that coincides with Project Co's approach to the operation and maintenance functions that will occur in the OMSF. Refer to other Articles in the Project Agreement for permitting requirements and environmental site conditions for this site.

## 16.2 Cited References

- (a) Applicable Codes and Standards
  - (i) The OMSF shall meet the Ontario Building Code.
  - (ii) Where no provisions are made in the codes for particular features of the design, the best industry practices shall be followed. Use the latest edition of the following:
    - A. National Fire Protection Association NFPA 130 Standard
    - B. Ontario Electrical Safety Code
    - C. Ontario Fire Code
    - D. Accessibility for Ontarians with Disabilities Act (AODA)
    - E. CAN-CSA B651-12 Accessibility

## 16.3 General Requirements

- (a) The design of the yard, maintenance shops, and Central Control Facility as well as the totality of the operating System shall provide sufficient flexibility that enables the LRT System to continue service, bypass the trouble areas, and/or restore service to the rest of the operational system, even at reduced headway, where necessary.
- (b) The treatment given to areas of employee personal comfort and safety is of additional importance. Due consideration shall be given to such areas as restrooms, training rooms, first aid, heating, air conditioning, ventilation, and lighting, as well as finish materials, stairs, elevator treatments and work area design. These considerations shall be carefully evaluated and made part of the basic and overall design for the Operations, Maintenance and Storage Facility.
- (c) The design for the OMSF shall achieve a minimum LEED Silver Certification.
- (d) For additional Fire Life Safety requirements, see Schedule 15-2 Article 20.

## 16.4 Appearance

- (a) The design of the Operations, Maintenance and Storage Facility shall be compatible in architectural character, materials, finishes, and functional relationships with the architecture of the adjacent community and surrounding environment.

## 16.5 General Characteristics

- (a) Project Co shall provide a Basis of Design Report explaining how Project Co will achieve all of the functional purposes of the Operations, Maintenance, and Storage Facility.
- (b) The OMSF shall provide a storage yard for LRT vehicle storage. The maintenance facility shall include space for the car shop, wheel truing, and consolidated component repair shops, wayside systems maintenance/repair shop, car cleaning facility (including the car wash and interior cleaning), Central Control Facility, and material and spare parts storage.
- (c) The Facility shall be responsive to all environmental requirements in providing for the following:
  - (i) Clearly defined interior zoning of major functions and grouping of complementary functions.
  - (ii) External means of ingress and egress clearly identified by architectural means other than graphics.

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- (iii) Visual and sound screening of maintenance and storage, road vehicle parking, and service delivery and loading functions, using materials compatible with and complementary to the urban design context.
  - (iv) Design objectives responsive to and compatible with the surrounding environment.
  - (v) Storage for revenue vehicles, maintenance equipment, parking space for employee vehicles, and materials required for maintaining and operating the System.
  - (vi) Inspection, maintenance, and servicing of light rail vehicles and associated maintenance-type vehicles.
  - (vii) Interior and exterior car cleaning.
  - (viii) Central Control Facility and Yard Operations
  - (ix) Support of wayside systems maintenance activities.
  - (x) Component repair shops.
  - (xi) Facility finished floor elevation at a minimum of 0.5 meters above the 100-year base flood elevation.
- (d) Exterior Building Appearance
- (i) The buildings comprising the Operations, Maintenance, and Storage Facility shall be considered important visual elements of the LRT System and shall have an appropriate architectural character. These facilities shall be constructed of aesthetically considered materials.
  - (ii) All exterior finish materials shall be selected to provide maximum resistance to predictable physical impacts, including normal usage, weather, graffiti and other vandalism, air pollution, and deterioration due to other forces.
  - (iii) Glazing shall be used whenever practicable to reduce the requirements for interior artificial lighting and sound transmission where required.
- (e) Interior Building Appearance
- (i) Interior building appearance shall accommodate the following requirements.
  - (ii) Ceilings
    - A. All ceiling installations shall be designed to facilitate alteration and expansion of specific interior functions. Ceilings shall minimize the transmission of disruptive noises from one space to another.
  - (iii) Walls
    - A. Walls in maintenance areas shall be constructed and finished to effectively resist predictable impacts and abrasions from the movement and maintenance of vehicles and equipment.
    - B. Walls near operations involving the use of corrosive agents shall be finished to resist deterioration of surface quality.
    - C. Walls in administrative areas shall provide for maximum flexibility of spatial arrangement.
    - D. Wall resistance to sound transmission shall be maximized.

- (iv) Floors
  - A. Floor areas requiring special finishes shall be identified.
  - B. Floor surfaces shall be designed to be skid resistant. In the construction and finish of floor surfaces, conditions which represent inherent hazardous conditions, such as arbitrary changes in floor texture without accompanying changes in color, shall be avoided.
  - C. Where possible it is preferred that floors within electrical and electronic equipment rooms shall be provided with raised flooring for future cabling, or with expandable and adaptable cable troughs for system expansion.
- (f) Vertical Circulation
  - (i) Enclosed stairwells shall be placed and treated to maximize visual surveillance into the stairwell interiors.
  - (ii) Exterior stair surfaces shall be protected from the accumulation of water, and steps shall have anti-skid surfaces.
  - (iii) Elevators shall be provided as required.

#### 16.6 Development Approach

- (a) The Operations, Maintenance and Storage Facility shall be an integral part of the System design. All elements and design impacts shall be considered from the beginning of the program, from the start-up of revenue operations, through future extensions needed to complete Stage 2 of the LRT System, to accommodate the needed sites, layouts, buildings, equipment, personnel, circulation, philosophy, policies, methods, procedures, records, standards, and work flow for all LRT System elements. Elements of consideration for the overall Operations, Maintenance, and Storage Facility shall include:
  - (i) Operating and maintenance philosophies, computerized data collection systems, operating and maintenance personnel training, planning and scheduling and personnel crafts, skill levels, and needs.
  - (ii) Location of facilities and LRT Stops, yard layout, structures and buildings, machinery and equipment, flow of work for personnel, vehicles, and equipment, material, inventory control and handling, and outside contract work.
  - (iii) Coordination of activities and schedules for the System, including communications with fixed facilities, track, vehicles, and operating personnel. Emergency operating communications contingencies shall also be included.
  - (iv) The Operations, Maintenance and Storage Facilities for the Stage 1 LRT shall provide all the structures for functions for System operations and shall include provisions for the expansion of the System to the meet the needs for Region's Stage 2 LRT. For additional information on the Region of Waterloo's Stage 2 LRT system, refer to Attachment 1 to Appendix A of the RFQ or the Region of Waterloo's website. The design may consider that a limited number of facilities will be moved with future improvements of the System, however, the CCF shall be designed to accommodate all central control functions for the Stage 1 and Stage 2 LRT system in the Stage 1 OMSF facility.
  - (v) The storage tracks constructed in the OMSF by Project Co for the Stage 1 LRT system shall accommodate a minimum of 17 LRT rail cars without relying storage capacity in the

shops or other tracks. To the extent possible, within the right of way designated by the Region for the OMSF for Stage 1 LRT system, Project Co's design for the OMSF shall provide for additional rail car storage tracks that could be constructed in the future to support a total fleet of 33 rail cars. All power supplies for the OMSF shall be sized for the total fleet of 33 rail cars. All yard control and communication equipment shall be provisioned for the final yard configuration for 33 rail cars. As required by the Region and as permitted under the Project Agreement, all changes to the Design and Construction Works required to accommodate an expanded storage yard at the OMSF for up to a total fleet of 33 rail cars shall be implemented by Variation subject to and in accordance with Schedule 22 – Variation Procedure.

- (vi) In the Basis of Design Report – OMSF, Project Co shall describe the capabilities of the OMSF to accommodate the functions of the Stage 2 LRT and noting which functions are assumed by Project Co as being accommodated at another location or support facility to be constructed as part of the Stage 2 LRT Work program.

### 16.7 Environmental Impact

- (a) The site design shall comply with all environmental requirements including the requirements identified in the Rapid Transit Project Environmental Report, minimizing negative impacts on adjoining properties. Considerations shall include air and water quality, noise, traffic, aesthetics, social, economic, and safety.
- (b) The addition of new fixed facilities such as the OMSF into the existing environment may increase the potential for water runoff. This potential may extend to both the construction and operation phases of the Project. Catch basins, curbing, culverts, gutters, pumping stations, and storm sewers shall be constructed, as necessary, for the permanent control of water runoff during the operation phase of the Project. Control of sediments, runoff discharge and dewatering fluid discharge, including turbidity and pH, shall comply with applicable environmental requirements.
- (c) During the normal course of yard and shop operations, oil and other substances may be introduced into the water drain system. Washing and service areas shall drain into a collection system where all effluents shall be treated before appropriate disposal. A separating system shall be used to remove unwanted or harmful substances from discharged water. The removed substances shall be disposed in accordance with the applicable regulations of the above-cited jurisdictions.
- (d) Machinery and equipment installed in the OMSF and elsewhere on the system shall be equipped with efficient noise and vibration suppression devices, and other noise and vibration abatement measures shall be employed as required.
- (e) Noise and vibration impacts may arise during the construction and operation of the System. In mitigating these impacts, the following basic goals shall be considered:
  - (i) Adhere to environmental requirements.
  - (ii) Provide LRT patrons and employees with an acoustically comfortable environment by maintaining noise and vibration levels in LRT vehicles along the way and in LRT Stop within acceptable limits.
  - (iii) Minimize adverse impacts of LRT operation and construction on the community by controlling transmission of noise and vibration to adjacent properties.
  - (iv) Provide effective noise and vibration control.

- (f) The design shall control airborne noise from train operations, ancillary areas, and facilities such as yard operations, electrical substations, and emergency service buildings. The design shall also provide for any required control of ground-borne noise and vibration from LRT vehicle operations.

#### 16.8 Design/Layout Considerations

- (a) The design and layout of the facility shall consider the maintenance requirements of the LRT System. All operations and maintenance planning shall satisfy the demands and requirements of revenue service operations. The design will be influenced by the type of operation, extent of operations, number of consists, number of vehicles, hours of service, physical system layout, complexity of equipment, availability of plant and equipment, allocated down-time, aesthetic impact, and management policy. Project Co shall provide preliminary through final design layouts to the Region for review.
- (b) In the design and planning of the yard and shops, specific attention shall be given to provide that:
- (i) The Operations, Maintenance and Storage Facility shall be sufficiently sized to accommodate vehicle repairs and maintenance as well as all other systems equipment.
  - (ii) Cranes with sufficient capacity but not less than 2½ tons shall be provided at service platforms or other work locations for the handling of roof mounted equipment. Cranes and wheel truing machines where used, shall be electrically interlocked with the traction power supply source.
  - (iii) The Maintenance and Storage Facility shall be laid out to provide a convenient and efficient facility where train consists can be put into and removed from revenue service with a minimum of effort, reverse movements and deadheading.
  - (iv) Transfer tracks, if required, shall be readily accessible from the main line into and from the yard, with yard to main line interface providing for maximum flexibility. The yard entry track shall be arranged for convenient routing of incoming consists to storage tracks, the shops, and the car washing facility, or for switching out defective vehicles.
  - (v) The design of the track connections between the yard and main line shall include redundancy in both directions.
  - (vi) Consists normally removed from service shall be able to move to the car wash facility without blocking access to the storage areas for consists immediately following. Likewise, consists in storage shall have ready access to the car wash facility without hindrance to normal yard operations.
  - (vii) The design for grouping of storage tracks shall provide sufficient lead tracks to all switching operations without blocking other track groupings.
  - (viii) Yard traction power electrification shall be provided with all necessary switchgear to provide for yard power sectionalization.
  - (ix) Emergency traction power trip stations, also referred to as Blue Light Stations (BLS) shall be strategically located throughout the yard and shop for emergency deactivation of traction power by yard and shop personnel. Normal control shall be provided via the Yard Control Console remote control. The requirement to be able to disconnect traction power along the trainway shall be permitted by an approved alternative means, See Schedule 15-2 Article 20.

- (x) It is preferred, but not a requirement, that the Car Shop Facility shall be double-ended, and shall be accessible from either end. It is required that sufficient space be provided so that an LRV which is undergoing wheel truing activity will be totally within the Car shop Facility and is not obstruction other Car Shop activities.
  - (xi) It is preferred, but not a requirement, that stub-ended storage tracks be avoided where possible. Where stub-ended LRV storage tracks are used, sufficient space from the designated LRV storage location and the end of the track shall be provided to reduce the potential of an LRV engaging a bumping post or other end of track restraining device.
  - (xii) The Maintenance Facility shall provide sufficient space to accommodate the System's management personnel and their staff, and shall provide all facilities to accommodate their needs.
  - (xiii) The Wayside Systems Maintenance and Repair Shop shall be equipped to provide all functions for wayside system inspections and maintenance, including traction power substations, train control, communications, trackwork, LRT Stops, fare collection, and other associated facilities and equipment.
  - (xiv) The Central Control Facility shall be sufficiently sized to support the System's main line operations.
  - (xv) Given the critical functions of the OMSF and Central Control Facility, UPS shall be supplied in case of a loss of local power to maintain all critical functions and other emergency related functions. The capacity of standby generators and battery banks shall be determined by Project Co.
  - (xvi) Adequate automobile parking shall be provided for supervisory and support personnel.
  - (xvii) The OMSF shall be adequately illuminated for operations to be performed in safety throughout a 24 hour day. Storage facility lights, towers, poles, or stanchions shall be located to be accessible for maintenance, and to minimize shadows. The lights and supports shall not interfere with operations or block designated paths of travel, service roads, or service aisles. All exterior lighting shall be controlled by photo-electric cells with manual over-ride. The design shall minimize off-site light pollution to the extent possible.
  - (xviii) The size of the Central Control Facility and ancillary equipment rooms shall be designed and arranged to accommodate the installation of additional equipment needed at a future date to operate and control the System.
  - (xix) Signs and graphics shall be provided throughout the yards and shops sites wherever necessary for safety, security, directional, informational, room identification, track identification or other such needs. Signage and Graphics shall be consistent with that provided at equivalent LRT facilities.
  - (xx) The OMSF shall be designed, constructed and equipped to load or off load Light Rail Vehicles that are being shipped to or from the OMSF either by rail or truck.
- (c) Operating parameters to be used in the design of the yards are:
- (i) Cars and trains shall be operated at a maximum speed of 16.6 km/h (10 mph) within the yard operating limits.
  - (ii) Manual operation with a conventional signal system or in combination with an automatic train control system shall be provided in the yard. Signaling in the yard for manual

- operation shall consist of conventional signals or push button route locking indications to indicate switch-point positions and, where deemed necessary, to govern train movements. If automatic train control is provided, shop tracks may be manual operation.
- (iii) Supervision of the yard track system shall be under the jurisdiction of a controller located either in the yard or in the Central Control Facility, depending upon the technology involved. The yard controller shall initiate, direct, and monitor all yard movements. The controller shall have the capability of two-way communications with yard operating employees.
  - (iv) Shop leads, holding tracks, and turnouts between these tracks shall also be under the jurisdiction of the yard controller. Shop tracks shall be under the jurisdiction of shop supervisory personnel.
  - (v) Movement within the yard shall be at the direction of the yard controller. Movements between the yard and main line shall be coordinated between the yard controller and Central Control Facility personnel. Alternately, Train Operator via the operator's console in the cab of the LRV shall be able to realign switches for yard movements.
  - (vi) In addition to the lead track and special trackwork needed to connect the main line and transfer track, the design shall provide facilities for transportation activities supporting the main line and storage operations. Crew Supervisor's Office, reporting and dispatching area for operating personnel, washrooms, lunch rooms, meeting rooms, lockers, showers, first aid rooms, time clock areas, and employee bulletin board areas shall be provided

## 16.9 Proposed Site Location

- (a) General Site Conditions
  - (i) The site for the Operations, Maintenance and Storage Facility is located on the Waterloo Spur as shown on Alignment Drawings refer to Appendix I. Project Co shall be responsible for the development of the OMSF, including the associated inter-related requirements, relationships, and responsibilities for LRT operations management between the maintenance facilities, Central Control Facility, and storage yard within the designated site.
- (b) Design, Construction and Provisioning
  - (i) The OMSF shall be designed, constructed and provisioned by Project Co, with all standard equipment normally and commonly found in light rail operations maintenance and storage facilities.
  - (ii) The design, construction, and provisioning of the OMSF shall provide for all functions related to LRT operations, including system components and LRT vehicles for inspections, maintenance, and repair of vehicles, trackwork, train control, communications, overhead contact system, traction power, fare collection, LRT Stops, structures and landscaping cleaning and maintenance, fencing, and other right-of-way elements.
  - (iii) The design shall minimize the need for future movements of control systems or other fixed facilities to another location due to the expansion of the LRT system.
  - (iv) The maintenance and storage facility shall be designed to support the detailed requirements of Project Co's approved Operations and Maintenance Plans.
  - (v) The design and provisioning shall meet the following requirements:

- A. The yard and shop facilities shall conform to all applicable regulations, industrial safety, health, and hygienic standards, local building codes, and air pollution regulations.
  - B. Facilities for vehicle maintenance, repair, and storage for the fleet of light rail vehicles shall be determined based on the LRT vehicle requirements.
  - C. The Wayside Systems Maintenance and Repair Shop shall be equipped, as required, to provide all functions for System maintenance, other than the LRT vehicle, including overhead contact system, traction power substations, train control, communications, trackwork, LRT Stops, and other functions as appropriate.
  - D. The Central Control Facility shall be equipped, as required, to provide all necessary operations for the LRT system, terminal transmission equipment, train control, communications, SCADA, signaling, emergency response functions, and other associated subsystems.
  - E. The OMSF shall include necessary structures, equipment, tools, and storage areas required to support maintenance and operational requirements of all LRT System elements and equipment.
  - F. Project Co shall provide track accessible, and self-powered Maintenance and Recovery Vehicles to inspect and maintain the trackwork and wayside equipment, retrieve failed trains anywhere on the System, provide re-railing capabilities, and move de-energized rail cars into the maintenance shops and storage yard.
  - G. Project Co shall provide facilities for personnel and storage areas to support materials management, procurement contracts management, inventory management, warranty management, material and spare parts storage, receiving, issuing and distribution of materials, and the disposition of surplus, obsolete, or scrap materials.
  - H. Project Co shall provide adequate facilities for various administration offices, including all Systems departmental management, personnel administration, and the Maintenance Management Information System.
- (vi) The design shall be determined based on Project Co's analysis of maintenance and storage requirements for the proposed technologies for the System, and design considerations for future expansion requirements of the LRT System.
  - (vii) In the design of the OMSF, Project Co shall give thorough consideration to maintaining the vehicle fleet for cleaning operations, routine maintenance activities, repairs, wheel truing, truck change-outs, and minor maintenance actions through supporting shops.
  - (viii) Major component and vehicle car body repairs and car painting may be performed off-site. Project Co shall furnish a listing of all components to be repaired, overhauled, or serviced by outside sources.
- (c) Electrical
    - (i) Electric power shall be provided in voltages and types needed for all offices, maintenance, and normal housekeeping activities in the OMSF. Power shall include voltages and capacities needed to operate electric-motored equipment, battery chargers,

- welding equipment, Heating, Ventilating, Air Conditioning (HVAC) equipment, and other associated maintenance equipment.
- (ii) Electric equipment and devices, and installations required for movement, maintenance, and testing of vehicles and other System equipment, shall include necessary manual and automatic controls, protective shields, and automatic power shut-offs to provide for personnel safety.
  - (iii) Back-up or redundant power sources shall be provided for those elements within the facility that require such power support.
  - (iv) There is an existing 2,000 kVA transformer at the OMSF site that Project Co can use for supplying power to the OMSF. If Project Co elects not to use this transformer, the Region will remove it from the site.
  - (v) It is preferred that outdoor receptacles be located in the yard and other OMSF outdoor spaces to assist in maintenance activities.
- (d) Mechanical
- (i) Mechanical equipment shall include plumbing, HVAC, and fire protection systems. All HVAC required for the activities of the Operation, Maintenance and Storage Facility shall be designed and provided by Project Co. HVAC and plumbing systems shall be designed for energy-efficient operation. The design shall include measures to maintain the temperatures and humidity ranges for all employee work areas. Where practicable, cooling and ventilation levels shall be augmented by the use of insulation and natural convection.
  - (ii) Air conditioning shall be provided to all offices, computer rooms, communications and train control rooms, electronic and other sensitive equipment, and electronic repair shops. Special ventilation shall be provided, where required by code, for shop and storage areas that produce undesirable emissions. All other shop and storage areas shall be adequately ventilated for their functions and local climate conditions.
  - (iii) Elevators shall be provided in all facilities with two or more floors or where required by AODA. The elevators shall have capacity to raise or lower equipment for storage and personnel.
- (e) Traction Power
- (i) Yard traction power may be fed from a yard substation, or from an isolated portion of a main substation, located to minimize yard traction power losses and negative potential on the return rail. The yard traction power system shall be independent of main line traction power sub-stations and the design of the negative return system between the mainline and yard as well as the yard and the shop areas shall include measures to prevent an undesirable potential rise in the running rails.

#### 16.10 LRV Maintenance and Repair Shop

- (a) General Requirements for LRT Vehicle Maintenance and Repair Shop
- (i) The LRT Vehicle Maintenance and Repair Shop, also referred to as the Car Shop, shall provide an effective layout for equipment and supporting shops. The design of the Car Shop shall include the location of major car repair areas in close proximity to supporting shops, with specific considerations of projected vehicle movements into and out of the

- shop. Shop access, space availability, and operating patterns for access and departure of trains from the shop to storage areas shall be designed for ease of movement.
- (ii) In addition to the Car Shop structure, provisions shall be considered for supplementing the shops for LRV cleaning (both interiors and exteriors of the LRV), blow-down and car wash activities. Where considered, the supplementary shops shall be independent and isolated from the Car Shop.
  - (iii) The Car Shop shall provide for all activities for vehicle maintenance and repair, including vehicle inspections and operational testing, scheduled preventive maintenance (including major component change-out), vehicle unscheduled maintenance and corrective repair, limited component repair and overhaul, exchange of trucks and wheel/axle assemblies, blow-down pit, wheel truing, steam cleaning, tool rooms, and material and spare parts storage.
  - (iv) The shop floor shall have a non-skid finish. All through track shall be designed so that the running rails are level with the shop floor, to permit ease of movement throughout the shop. An effective drainage system to compensate for snow melting or accumulation and other weather-related elements shall be provided.
  - (v) The design shall provide for the most effective and ergonomic solutions to permit inspections, corrective maintenance, and repair activities for undercar-mounted and roof-mounted equipment. The design shall provide “pits”, car hoist and body supports, or platforms for the performance of these activities. Where pits are provided, they shall be designed to permit personnel in a standing position to service equipment mounted under the car and from the side. The quantity of these work areas shall be determined by Project Co and included in Project Co’s Operations and Maintenance Plan.
- (b) Vehicle Considerations
- (i) Project Co’s Operations and Maintenance Plan shall include specific data considerations required to define the number of required vehicle work positions for the repair facility. These data shall include:
    - A. Vehicle characteristics, inspection scheduling, corrective maintenance, and the Manufacturer’s recommended overhaul frequency. Frequency of overhaul shall be based on time or mileage.
    - B. Time in the shop, per vehicle, for scheduled and unscheduled maintenance activities.
    - C. Assignment of vehicle work positions for both short-term and long-term activities.
    - D. Number of work shifts utilized, with consideration for future requirements.
    - E. Frequency of, and anticipated repair time required for, various mechanical, electrical, electronic, accident damage, and body repair tasks and car painting tasks performed in the repair facility.
    - F. Access into and from the Car Shop, and storage track access and arrangements.
    - G. Adequacy and type of heavy lifting equipment and its relationship to the vehicle.
    - H. Internal shop circulation and proximity of support shops to repair areas.
    - I. Requirements for special component handling equipment.

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- J. Layout and sizes of material storage areas.
  - K. Shop operating and work scheduling procedures.
  - L. Outside contract maintenance services.
- (c) Built-in Equipment
- (i) The Car Shop shall include a sufficient number of through tracks, which shall be equipped with pits, underfloor car and body support lifts, truck lifts, turntables, cranes, service platforms, and other devices required for exchanging trucks and undercar equipment, and servicing of roof-mounted components. The shop floor shall be free of obstructions, with sufficient capability to permit entry and offloading of materials and vehicles from roadway-type trucks and trailers.
  - (ii) The vehicle inspection areas shall be equipped with overhead reel-type compressed air, lubrication, and electrical power supply devices, primary power system for routine maintenance activities requiring the vehicle's auxiliary power source, and vehicle movement within or from the shop.
  - (iii) All vehicle maintenance positions and supporting shops shall be equipped with compressed air outlets for operation of pneumatic devices, and 115 Vac shop power for powering small electrical devices, drills, solder irons, heat guns, and other equipment.
- (d) Car Hoist and Body Supports
- (i) Project Co shall design, furnish, and install in-floor hoisting equipment, consisting of car hoist equipment and associated appurtenances. This equipment will be utilized to facilitate car truck removal and replacement, and to provide access to under-car mounted equipment while in the elevated position. Detailed foundation requirements shall be submitted for review to equipment installation.
- (e) Truck Repair Hoist
- (i) Project Co shall design, furnish, and install truck repair hoist equipment, and associated appurtenances. This equipment will be utilized to facilitate truck repairs and component replacement while the truck is in an elevated position. Detailed foundation requirements shall be submitted for review prior to equipment installation.
- (f) Turntables
- (i) Project Co shall design, furnish, and install turntables and associated appurtenances. The turntables shall function to rotate vehicle trucks during removal and replacement activities from the car, and to provide access to the truck repair hoist. All turntables installed within the through shop tracks shall be capable of supporting the weight of an empty LRT vehicle. Detailed foundation requirements shall be submitted for review prior to equipment installation.
- (g) Portable Equipment
- (i) The shop floor design shall provide for utilization of and accessible storage for, portable jacks. Floor reinforcement shall be sufficient to support the weight of an empty LRT vehicle in the raised position on portable jacks. Storage shall be provided for the appropriate number of jacks to hoist the vehicle.

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- (ii) Storage for stairs, scaffolds to access vehicle interiors, roll-about tool chests and other repairpersons' standard equipment, and supervisory stand-up type desks with forms storage shall be provided.
- (h) Mobile Equipment
  - (i) A motorized, electrical-type lift truck, with various appurtenances for handling material and undercar-mounted equipment, shall be provided. Various items of special test equipment and air conditioning (charging and recovery) service units shall be supplied as required to meet the maintenance requirements of Project Co's Operations and Maintenance Plan.
- (i) Service and Inspection Area
  - (i) The Service and Inspection area shall be provided with all capabilities for scheduled and unscheduled transit vehicle preventive and corrective maintenance, generally of a light and routine nature, in order to promote a high level of vehicle serviceability and availability.
  - (ii) Service and inspection activities contributing directly to daily operations shall be capable of operating 24 hours per day, seven days per week. The actual operating schedule shall be determined by Project Co's approved Operations and Maintenance Plans.
- (j) Minor and Heavy Maintenance Areas
  - (i) Repair areas shall be provided to perform unscheduled and corrective maintenance actions and repair of minor damage to cars. These areas shall be equipped with car hoists, body supports, and turntables to elevate the vehicle during repair activities. Other areas may be flush with the floor (with platforms installed to service roof-mounted equipment) for minor car repairs and the performance of actions that do not require the car to be in an elevated position.
  - (ii) All repair areas shall be equipped with overhead cranes, jib cranes, and other lifting devices as required during the performance of repair and corrective actions.

**16.11 Support Shops**

- (a) General Requirements for Support Shops
  - (i) Various shops shall be provided to perform anticipated in-house component repair activities and to provide support for the vehicle repair bays. Project Co shall design each shop based on the operations to be performed within that area, the projected workload, and the equipment layout required to support such operations.
  - (ii) The various shops identified may be combined, or grouped to provide multi-functions for common component repair activities, with supporting supervision and administration. In some cases, Project Co may prefer to subcontract out maintenance and repair services in lieu of performing those services with in-house staff. The services that will be subcontracted out shall be fully described in Project Co's Basis of Design Report – OMSF. All shops shall require work benches, diagnostic test and ancillary test equipment and components, tools and materials storage, and combinations of compressed air, hydraulic pumps, manifolds, gauges, portable power supplies, and other equipment as required.
- (b) Support Shop Operating Philosophy

- (i) The support shops shall be multi-functional for component repair of all System elements. The shops shall provide the basic requirements for System equipment calibration, repair, testing, and minor overhaul. Such repair actions shall be accomplished, normally, through maintenance personnel troubleshooting the equipment down to the Lowest Level Replaceable Unit (LLRU), and then replacing that unit or device with a known serviceable unit. Removed units or devices shall then be returned to the respective component repair areas or facilities for further analysis and repair.
  - (ii) Major subsystem and selected component repair activities may be performed by outside contractors. In this case, the component repair shop shall test the unit or device, determine whether the unit or device has failed, and establish the actual nature of the fault, prior to transfer to an outside contractor.
  - (iii) Units or devices returned by outside contractors shall be tested and verified for complete repair prior to return to inventory.
  - (iv) Typical component repair shop activities shall include: servicing or overhaul of scheduled preventive maintenance units or devices, failure verification, correction or repair, repair of accident or vandalism damage, modification/retrofit programs, failure analysis, testing and test monitoring, and providing input to the Maintenance Management Information System (MMIS) regarding component failure history for warranty and reliability analysis.
- (c) Component Repair Shops
- (i) Design of the various component repair shops shall be based on the characteristics of the Stage 1 LRT Project and future expansions of the LRT System. The component repair shops shall also be based on the characteristics of the LRV being provided by the Region. The following shops or functions shall be addressed in the Basis of Design Report - OMSF.
    - (ii) Electronic Shop
      - A. The electronic shop shall require environmental stability for temperature and humidity control, and shall be a multi-function facility addressing all systemwide electronics components and devices applicable to the vehicle, Central Control Facility displays and monitors, train control, communications, fare collections, variable message signs, and other support systems equipment. Electrical power shall be supplied for special or diagnostic test equipment and associated ancillary devices.
      - B. This equipment may include: diagnostic test equipment (portable and bench-type), power supplies of various output levels and characteristics, oscilloscopes, multi-channel chart recorders, special and multi-purpose testers, signal generators, microprocessors, and mini-computers. The electronic shop shall have the capability to clean and test circuit boards and other solid state components for failure analysis and repair.
      - C. It is preferred that radio repairs not be performed as an in-house shop service, but performed by a designated outside contractor. Radio maintenance should be limited to unit exchange only.
    - (iii) Electrical Shop
      - A. The electrical shop shall be a multi-function facility addressing all Systemwide electrical components and devices, and shall perform basic troubleshooting,

minor repair, servicing, and functional testing. Electrical shop activities shall address systemwide electrical equipment and component repair, and failure verification for vehicle electrical coupler heads, current collector assemblies, knife switches, controllers, brake grids and other large resistors, various wayside equipment, shunts, bonds and other cable-type items, other equipment such as relays, switches, power contactors and circuit-breakers, lighting fixtures, signals, wiring, cabling, harnesses, small motor bearing replacements, motor failure verification for traction motors, blower motors, switch machine motors, and other high- and low-voltage drive motors. All components and devices, designated by Project Co, shall be tested prior to transfer to designated outside contractors for repair and verifications of corrective actions on return. Electrical power shall be supplied for special or diagnostic test equipment and associated ancillary devices, and for tools at each work station, along with appropriate room and local illumination.

- B. The shop may require materials handling equipment for large and bulky items, stands, and holding fixtures. The shop functions may be combined or grouped to provide a multi-function and common System component repair facility.
- C. Electrical power at various values for testing equipment shall be provided. Test equipment such as continuity testers, "meggers", and high-potential testers shall be provided.

(iv) Pneumatic/Hydraulic Shop

- A. The pneumatic/hydraulic shop functions may be combined or grouped to provide a multi-function and common System component repair facility. Such functions may include revenue vehicle component repairs and support of non-revenue vehicle repairs and other System components as required. Shop support equipment shall require various brake component test racks, brake caliper repair, actuator rebuilding, cylinder honing devices, minor pneumatic compressor repairs, and test stands for equipment checkout and functional testing and repair for other System pneumatic and hydraulic apparatus. The shop shall require work benches, diagnostic test and ancillary test equipment and components, tools and materials storage, and combinations of compressed air, hydraulic pumps, manifolds, gauges, portable power supplies, and such other equipment as System design may dictate.
- B. The basic function of the shop shall be to provide support to the revenue service fleet of transit vehicles, including activities addressing testing, repair, modification, and certification of pneumatic or hydraulic truck-mounted friction brake assemblies, compressors and pumps, various valves and distribution devices, reservoirs, lines and fittings, suspension components, and various systems equipment, including hydraulic elevators.

(v) HVAC Shop

- A. The HVAC shop functions may be combined or grouped to provide a multi-function and common System component repair facility. The HVAC shop activities shall address vehicle air conditioning and heating equipment and all HVAC systems within the LRT Stops and the OMSF. The shop shall be provided with a clean working environment. Shop repair activities shall address items including refrigerant compressors, refrigerant lines and hoses, condensers,

evaporators and dryers, and temperature and humidity sensors. Soldering equipment shall be provided as required. Shop support equipment shall include refrigerant storage and refrigerant charging and recovery apparatus.

- B. Where air conditioning equipment requires servicing as a modular integral unit, such units shall be tested and verified for existing failure, or shall be designated for routine preventive maintenance overhaul prior to transfer to a designated outside contractor.

(vi) Wheel Reconditioning and Truing

- A. The wheel reconditioning and truing operations shall be located in the Car Shop in an area that will not disrupt movement about the shop area, and within an area where noise will not interfere with other operations. The wheel truing machine should be located in the center of the shop with spatial provisions on both sides sufficient enough to accommodate and LRV and service aisles. This shall permit the entire LRV to be within the confines of the shop and not block access to other areas of the Car Shop.
- B. The wheel truing machine may be milling machine or tracer lathe-type for reconditioning worn wheel treads and flanges to the desired profile on the vehicle or on individual trucks. Project Co shall perform a life cycle cost analysis of the operational and physical characteristics of the desired machine, training requirements, set-up time, cutting time per wheel set, indexing requirements, cutter replacements, routine maintenance (time and labor) requirements and personnel requirements for normal operation. A chip collection system shall be provided to convey removed metal chips to a collection container for disposal. The equipment shall be interlocked with primary vehicle power to prevent operation and damage to the equipment.
- C. The wheel truing machine shall include all provisions for operator safety, with an emergency “shut-down” and other appropriate protective devices for protection of personnel and equipment during operation. The installation shall provide protection against open pits.

(vii) Truck Repair Shop

- A. The truck repair area shall provide for routine maintenance inspections and repair activities, and minor overhaul or component replacement. The repair area shall provide overhead or jib cranes capable of lifting the complete truck assembly and controllable for removal and reinstallation of truck-borne components or assemblies for complete teardown, repair, or replacement.
- B. Truck repair activities, in-house, shall include removal and replacement of wheel/axle assemblies, traction motors, bolsters, brake caliper and actuators, friction brake discs, disk brake pads, and suspension system components. Testing operations shall include the capability to perform tram and parallelism checks, equalization, truck suspension, load weight, and height adjustment. Some testing shall be performed with the truck mounted under the vehicle.
- C. Major truck repairs and complete overhauls may be contracted to an outside source.

- D. Truck shop equipment shall include the truck repair hoist, various stands and holding fixtures, and facilities to handle truck-related components and the complete truck assembly.
  - E. Space for storage of spare truck components, and space for Project Co's determined quantity for the spares ratio of completely assembled trucks, shall be provided.
- (viii) Machine Shop
- A. The machine shop, a multi-functional shop to support the System, shall be provisioned with sufficient machine shop equipment to perform basic machining and sheet metal work, supporting such activities as component enclosure repairs, minor collision and minor car body repairs including minor painting, and miscellaneous customizing or fabrication work; special tools; repair fixtures; and other system or facility maintenance items. The area shall be provided with work benches, tool storage, supplies and tooling accessories, and a secured holding area for material storage.
  - B. A Magnaflux unit capable of examination of friction brake equipment may be provided as an optional piece of equipment.
- (ix) Welding Shop
- A. The welding area may be combined as part of the machine shop, with additional provisions such as steel-faced, heavy grid work benches, various clamps and holding fixtures, pre-heat welding rod oven, and secure material storage areas, to support various built-in and portable welding, brazing, heliarc, and other welding systems for the materials anticipated to be utilized in the System.
  - B. Welding shop equipment shall have the capability of cutting or welding various similar and dissimilar ferrous metals as well as aluminum. Welding requirements shall be primarily associated with non-routine repair or fabrication requirements. Portable emergency equipment shall be housed in this shop.
  - C. Ventilation equipment and various shields and barriers conforming to applicable safety standards shall be provided.
  - D. Methods for handling of materials, such as a jib crane, shall be included.
- (x) Upholstery Shop
- A. An area shall be established for the storage and minor repair of upholstery components and floor coverings, related to the vehicle interior design.
- (xi) Battery Shop
- A. The battery shop design shall include provisions for testing, charging, servicing, and storage of the transit rail vehicle batteries. This facility shall be power ventilated. All lighting, switches, and electrical connection boxes shall be explosion proof. Floor drains shall be provided with containment tanks for possible alkaline or electrolyte solution spills and clean-up. Electrolyte storage facilities conforming to applicable safety standards and regulations shall be provided. Battery charging and discharging equipment shall be provided with all appropriate cabling. An emergency shower facility, with an additional supply of fresh water for an eye wash facility, shall be provided.

- (xii) Pantograph Shop
  - A. A pantograph repair shop shall be provided for the repair of pantographs and shall be equipped with a 2½ ton capacity hoist, shop power and compressed air.

## 16.12 Wayside Systems Maintenance and Repair Facility

- (a) General requirements - Wayside Systems Maintenance and Repair Facility
  - (i) The Wayside Systems Maintenance and Repair Facility shall provide for inspection, preventive maintenance, and corrective maintenance actions required, other than vehicle maintenance, for all fixed facilities and wayside equipment. This area shall also provide for the staging and dispatching of personnel for performance of various external activities.
  - (ii) The Wayside Systems Maintenance and Repair Facility shall be equipped and provisioned, as required, to provide all functions for wayside system maintenance, including overhead contact system, traction power substations, train control, communications, trackwork, LRT Stops, and other associated wayside and Maintenance-of-Way (MOW) components. In some cases, Project Co may subcontract out wayside systems maintenance and repair service in lieu of performing those services with in-house staff. The services that will be subcontracted out shall be fully described in Project Co's Basis of Design Report – OMSF.
  - (iii) Wayside Systems Maintenance and Repair Shops
    - A. The Wayside Systems Maintenance and Repair Shops shall support all System elements, excluding the Car Shop. The shop design shall provide the capability to maintain accessibility for non-revenue vehicles, and shall provide ease of access for staging and dispatching of material and personnel throughout the System by track-borne or roadway equipment. Support shop functions shall be designed, as practicable and as necessary, to be multi-functional in conjunction with shops within the Car Shop.
    - B. The Wayside Systems Maintenance and Repair Shop shall also be designed to provide sufficient accommodations for external storage areas, car wash facilities, cleaning platforms, supervisory and operating personnel parking, special non-revenue equipment, and track-accessible and track-borne supporting equipment. The Wayside Systems Maintenance and Repair Facility may be attached to the Car Shop facility, but shall be independent and isolated from that facility. Design and layout of the facility shall be the responsibility of Project Co.
    - C. The layout for the System wayside systems maintenance and repair facility shall allow for possible expansion of the System's requirements, which shall be achievable via movement of specific functions, accomplished through minimal efforts and minimal disruption of System operations.
- (b) Wayside Systems Maintenance and Repair Shop Functions
  - (i) Shop functions shall include the repair and potential fabrication of special track components, LRT Stop and other facility components, running track and OCS components, fasteners, signs and other graphics, rail cutting and drilling, maintenance and repair of non-revenue support equipment associated with maintenance-of-way, and other fixed facility maintenance and repair activities.

- (c) Wayside Systems Maintenance and Repair Shop Activities
  - (i) Maintenance and repair activities shall include inspection and maintenance of non-revenue maintenance support vehicles, rubber-tire motor vehicles (such as automobiles), and light and heavy trucks (including those that may be track-equipped) and may include special equipment such as generators, air compressors, and cranes. Equipment serviced shall include locomotives (where required), ballast cars, flat cars, and special purpose vehicles, traction power substation and distribution equipment (including such items as circuit breakers, rectifiers, battery systems, relays, switches, and cables), repair or failure verification of electronically controlled mechanical equipment for signals, control, and communications, shop equipment and portable equipment for plant maintenance, routine inspections and maintenance of all installed support equipment, cranes, hoist, vehicle washing, and other LRT structures, passenger LRT Stops, buildings and other fixed facilities, mechanical and electrical systems, signs, graphics, fencing, roadways, and parking lots.
  - (ii) The facility shall provide, as a minimum, one enclosed track area to maintain track-borne support equipment and to provide an enclosed staging area.
- (d) Track Maintenance Shop
  - (i) The Track Maintenance Shop design shall contain provisions necessary for management and supervisory personnel, staging, and point of dispatch of track maintenance personnel. The facility shall provide an enclosed track area for the maintenance of non-revenue vehicles, shop areas for storage-specific materials and equipment, and outside storage of materials required by trackwork design for track types such as ballasted, direct-fixation, slab track, embedded track and special trackwork, direct fixation fasteners, ties, switches, and associated track apparatus.
- (e) Power Maintenance Shop
  - (i) Power Maintenance Shop design shall contain provisions necessary for management and supervisory personnel, staging, and point of dispatch of maintenance personnel for traction power, LRT Stop and yard illumination, and facilities AC service requirements. Where applicable, the Power Department shops may be combined or grouped with the Car Support Shops to provide a common System component repair facility.
- (f) Facilities Maintenance Shop
  - (i) The Facilities Maintenance Shop shall be involved in the inspection, preventive maintenance, and corrective maintenance required for all fixed facilities and wayside equipment enclosures, installed environmental systems, lighting, elevators, and other installed apparatus. This area shall provide for the staging and dispatching of personnel for performance of various activities.

### 16.13 LRV Car Wash

- (a) General requirements – LRV Car Wash
  - (i) To achieve a consistent clean appearance, and to prevent the buildup of graffiti, dirt, and grime on the LRVs, provisions shall be made for daily exterior washing of all LRVs which have been in revenue service.
  - (ii) The design shall provide car wash equipment for cleaning the exterior of the LRVs. The car wash equipment shall include structural, mechanical, and electrical items necessary to

- wash the exterior of the vehicle, using the appropriate solution agent (mixed with recycled rinse water) and final rinse with fresh water.
- (iii) To achieve these requirements, the car wash facility shall be located with direct access from the main line, attached to the Car Shop, but independent and isolated from that facility. The car wash shall permit operating the vehicles automatically at a slow speed, under their own power, through a series of water and detergent sprays, rotary brushes, and blowers, or shall permit all car washing equipment to circulate about the stationary car. The design shall provide that the soak cycle recommended by the car wash manufacturer is maintained.
  - (iv) The car wash track shall be able to accommodate the largest train consist without interfering with other track movements.
  - (v) The car wash shall meet all environmental control standards, including reclaiming tanks for acid wash solutions, automatic pH neutralization, and recycling of rinse water. Overflow or unreclaimed water to be discharged into the local sewer system shall be treated for oil removal and pH adjustment prior to discharge.
  - (vi) Associated water softening reclamation and suitable bacterial control equipment shall be provided.
  - (vii) The rinse water recovery ratio shall meet or exceed the requirements of local jurisdictions, with minimum 80% recovery.
  - (viii) Tanks for water reclamation or storage designed for location underground shall be anchored so that they will remain stable when empty in high water table conditions.
  - (ix) Project Co shall design the car wash in accordance with the Region's requirement for sewer use as per Bylaw 1-90 and 92-050.
- (b) Daily LRV Interior Cleaning
- (i) Revenue service LRVs shall have interior cleaning prior to re-entry into revenue service on a daily basis. Interior cleaning may be performed during nightly layovers. Cleaning shall include vacuuming of carpets, collection and removal of trash, and removal of light stains, spills, and graffiti. These functions may be performed in the storage yard, end-of-line tail tracks, or track areas adjacent to the car washing facility.
  - (ii) Heavy cleaning shall be performed on an as-needed basis, or shall be accomplished when the vehicle is scheduled for preventive maintenance inspections.
- (c) Interior Heavy Cleaning
- (i) Interior heavy cleaning of the LRVs may be provided within the car wash facility. The area shall be provided with water service, electric power, compressed air, and a centralized vacuum cleaning system, with wall-mounted hose connections along the cleaning platform placed at intervals aligned to vehicle doorways.
  - (ii) The design shall include, as an optional item, a centralized carpet shampooing system in connection with the vacuum cleaning system for the vehicle interior floor covering.
  - (iii) The design shall include provisions for window/glass replacement and running repairs to the vehicle's interior mounted equipment.
- (d) Under Car Cleaning

- (i) As an optional facility, a “blow-down facility” may be provided to clean the under car areas, prior to shop activities, for the removal of built-up dirt, iron dust, and grease on the equipment, trucks, coupler anchorage, and other areas that may become contaminated, to allow more extensive visual detection of vehicle defects during inspection.
- (ii) The pressurized air facility for this cleaning operation shall include an adequate pit with a suitable compressed air and filtered exhaust system. The area shall be capable of accommodating at least one vehicle. The blow-down facility shall provide for fixed air nozzles, properly located to effectively blow compressed air against all parts of the car underfloor structure. The compressed air nozzles shall not be directed at any point above the vehicle thresholds. The exhaust system shall provide collection of air-borne particles within the blow-down facility. Accessory outlets for the connection of a hose extension and a hand-held nozzle to reach hard-to-get at areas shall be provided. This accessory outlet shall be provided with an air pressure reducing valve to permit the blow-down of electronic components. The collection system shall filter the air, and shall not release or permit any particles to be transmitted into the atmosphere. The air-borne particle collection system shall be designed for easy maintenance and cleaning.
- (iii) The blow-down facility may also include a steam cleaning system, to allow cleaning of individual trucks prior to commencement of inspections or maintenance activities. The facility shall also provide for the steam cleaning of batteries, coupler anchorages, component assemblies, and other related parts.
- (iv) The pit floor shall be a removable, non-skid, grid design, to provide for drainage and water disposal. All drainage originating from the steam cleaning area shall pass through an oil separator prior to discharge into the sewer system.

#### 16.14 Central Control Facility

- (a) General Requirement for Central Control Facility
  - (i) The Train Control subsystems for the System shall be developed using a modular design approach. The design criteria shall include hardware and software design provisions for accepting expansion of the service with minimal modification to hardware, software, and facilities. These provisions shall include facility allowances for the equipment rooms, and hardware allowances for the apparatus affected by the projected System.
  - (ii) The Central Control Facility shall be located in the Operations, Maintenance and Storage Facility. The design of the facility shall provide Yard Control Operations with full visual observation of the operating yard, lead tracks, and mainline interlockings to the greatest extent possible using CCTV and glazing as appropriate.
  - (iii) The design for the layout of these rooms shall include provisions for possible future expansion. The design shall provide all equipment installations associated with operation and control of the LRT System. The size of the CCF and ancillary equipment rooms, equipment racks, display panels, operators’ positions, and associated equipment shall be designed and arranged to accommodate the installation of additional equipment needed at a future date to operate and control the System.
  - (iv) The data processing rooms shall house all data processing and data storage apparatus for Central Control, including computers, associated peripherals, telephone systems, process controllers, and other equipment requiring strictly regulated temperature and humidity control. A system programmer console shall be provided in the data processing room.

Data processing rooms shall have a raised computer-type floor. All cabling under such floor shall be plenum rated as required in the OESC.

- (v) The CCF shall also contain all equipment necessary for the Supervisory Control and Data Acquisition (SCADA) subsystem, which shall provide supervisory control of the train control system, auxiliary and traction power, the environmental control system, and other systems and subsystems. Status reporting, information storage and retrieval, alarm processing, trends, and incident and operations reports shall be provided via status boards.

#### 16.15 OMSF Communications

- (a) Communications Equipment Room
  - (i) The Communications Equipment Room (CER) shall be located in close proximity to the CCF. All terminal equipment for communication circuits to, from and within the Operations, Maintenance and Storage Facility shall be installed at this location.
  - (ii) All communications yard duct banks and yard-to-main line transitional communications duct banks shall terminate in a cable vault under or adjacent to the Communication Equipment Room.
- (b) Cable Transmission System (CTS)
  - (i) The fiber optic and multiplex CTS terminals for the Central Control/Yard backbone line shall be located in the CER.
  - (ii) Local telephone distribution, throughout the facility and associated structures, shall be implemented.
- (c) Telephone Service
  - (i) Telephone services including dedicated telephone circuits shall be provided from the appropriate facility.
- (d) Facility Inter-Communications
  - (i) All telephones shall be equipped to interface with all offices, using an abbreviated dial scheme.
- (e) Public Address
  - (i) A PA system shall be provided that covers all areas of the OMSF.
- (f) Fire Detection and Suppression Monitoring
  - (i) All fire detection and suppression monitoring devices shall be annunciated locally at the Fire Alarm Control Panel, and remotely at Central Control and at the yard control console.
  - (ii) Fire Emergency System
    - A. An electrically supervised, closed circuit, selective code fire alarm system controlling an automatic sprinkler system shall be provided for all structures within the Operations, Maintenance and Storage Facility. Manual fire alarm stations readily identifiable and easily accessible to all personnel shall also be provided. Automatic devices, such as fixed temperature detectors, shall be installed as required by fire codes. Audible and visual alarms and indications shall be provided at local points as necessary. There shall be automatic shutdown

of HVAC systems in the area of an alarm. Fire extinguishers shall be provided as recommended by NFPA and local jurisdictions.

- B. The design of the maintenance facility and storage shall accommodate fire fighting equipment and other emergency response vehicles. Fire hydrants, standpipes, hoses, and other associated fire fighting equipment shall be installed within the storage yard and all facilities, as required by local jurisdictions and as recommended by the NFPA.

#### 16.16 Security

- (a) Due to the nature of electrification, train control, and accessibility to vehicles, the entire Operations, Maintenance and Storage complex shall be fenced off from the general public, except for access through a main gate. This gate shall be attended, and shall permit limited employee parking. Parking areas shall be arranged so that parking is restricted, or so that it is not possible to park immediately adjacent to any fixed structure or electrified track areas.
- (b) Areas such as outside material storage, parking areas, gate area, and other areas, shall be sufficiently illuminated to discourage trespassers and vandals. CCTV surveillance for security purposes shall be provided.
- (c) The facility's security shall not impose any restriction for emergency response vehicles from access to the OMSF.

#### 16.17 Hazardous and Toxic Material Storage

- (a) During the operation of the System, hazardous and toxic materials such as fuels, paints, thinners, and solvents may be used. Project Co shall identify and quantify the need for such materials, and shall evaluate requirements for special storage and disposal. The maintenance and storage facility shall include all necessary equipment for handling, storage, and disposal of such materials. All handling and disposal of hazardous materials shall be in accordance with all applicable laws and regulations, and shall depend on the hazardous or toxic nature of the material specified in the environmental assessment report. Project Co shall identify all such materials, and shall provide the procedures and methods of storage and disposition.

#### 16.18 Drainage and Services

- (a) Project Co shall design, and submit for review, a complete storm drainage system for the maintenance and storage facility. The system shall consist of a combination of graded sub-grade areas and perforated self-cleaning subdrains, located between alternate pairs of tracks and connected to the necessary laterals, collectors, and outfall structures. A system of ditches, catch basins, and storm drain pipes shall be designed to direct surface run-off away from all track areas, and also to handle flow from the subdrain and roof drain systems. In no case shall a storm drain flow into a subdrain. Measures shall be taken to protect the subdrain system against cathodic deterioration.
- (b) Areas where hazardous waste products are utilized shall be designed to flow to the appropriate type of decontamination system as required. Such waste fluids shall not be permitted to enter the local drainage system without proper treatment.

#### 16.19 Fuel Storage

- (a) An environmentally compliant, automotive fuel storage and dispensing area shall be provided within the facility. The facility shall be located in an area isolated from all other buildings but

within easy access of the interior service roads, to service road vehicles, Maintenance Recovery Vehicles (MRVs), and vehicle-mounted equipment.

#### 16.20 Service Roads and Aisles

(a) Interior Service Roads

(i) A network of paved interior service roads shall be provided to permit access for yard personnel, emergency response units, and fire fighting equipment, and shall permit access to maintenance-of-way external storage areas. It is preferred that roads avoid crossing the body of the transit vehicle storage yard at-grade, unless a fire access road is required. It is preferred that track turnouts are not located within the paved area of a grade crossing. The desired minimum width of the interior service road is 4.6 meters, and the desired minimum width of the shoulder shall be 1.0 meters. If the service road is located close to OCS wires that are less than 5.6 meter above the roadway, a curbing or barrier rail shall be provided adjacent to the service road, to mitigate the potential of vehicle incursion.

(b) Exterior Service Road

(i) An exterior service road shall be provided to connect the maintenance and storage facilities to the nearest public thoroughfare. Ingress to the storage facility shall be provided through controlled check points or at a facility entrance gate house. Exterior service road design shall conform to applicable local codes.

(c) Service Aisles

(i) The overall design of the facility shall provide, where applicable, paved service aisles between the storage tracks, to facilitate the ingress and egress of personnel and equipment. Paved service aisles shall be provided throughout the length of alternating pairs of tracks. In designing the service aisles, consideration shall be given to the movement of fire trucks and fire fighting equipment to all areas of the storage facility.

#### 16.21 Material and Spare Parts Storage

(a) The design and layout of the materials management area shall provide facilities for material and spare parts storage and staff personnel to support materials management, procurement contracts management, inventory management, warranty management, material and spare parts receiving, issuing and distribution, and the disposition of surplus, obsolete, or scrap materials. Project Co shall consider future requirements for possible System expansion to confirm that adequate space is maintained for availability of materials to support the System.

(b) Planning may include a feasibility study to implement future transfer of the main storage area to another facility. The System storage area may in the future be configured as a satellite facility. Where practicable, material and spare parts stores for vehicle repair, system maintenance and fixed facility maintenance, as well as other activities, shall be combined in a single stores facility.

(c) The primary responsibility for the material and spare parts storage area shall be to maintain material spares to support the Stage 1 LRT System's overall availability. The success of the operation will depend upon the pipeline of spare parts, properly stocked with workable assemblies, subassemblies, and replaceable components ready for use. Effectively managed inventory control and records shall be maintained to provide for interchangeability of properly tested assemblies.

(d) In addition to enclosed stores facilities, an area may be provided for open storage of items and materials capable of being stored exposed to the environment. Typical items may be: track

components and accessories, rail, ties, switches, vehicle wheels, and spare truck frames and components.

- (e) It shall be Project Co's responsibility to provide an adequate and accurate supply of replacement spares, available at the termination of component warranty periods. This stock of spares, both consumable and repairable, shall be constantly maintained through the final turn-over of the LRT System to the Region.

#### **16.22 Administration Facility and Offices**

- (a) The Maintenance Facility shall provide sufficient space to accommodate the Stage 1 LRT management personnel, and shall provide all facilities to accommodate their needs.
- (b) The design and layout of the Operation, Maintenance and Storage Facility shall provide adequate facilities for various Management Administration Offices, including all systems departmental management, personnel administration, and the Maintenance Management Information System.
- (c) Minimum requirements shall be based on and provide for: operations management staffing for vehicles, track, power, train control, building maintenance, personnel administration, maintenance management information system, and vehicle record and technical manuals storage.
- (d) Washrooms, lunch rooms, meeting rooms, lockers, showers, first aid rooms, time clock areas, employee bulletin board areas, and ancillary spaces shall be provided.

#### **16.23 Maintenance Management Information System (MMIS)**

- (a) The MMIS shall provide System departmental managers with operational data required for analysis and determination of systems performance and efficiency. Project Co shall establish a computerized MMIS capable of collection, processing, storage, retrieval, analysis and reporting of reliability, efficiency, and effectiveness-related information pertaining to all aspects of the System.
- (b) The MMIS shall provide for overall System availability, systems configuration management, maintenance scheduling, and component histories, and shall be capable of identifying System deficiencies, eliminating their causes, and providing for the implementation of corrective actions to be taken. The MMIS, as a minimum, shall provide for the function identified below.
- (c) Operational Evaluation
  - A. Systems analysis shall provide all aspects of performance monitoring, including operating hours, mileage for total System accumulation and per individual vehicle, resource planning, reliability and failure monitoring, failure definition, relevant versus non-relevant, and report generation. The MMIS shall provide an automatically generated report on systems or components that approach or exceed contractual limitations on reliability. This report shall be made available to the Region on a bi-weekly basis.
- (d) System Availability
  - (i) The system shall analyze and report upon vehicle availability, incident reporting, System delays, equipment failures, accident analysis, investigation reports, and ridership data collection and analysis (forecasted versus actual).
- (e) Maintenance Planning
  - (i) The system shall analyze and report upon inspection schedules, personnel requirements (identifying crafts, skill levels, and training requirements), materials requirements, equipment availability, support equipment availability, repair records for systems

equipment and rolling stock, configuration management and control, and modification and retrofit programs.

- (f) Component History
  - (i) The system shall analyze and report upon component part numbers, Manufacturer's and System stock numbers, on-line repair records, support shop component repair records, and equipment installation dates (including items reflecting safety, interference fit mounting pressures for wheels / axles, gear units, axle-mounted brake disc, and other information as required).
- (g) Manufacturer's Listing
  - (i) The system shall contain cross references to component Manufacturers and warranty expiration dates for assistance in ordering additional materials.

#### 16.24 Maintenance and Recovery Vehicles

- (a) Project Co shall provide track-based or track-accessible, individually powered, MRVs to inspect and maintain all trackwork and wayside equipment, retrieve failed trains on the System, and move vehicles or consists within the Operations, Maintenance and Storage Facility's yards and shops. Project Co shall determine the number and type of vehicles needed, and shall including in Project Co's design all supporting information, including the vehicle's design, capabilities, and related equipment.
- (b) If, during the operation of the System, it is determined that insufficient MRVs have been provided to meet operational, maintenance and System service availability requirements, Project Co shall provide the necessary additional vehicles of the appropriate type.
- (c) The following features and capabilities shall be provided in one or more types of MRVs.
  - (i) The vehicles shall be bi-directional, with equal performance in both directions, and shall be operable by the vehicle's own energy source.
  - (ii) Ability to couple or have provisions for attachment with any train, to push, pull, and stop a W1 train over the entire length of the System.
  - (iii) Be able to load and unload LRT vehicles from the unload/load ramp.
  - (iv) Carry replacement parts for maintaining and repairing trackwork and wayside equipment.
  - (v) Carry jacking and re-railing equipment for vehicle/consist recovery.
  - (vi) Have the means, such as a permanent or detachable crane or winch, to place and remove equipment, materials, jacking, and re-railing equipment.
  - (vii) Have permanent or temporary installed emergency equipment and the capabilities to provide the following:
    - A. Generate compressed air and 120 volt ac auxiliary power.
    - B. Have on-board storage for selected maintenance equipment and parts.
    - C. Be able to operate on all sections of the System right-of-way characteristics and under all environmental conditions.
    - D. Be retained on the trackway, satisfying all requirements for safety, and have necessary additional stabilizing devices to prevent tipping or derailment while performing System maintenance and train recovery functions.

- E. Have on board radio communications.
- (viii) Any MRV or associated emergency equipment, when fully loaded for any of its functions, shall not exceed the load limits or clearance requirements established for the passenger vehicles for the right-of-way structure, nor of any other type of track maintenance equipment.
- (d) Road-Based Operations and Maintenance Vehicles
  - (i) Project Co shall provide a sufficient number of road based vehicles for access to the System, to conduct all operations and maintenance tasks, including rapid access of O&M personnel to any System location to respond to failures and malfunctions, and pickup and delivery of O&M equipment, parts, consumables, and expendables.
  - (ii) These vehicles shall be designed to meet the intended service requirements, and shall be heavy-duty construction, equipped for the purposes intended by Project Co.
  - (iii) All such vehicles shall meet all requirements for operating on public roads.
  - (iv) The vehicles shall have flashing amber lights, mounted for visibility by other motorists.
  - (v) The vehicles shall have on-board mobile radios, or integral mounts for hand-held portable radios, to give full coverage wherever driven.
  - (vi) The vehicles shall have an appropriate color scheme, markings, and logos to identify them as System vehicles.
  - (vii) Project Co shall determine the number and type of vehicles needed, and shall submit for review supporting information, including the vehicle's design, capabilities, and related equipment and include this information in the Basis of Design Report – OMSF.