

## 18 Lyttonsville Yard and Shop

In order to successfully operate the Purple Line, the MTA must house administration for the line, operations related to the storage and dispatch of approximately 56 railcars, and maintenance of approximately 56 railcars. A single site large enough to house a Yard and Shop complex was not available along the corridor, so the railcar storage and maintenance activities were divided between the two sites: Lyttonsville in Montgomery County and Glenridge in Prince George's County.

The Purple Line Yard and Shop Concept Report was completed in November 2010 and outlined maintenance activities and functional requirements for support of the Purple Line Light Rail system. This report identified the need for two separate yard and/or shop locations and stated that one would be in Montgomery County (Lyttonsville) and one would be in Prince George's County (Glenridge), and proceeded with the assumption that the line would be constructed in a single phase. An alternative scheme was developed to support the line if it is to be constructed in two phases, but this approach would require duplication of many functions, which is undesirable for the overall cost of the project and would result in redesign of the buildings. In the Concept Report, Lyttonsville shop functions were identified as regular duty Light Rail Vehicle (LRV) repairs and inspections, unscheduled repairs, wheel truing, truck change out and mid-life overhaul, while the Glenridge shop would house LRV inspection, Maintenance of Way (MOW), Systems, Catenary and the Body Shop. Operations and maintenance staff would be divided between the two shops, to reduce the size of the support spaces for staff.

The Concept Report also outlined the major maintenance operations, hours of operation, shift work allocation and assignments, spot requirement calculations, descriptions of specific maintenance functions, proposed equipment and anticipated square footages for the spaces within the buildings. The report concluded by stating that final operations analyses and sustainability analyses were still to be performed.

In February 2012, the Yard and Shop Facilities Teams conducted three studies: one to validate the program requirements, one to evaluate the cost and operations impacts of LEED certification on the facility design, and one to determine the relevant codes, building systems, and materials to be used. The Program Requirement study evaluated the program elements identified in the original concept study using current MTA requirements prior to the value planning exercise. The LEED study identified the requirements for LEED Silver certification, evaluated which credits would be easily attainable based on previous shop facility experience, and identified what credits would require additional money or reduced operational efficiency. The third study looked at applicable codes, systems, and materials and identified the items that would govern the design of the facilities.

At about the same time, a value planning process was completed for the Purple Line. As part of that exercise, it was proposed that all planned LRV maintenance occur at Glenridge. Not all activities were proposed for both Glenridge and Lyttonsville following the 2010 Concept Report; however, both facilities were planned to support LRV inspections, thus requiring similar building characteristics and equipment at the two facilities.

In January 2013, the draft MTA Purple/Red Light Rail Design Criteria was issued with the intent of unifying the designs of both the Red and Purple Line components. Applicable codes for the entire line found in Chapter 01; specific criteria for yards and shops are found in Chapter 13. The Purple Line Yard and Shop Building Code, Systems and Materials Study (February 2012) identifies which codes from that chapter apply to the construction of the yard and shops.

## **18.1 Geotechnical**

### **18.1.1 Existing Conditions and Project Status**

Inadequate subsurface data is available for the proposed yard at this time. A minimum of one boring per 2,500 sf. of building will be obtained in accordance with the MTA Red/Purple Light Rail Design Criteria. Once the borings are obtained, a Geotechnical Engineering Report will be developed in accordance with the Geotechnical Program Plan. The report will include subsurface data, site descriptions, descriptions of field and laboratory testing, site geology, subsurface conditions, geotechnical design parameters, geotechnical analyses and design recommendations, and cost and construction considerations.

## **18.2 Civil**

### **18.2.1 Existing Conditions**

The proposed site is located in the Lyttonsville neighborhood of Montgomery County, Maryland south of I-495 and west of Georgia Avenue. Brookville Road, Lyttonsville Place, Pitman Drive and other access drives intersect at the site. The site is located near the terminus of Brookville Road.

The existing site land use is a linear park (part of the Georgetown Branch Trail) which follows the drainage path of a stream tributary to Rock Creek. The park is predominantly grass and trees with a paved trail and surface parking lots. The edges of the proposed facilities will impinge on commercial businesses and government facilities, including Montgomery County road operations yards and maintenance buildings. The proposed facility will cross several parcel boundaries and require acquisition of land. The immediately surrounding portion of the neighborhood is predominantly commercial and governmental. The larger vicinity includes significant numbers of single and multi-family dwellings.

Zoning of most of the site area is R60 (Single Family Residential) and the area to the north of Brookville Road is I1 (Light Industrial). Much of the R60 zone has been developed as governmental facilities.

Demolition will include portions of the park land, trail, commercial buildings, parking lots and government facilities. Portions of the trail, Brookville Road, Lyttonsville Place, Pitman Drive and other access drives will be relocated to accommodate the project.

Existing utilities include water, sewer, storm drain, gas and electric transmission in the County right-of-way. These utilities will be relocated in conjunction with the right-of-way relocation.

### **18.2.2 Site Layout Requirements**

The proposed facility will include a multiple line rail yard, a train facility building with rail lines coming in and out, an administration/operations storage building with offices and work spaces, a train washing building, an electrical sub-station, a bridge carrying Lyttonsville Place over the rail tracks, as well as a single level parking structure above the storage yard. A station will be installed to the east of the proposed facility and relocated to Lyttonsville Place. Infrastructure associated with the station will be provided as part of the Basis of Design for the Lyttonsville Station.

Topographic and property boundary surveys will be required to develop new parcel boundaries. New County road rights-of-way need to be created. Design of relocated County roads is required with the associated traffic control and relocated utilities. Coordination regarding planning related issues will be necessary with the Maryland-National Capital Park and Planning Commission (M-NCPPC).

The existing Lyttonsville Place Bridge will need to be rebuilt to accommodate the proposed yard and the relocated Georgetown Branch Trail and associated access. The alignment and trail will go under the proposed Lyttonsville Place Bridge. The Lyttonsville Station platform will be located at grade after the alignment passes under the proposed bridge. The alignment continues and crosses Stewart Avenue at grade.

Relocation of Brookville Road will include construction of a retaining wall on the south side of the road because of the narrow space available.

All of these facilities will require an approximately 8 acre site. Under the currently proposed site layout, approximately two acres of new impervious surfaces are being added, five acres of impervious are being reconstructed, and a half acre of impervious surface is being removed.

### **18.2.3 Utilities**

#### **18.2.3.1 Sanitary Sewer**

There is a 6" sanitary sewer running lengthwise west to east across the Lyttonsville Yard with one 6" lateral entering from the south. After traversing the yard area for approximately 700', the existing 6" line crosses the Purple Line main tracks at station 243+00 to connect with a 12" sanitary sewer south of the tracks. The 6" sanitary sewer will require relocation through the yard to connect with the 12" sewer approximately 750' downstream (west) of the current connection. The sewer will also need to be upsized to a minimum of eight inches to meet WSSC's current standard for main line sewers. Approximately 500' of new sanitary sewer will need to be installed and approximately 1,000' will be abandoned.

An additional 8" sanitary sewer extension of approximately 450' will be needed to connect the shop building and train wash building to the existing sewer main as well as approximately 250' of 8" sanitary sewer to connect the maintenance pit to the sewer connecting the train wash building. A 1,600 gallon oil water separator will serve the train wash building and maintenance pit (per WSSC requirements and standards).

#### **18.2.3.2 Storm Drain**

The existing storm drain in Brookville Road east of the shop building does not appear to be affected by the proposed Lyttonsville Shop and Yard; however, see Section 18.2.4, Stormwater Management, for information on proposed storm drains and stormwater management facilities required for this area.

#### **18.2.3.3 Water Service**

There is a 16" water main that crosses the main tracks at station 231+25 from the Grubb Road trail access and then traverses the site west to east lengthwise across the Lyttonsville Yard and Shop area in Brookville Road. This water main will require approximately 600' of relocation to the west as it crosses the tracks to create a perpendicular crossing and to minimize conflict with the proposed retaining walls. Test pits are proposed on this water main in the Brookville Road corridor to determine if conflict exists with the footings of the proposed retaining walls along the southern edge of the road. If there is a conflict, additional relocation will be required along Brookville Road.

Water service to the new building can be by a short extension off of the 16" main in Brookville Road. An 8" connection is anticipated, however the connection may change based on the domestic and fire demands predicted for the shop building.

Water service will also extend to the train wash building and the Lyttonsville Station.

#### **18.2.3.4 Fire Main**

Fire flow is included in the sizing of the water mains as per WSSC's Design Criteria. Hydrants will be spaced approximately every 300' or as required by the Fire Marshall. Separate connections to the 16" main within Brookville Road will be installed for the fire hydrants.

#### **18.2.3.5 Electric**

Overhead electric lines cross the main tracks at station 231+25 from the Grubb Road trail access, and also traverse the yard and shop area lengthwise along Brookville Road and widthwise along Lyttonsville Place. Approximately 1,200' of overhead electric lines will need to be relocated at the main track crossing and north of the proposed shop where the existing utility poles are in conflict with proposed retaining walls and sidewalks. Service drops will need to be maintained from the relocated portions of the line to the properties north of the proposed shop. Service drops from the overhead line can provide electric power to the shop facility. The overhead line traveling along Lyttonsville Place requires approximately 500' of relocation to the proposed bridge, travels underground to a manhole, and then becomes aerial at Brookville Road.

A separate dedicated primary power feed from Pepco will be needed to supply a substation located on the far western edge of the yard and shop site. A 2 MW 13KV primary/750 VDC rectifier is required to provide traction power for train movement within the yard and shop. The secondary of this rectifier may be configured to supply the building electrical loads of the shop in lieu of a separate service drop from the relocated aerial line.

#### **18.2.3.6 Fiber Optic Communication**

Existing fiber optic lines traverse the yard and shop area both lengthwise in the Brookville Road corridor and widthwise along Lyttonsville Place. The underground line north of the shop will not be impacted and can be maintained. The overhead line traveling along Lyttonsville Place requires approximately 500' of relocation to the new bridge, travel underground to a manhole, and then become aerial at Brookville Road.

#### **18.2.3.7 Gas**

There is a 6" low pressure (20 #) natural gas line that travels lengthwise in Brookville Road north of the yard and shop with a single 4" lateral extending north of the site. This gas line will require approximately 270' of relocation north of the shop in the Brookville Road corridor to avoid proposed Lyttonsville Yard and Shop buildings and retaining walls. Test pits are proposed on this gas main to determine if conflict exists with the footings of the proposed retaining walls along the southern edge of the road. If there is a conflict, additional relocation will be required along Brookville Road.

Washington Gas is able to provide gas service to the proposed shop from the 6" line.

#### 18.2.4 Stormwater Management

The project requires Stormwater Management (SWM) Plan approval and Erosion and Sediment Control (ESC) Plan approval by the Maryland Department of the Environment (MDE). SWM and ESC plans for the Lyttonsville Yard will be submitted to MDE as part of the entire Purple Line project. The plans will be prepared in accordance with the *2000 Maryland Stormwater Design Manual with supplements, Maryland Stormwater Management Guidelines for State and Federal Projects, and Maryland Standards and Specifications for Erosion and Sediment Control*. The drainage associated with the Lyttonsville Yard includes portions of the Lyttonsville Station, as well as a small portion of the Lyttonsville Place Bridge Replacement, and totals approximately 6.6 acres extending from Mainline Track 1 Station 232+00 to Station 255+00. The yard consists of an approximately 100,000 sf. maintenance yard covered by a parking deck. In addition to the parking deck, the upper level contains a proposed administration building. A proposed train wash will be placed adjacent to the larger storage building. The yard will also contain up to ten tracks entering and exiting the building for service and storage. The entire area will contain a ballasted track section. Per MDE's direction, ballast will be considered pervious, which is consistent with the overall Purple Line SWM computations. Some of the areas between tracks will be paved to allow for vehicular access to the parked trains. Portions of the track extend to the north of the Lyttonsville Place Bridge replacement.

The existing site contains surface parking, some grassed and wooded areas, and an existing building. These facilities will be demolished to allow for the construction of the yard. The existing land use is approximately 44% impervious and the proposed land use is approximately 77% impervious coverage; therefore, the site has been classified as redevelopment for SWM analyses. SWM quality requirements involve designing the site according to Environmental Site Design (ESD) principles to the Maximum Extent Practicable (MEP).

The existing point of investigation is located on an existing 60" RCP at Station 242+99\_R to the southeast of the Lyttonsville Yard and is conveyed to the 60" system through a 21" RCP. The system flows from north to south discharging to a swale northeast of Grubb Road and west of Lyttonsville Road and eventually outfalls to Rock Creek. The proposed POI is located on an existing 60" RCP at Station 235+63R to the south of the Lyttonsville Yard. The existing 21" storm drain system from the site will be abandoned and a new outfall will be installed further downstream along the 60" system. The entire drainage area is within the Middle Potomac-Anacostia-Occoquan watershed (MDE: 02070010).

The building footprints, a large retaining wall, limited right-of-way, the Lyttonsville Place bridge replacement, and tracks used throughout the Lyttonsville Yard limit the opportunities for implementation of surface stormwater management. The 10-year storm (Overbank Flood Protection – Qp10) is required at the POI because the proposed improvements result in an increase in the 10-year discharge. Two potential ESD facilities were identified in the Lyttonsville Yard area, as well as one StormFilter® system (WQv) and one underground stormwater vault system, for quantity management.

Two green roof systems for the Administration Building portion of the Lyttonsville Yard are anticipated. The media will be six inches thick. Drainage from the green roofs will eventually drain to the underground StormFilter® and detention systems. Green track will also be installed for a portion of the mainline track draining to the POI, consistent with the adjacent main line track sections. Green track will not be installed within the limits of the yard itself.

A Contech StormFilter® system will be installed to the east of the parking deck/covered storage yard for water quality treatment. The system has been placed to limit the area that would be disturbed should the facility need to be replaced, as well as during normal maintenance. The system will treat the

remaining impervious area not already accounted for in ESD facilities. Nine StormFilter® cartridges will be placed within an underground concrete vault. An additional underground vault system will also be placed to account for the entire required WQv. A splitter manhole will be placed to direct the required WQv storm to the facility, which will allow the larger storms to bypass the system and flow to the larger underground detention facility described below for Cpv and Qp10.

Two vaults will be placed for the proposed underground stormwater management vault system located to the north of the StormFilter® system. No utility conflicts were identified in the vicinity of the proposed facility. The underground vault system is sized to attenuate the increase in discharge between existing and proposed discharge at the POI. Due to known downstream flooding issues, detention will be provided for the 10-year storm (as typically required by Montgomery County for the drainage area) and the 1- and 2-year storms (to meet LEED Credit SS 6.1). The Cpv volume is contained within the facility as well.

Entire CPv and Qp10 will be provided at this POI so that the peak discharge rate for 1-year and 10-year storms will be equal to or less than the existing condition. Therefore, the proposed development at this POI will not adversely impact the downstream hydrologic conditions.

### **18.3 Landscape Architecture**

#### **18.3.1 Design Approach**

Proposed landscape architectural work within the project site will include hardscape and landscape improvements. These improvements are meant to accommodate the maintenance function for the Purple Line light rail, support use by MTA employees and visitors, and to respond appropriately to situating the new facility into the surrounding site context. The project site will provide safe and pleasant connections between the facility and all roads, parking garages, trails, and exterior spaces for employees to take breaks. It will clearly define public and private use areas, and provide screening or buffering of excessive noises, pollutants, and views from nearby commercial and residential areas. Planting requirements for reforestation will be addressed off site within a land bank established between MTA and MD DNR. Where opportunities present themselves for on-site reforestation, coordination will be required to eliminate conflicts with areas dedicated for stormwater management.

Hardscape areas will consist of sidewalks, ADA compliant ramps, steps and handrails where required due to grade change, bike lanes or striping, a small courtyard for employees, and parking areas. Pedestrian and bicycle connections will be made from existing adjacent land uses (residential, commercial) to the proposed light rail station and the yard and shop. Paving materials will be selected to reduce the urban heat island effect and stormwater run-off. Recycled content in materials should be maximized to the extent practical while ensuring durability. All site material selections should be made with consideration for maintenance and life cycle costs. Concrete will be the predominant material for walkways with special paving at activity nodes. Paving material selections should also be made with noise abatement between yard, shop, and surroundings in mind.

Site amenities will include seating, benches, seat walls around the proposed shop building to provide gathering or waiting, and a designated smoking area for MTA employees and visitors. Likewise, trash and recycling receptacles, bus shelters, bike racks, and tables and chairs are all amenities that will improve the pedestrian experience around the yard and shop. There is potential to incorporate green technology with these site furniture elements; solar panels and green walls/roofs are possible on yard facility, bus shelters and shade structures for the parking deck. Fencing will be incorporated around the

site perimeter to secure and define the facility. Fencing materials are to be low maintenance, complement the building architecture, and selected for durability. Planters shall be incorporated around the building to define an outdoor plaza and designated smoking area, separate the parking area from the entrance to the building, and buffer the plaza users from the road and bridge noise. Planters will be incorporated on the parking deck at corners and unused parking areas. The planter design is to take into consideration snow removal and storage, the opportunity for shade plantings, and survivability of plantings. Planter walls shall be of sufficient height to accommodate a mix of shrubs, trees and groundcover. Planter walls shall complement the architecture of the facility and meet weight load considerations

Site lighting, both vehicular and pedestrian scale, will be incorporated to provide visibility and safety on the yard and shop property and along connections leading to the facility. Light fixtures should minimize light trespass and respond to dark skies criteria. Lighting shall complement the architecture of the facility and use long lasting, low energy, and low maintenance fixtures. Lighting will include a white spectrum of light to maximize safety and security.

Site signage will be used as part of a site-specific identity and directional system. Buildings, facility address, accessible routes, and bike ways shall be clearly and uniformly signed. Materials and design of signs shall complement the architectural standards of the site and complement the surrounding area.

### **18.3.2 Proposed Plant Materials**

Landscape design solutions are to incorporate local landscape manuals, reforestation and stormwater requirements, and support a healthy sustainable environment for people and animals, while ensuring the minimum State standards. Plant material will be selected based on the specific application area and site constraints. Landscaping along street connections should complement the existing streetscape treatments, while setting the standard for future redevelopment. At a minimum, the streetscape should include street trees to define the street edge and low plantings to accent key locations such as property entrances, or around signs. Buffer plantings are appropriate between the Lyttonville Yard and Shop facility and differing adjacent uses, especially residential uses. Where space allows, reforestation requirements may be met in these buffer zones.

Landscaping at the Lyttonville Yard and Shop facility and parking areas will focus attention on reinforcing way-finding to and around the site, points of entry to buildings, and public open space. Plant material will tolerate harsh urban conditions, be low maintenance, and emphasize a native/non-invasive palette of species. Plant selections will be made to maintain visibility to and from the facilities and provide for a sense of security. Plants with a high pollution-absorbing ability should also be considered next to this facility which may generate emissions.

Where the limited right of way allows for stormwater management facilities, small facilities close to the impervious areas that generate the runoff are preferred. Plantings within stormwater management facilities should be hardy and native species, where practical. Stormwater plantings are to be tolerant of occasional inundation and periods of drought. The ground plane, building façade, and roof should be considered for applying green stormwater techniques where practical.

## **18.4 Trackwork**

### **18.4.1 Integration with the Overall Purple Line**

The Lyttonsville Yard lead tracks will connect to the Purple Line mainline on the west end (just east of Rock Creek Bridge) at Station 222+66(to the WB mainline). There will be a crossover just west of this connection and east of Rock Creek to allow eastbound LRV's to enter the yard from the west.

On the east end there are two locations at Station 252+28(to the WB mainline) and Station 252+70 (to the EB mainline). The connecting track to the EB main crosses the WB main with crossing frogs.

### **18.4.2 Yard Operation**

Fleet movements within the yard tracks shall be conducted under the supervision of a Central Control dispatcher. Movements within the yard shall be executed by an operator in coordination with the yard control center.

It is anticipated that road operators will bring the vehicles into the yard at the end of the day. The road operators will spot the vehicles in a storage location in the yard as directed by the yard control center. Vehicle movements between the storage tracks and the car washer or cleaning, maintenance areas at track level will be conducted by a yard operator under the direction of the yard control center.

The yard configuration shall facilitate movements to and from the designated storage areas and car wash areas with the least number of movements and without blocking other movements.

It is anticipated that vehicles will park overnight in the yard within the 55 available yard spaces, during which time they will undergo daily cleaning.

### **18.4.3 Lead Tracks**

Fleet movements within Vehicles arriving at Lyttonsville Yard from the west end (Bethesda) will use a crossover just east of Rock Creek Bridge at Station 220+41 and travel against WB traffic for approximately 100' before entering the lead track into the yard. The WB main will be fouled for approximately 400' of travel by the vehicle entering the yard. These movements across the WB main track will need to be governed and protected by signals. Vehicles leaving the yard westbound will travel down the lead track and enter directly onto the west bound main near Station 222+16.

Vehicles entering the yard from the east end (Silver Spring) will use the lead track directly from the WB main at Station 252+28. Vehicles leaving the yard eastbound will use the lead track and cross the WB main through a crossing frog at Station 250+24 and connect to the EB main at station 252+69. The WB main will be fouled for approximately 400' of travel by the vehicle leaving the yard. These movements across the WB main track will need to be governed and protected by signals.

The lead track will run through the yard area between the yard tracks and the wash track. The lead track will connect to the shop ladders on both ends. This will allow movements from any yard track to any other track from either end of the yard or shop. These moves will require a reverse movement. It is intended that the lead track will be kept clear to allow vehicle movements as needed.

### **18.4.4 Shop Tracks**

All shop tracks will be provided at the Glenridge Facility; however the northernmost track in Lyttonsville Yard will have an emergency inspection and repair pit installed under it.



A paved access road will run adjacent to the pit to handle material deliveries and access to the pit.

#### **18.4.5 Storage Yard Tracks**

The storage yard portion of the facility will be the point of origin and termination for all mainline service. Functions of the yard include storage of vehicles, vehicle interior cleaning, vehicle testing, and making/breaking of train sets.

Diverse yard functions necessitate a yard layout that provides maximum flexibility of movements. Key yard operations include:

- Insertion and removal of vehicles into mainline service as required by the operating schedules
- Increasing fleet service levels to meet peak hour and emergency requirements
- Decreasing fleet service levels as required for off-peak periods
- Replacing malfunctioning vehicles with properly operating vehicles

Storage tracks to provide a minimum capacity of 55 vehicles (within the 13' clearance points). Double-ended tracks are designed to provide for operational flexibility and to reduce non-revenue movements.

The minimum length of a car spot on a storage track has been based on the length required to accommodate a double-articulated low-floor light rail vehicle 95' in length with a five' gap allowance between vehicles, or a total of 100'.

Storage tracks will be configured with minimum track centers of 18.5' with 23' track centers as needed for supports for the overhead canopy/parking garage.

Service aisles between the tracks will be predominantly 8.5' or 13' wide with a minimum of five' wide at some pinch points and paved with bituminous concrete.

#### **18.4.6 Tail Tracks**

The clear length of the tail track for the yard or shop beyond the end of the last point of switch should accommodate, at a minimum, a 2-car train plus sight distance from the operators position to the points of the switch. A 3-car train length is preferred.

Due to the close proximity of the yard/shop to the east connection to the mainline a tail track was added on the east end to allow for switching movements between the yard and shop that would not require the movements to foul the mainline. The tail track runs parallel to and north of the WB main and allows for storage of two vehicles clear of other vehicles coming off the main. During use of this tail track the entrance into the yard from the east end may be temporarily blocked. This tail track is also to be used for temporarily storing MOW equipment. There is room for the tail track operation and 250' for MOW equipment.

On the west end of the yard/shop there is ample room (500' clear) on the lead track for switching between the westerly switch off the main and the most westerly switch in the yard.

### 18.4.7 Required Design Criteria

The absolute minimum, desirable minimum and preferred standard design requirements are outlined in the chart below:

PARAMETER	ABSOLUTE MINIMUM	DESIRABLE MINIMUM	PREFERRED STANDARD
LRT Maintenance and Storage Facilities			
Track Centers (Storage with Service Aisles)	18'	19'	20'
Track Centers (Storage Aisles with Catenary Poles)	20'	21'	22'
Track Centers (Inspection and Shop)	25'	25'-6"	26'
Track Centers (Lead Tracks)	14'	15'	16'
Service Aisle Widths	8'	9'	10'
Curve Radius	82'	100'	300'
Yard Turnouts	No. 6	No. 6	No. 6
Lead Track Turnouts	No. 6	No. 6	No. 8
Turnouts & Crossovers - Main Line	No. 8	No. 8	No. 10
Shop Track Grade	0% max.	0% max.	0% max.
Storage Track Grade	1% max.	0.5% max.	0% max.
Lead Track Grade	4% max.	3% max.	0.5% max.
Number of Car Spots in Yard	55	-	-
Number of Car Spots in Shop	6	8	8
Maintenance-of-Way Yard Track Length	200'	225'	250'
Track Length for Light Rail Vehicle Washing Equipment	135'	-	-

## **18.5 Architectural**

### **18.5.1 Building Description**

The design for the MTA Purple Line light rail facility at Lyttonsville is a one level parking deck over the yard and track storage area for the trains. There is a two story office building located on the North side of the parking deck, separated from the new Lyttonsville Place bridge by a small triangular plaza. Circulation from the office building leads down to track level where the cleaning and maintenance areas are located and on the opposite side of the tracks to the Train Wash building. The office building will house Light Rail administration, support space for the line operators and an Operations Control Center. The parking deck of approximately 304 spaces will be shared by MTA staff and the Montgomery County personnel displaced by the project. Approximately 200 spaces will be identified for the County, per agreement with County.

The main entry for the office building is from the parking deck, and has a controlled access vestibule. There is a stair from the sidewalk on Brookville Road that leads up to the office entry on the deck. An additional entrance for operators only, also from the parking deck, provides the Dispatcher with visual control of all who enter. A ramp will lead from the Southeast corner of the parking deck up to the new Lyttonsville Place Bridge to connect to another ramp/stair of the new Station opposite the bridge from the Office Building. From the Southwest corner of the parking deck a stair and two elevators will lead to the sidewalk at Brookeville Road for the convenience of the Montgomery County personnel who will share the parking.

To the North of the Office and new bridge at the intersection of Pittman Drive and Brookville Road, there is an entrance for service and emergency vehicles. Another site access point is located south of the Parking deck, where Brookville Road slopes to the elevation of the track level

The Train Wash building located on the Yard level will be accessed from a stair on the East side of the parking deck. It is planned to be a pre-engineered building containing the train wash equipment and a convenience toilet.

The design of the building complies with all current requirements of the Americans with Disabilities Act Accessibility Guidelines (ADAAG). Elevators are located in the office building, leading down to the track and maintenance areas, and at the south end of the parking deck for county employees going to the County facility across Brookville Road.

### **18.5.2 LEED Requirements**

The initial concept design reflected only the LEED input of a vegetated roof and cisterns for collection of rain water. As the design has progressed, the decision was made that the Lyttonsville facility must be certified LEED Silver. The current design attempts to capture points in all the LEED areas: Sustainable Sites, Water Efficiency, Materials and Resources, Energy and Atmosphere, Indoor Environmental Quality, Innovation and Design Process, and Regional Priority credits. This effort is in progress.

### **18.5.3 Exterior Design**

#### **18.5.3.1 Exterior Walls**

The Parking Deck will be a poured in place concrete structure. Along the western edge of the deck and building, following the grade of Brookville Road, will be a concrete retaining wall that steps down with the slope of Brookville Road as it slopes to the level of the track. Between the cap of the retaining wall

and the bottom of the concrete parking structure will be an open space filled with either louvers or open metal mesh panels. The storage and office spaces at track level will have CMU walls. The exterior walls of the office building will be a combination of masonry veneer and metal panels over a system of continuous insulated sheathing and metal studs with sprayed or batt insulation.

The exterior walls of the train wash building will be an insulated metal panel with some masonry in limited areas.

#### **18.5.3.2 Windows**

A combination of pre-finished aluminum store-front glazing systems and fixed aluminum windows with insulated Low E glass and a thermal break is proposed to be used.

#### **18.5.3.3 Doors**

Light Rail Vehicle access into the Train Wash building will be accommodated by 18' high insulated Bi-fold doors. Vision panels are desired in these doors for employee safety. Standard roll up doors will be used at the Cleaning Storage Room. Personnel doors and frames to the exterior will be fiberglass to minimize damage to the doors from site salt use. Fully glazed entry doors will be used with an aluminum entrance system in the office building.

#### **18.5.3.4 Roof**

The roof will be a combination of low sloped and pitched planes. The low roofs (minimum 1/4" per foot) will have fully adhered white PVC membrane, mechanically fastened to the structural metal deck. Where there is a vegetated roof, a green roof compatible membrane and insulation system will be used. The vegetated roof will include a 6" media thickness. The roof construction will include structural metal deck, plywood sheathing, and 4" rigid poly-isocyanurate to achieve a continuous R-25 rating, underlayment and PVC membrane roofing system. The steep sloped roofs will also have the 4" rigid insulation and plywood sheathing and standing seam metal roof. Additional layers of sheathing and insulation may be installed to reduce thermal bridging and increase the desired roof R-value though these will increase overall project first cost.

Snow guards will be provided for pitched roofs. Drainage will be through gutters and downspouts.

### **18.5.4 Interior Design**

#### **18.5.4.1 Interior Partitions**

The interior partitions in the Office building will be painted gypsum board with vinyl base on metal framing. Interior walls in the Cleaning, Maintenance offices and storage areas at track level will be CMU or concrete. At walls between offices acoustic insulation will be installed to provide privacy between offices. See section 18.5.4.4 for restroom wall finishes and construction.

Surfaces should be light in color to assist with daylight reflectance wherever possible. Access panels or chases will be provided for maintaining plumbing fixtures.

#### **18.5.4.2 Ceilings**

Ceilings will be steel structure and metal deck in storage areas and in open break rooms. All exposed elements will be painted. Where fireproofing is required, exposed ceilings will be painted with

intumescent paint. Steel requiring fireproofing that is hidden from view with other ceiling finishes may use dense sprayed fireproofing. Administrative and semi-finished areas will have 2' x 4' lay-in acoustic ceiling panels with an exposed grid. Restrooms will have painted gypsum board ceilings. Bulkhead and accent ceiling areas will be painted gypsum board.

#### **18.5.4.3 Flooring**

Equipment, service, and other work areas will have epoxy coated non-skid concrete traffic coatings with thermoplastic safety yellow floor striping. Semi-finished areas including employee areas, break rooms, kitchen, locker rooms, etc., will have resilient flooring. Administrative offices not associated with light rail maintenance functions (operators, operations control center) will have resilient tile or carpet.

Epoxy coating and vinyl cove base will be provided where appropriate. Recessed walk off mats will be provided at all entrances. Concrete containment curbs will be provided integral to the floor construction where hazardous materials are to be located for compliance with EPA regulations.

#### **18.5.4.4 Toilet Rooms**

Restrooms will have sealed epoxy or resinous floor finishes with an epoxy base. Walls will be fiberglass reinforced plastic coated gypsum board on metal studs. Ceilings will be painted gypsum board. Two tiered lockers, 12"x 18" will be provided for operations personnel.

#### **18.5.4.5 Doors**

Interior doors will be galvanized painted hollow metal steel with hollow metal frames. Office areas may have solid core wood doors if desired by MTA. Doors leading from occupied areas to circulation paths will have vision panels. Vision panels for Mechanical, Electrical, Telecom and similar support spaces are not needed. Locksets will comply with all requirements set forth in the ADAAG requirements. Lever style handles will be used on all doors.

#### **18.5.4.6 Vertical Circulation Elements**

Exit stairs will be concrete filled metal pan stairs with slip resistant coating. Stair systems to access the rooftop maintenance platforms and the recessed pit bays within the shop will be metal grate with enclosed risers. Elevators will be electric traction machine room-less type. Elevator capacity will be 3500 lbs. for passenger elevators and 4500 lbs. for freight elevators.

### **18.5.5 Codes and Standards**

A Code Compliance Report is required by the Scope of Work. A draft of that report has been submitted. The current design conforms to that draft Code Compliance Report. As the design progresses, the design will be continuously coordinated with the current version of the Code Compliance report.

## **18.6 Structural**

### **18.6.1 Existing Conditions**

The proposed Lyttonsville yard and shop will be placed on a site surrounded by a commercial building, government facilities and a park. The park for the greatest part is trees and grass with a paved trail and parking lots.

## **18.6.2 New Construction**

### **18.6.2.1 Foundation Conditions**

The steel columns of the wash building will be supported on spread footings while the interior and exterior walls will be supported on strip footings.

As for the parking garage, depending on the results of the Geotechnical Report, shallow foundations or deep foundations will be designed for the imposed loadings. Shallow foundations typically consist of reinforced concrete, spread footings. Deep foundations typically consist of steel H-piles or concrete piles, either driven or augured to required depths. The bottom of all exterior footings and footing in unheated spaces will be located a minimum of 30 inches below finished grade for frost protection. Steel columns carrying the floors and roof loads will be supported on isolated spread footings while the exterior and interior walls will be supported on strip footings. Reinforced concrete will have minimum 28 days strength of 4500psi and the yield strength of the rebar used will be 60ksi.

### **18.6.2.2 Floor Systems**

Apron slabs will be provided at the entrances of the shop facilities for each track entering or exiting the facility. There will be a minimum of 50' apron slabs (along the length of the track) where possible. The slab will be a minimum 12" thick placed on a layer of polyethylene over a 6" layer of washed gravel.

The first floor slab will consist of a minimum 12" thick reinforced slab on grade placed on a layer of polyethylene over a 6" layer of washed gravel. See soil report for sub grade preparation.

The second and third floors structural system will consist of composite metal deck slab supported on wide-flanged steel beams, columns and open web steel joists. Concrete topping on metal deck will be lightweight type with minimum 28 days strength of 3500psi.

The roof level platforms will consist of open metal grating walk surface and cantilevered out from the building's steel columns. The whole platform is supported on hollow structural steel section (HSS) members in the transverse and longitudinal direction. The metal grating will be stainless steel conforming to ASTM as applicable.

Structural floor slab shall be in compliance with deflection criterion of  $L/600$ .

Structural steel will conform to the following standards:

- Wide-flange shapes: ASTM A992
- All other members: ASTM A36
- HSS members: ASTM A500 Grade B

Reinforced concrete will have minimum 28 days strength of 4500psi and rebar used will have a yield strength of 60ksi.

### **18.6.2.3 Roof Framing Systems**

The roof structural system of both the wash and office buildings will consist of galvanized metal roof deck supported on open web steel joist, wide-flanged beams and columns.

The roof deck will conform to ASTM A924 with coating G60 or G90 as defined in ASTM A653, gauge as shown on drawings. The steel joists designations will be as shown on the drawings, fabricated in

accordance with SJI requirements and coated in accordance with the recommendations in the Steel Structures Painting Council specifications.

Deflection will not exceed the limitations provided in IBC 2012.

Openings in the roof will be supported by additional steel framing. Galvanized metal deck pans will be placed on top of the steel framing system with an architectural roofing system as described in Section 18.5.3.4.

**18.6.2.4 Special Building Features**

The parking garage structural system will consist of moment connections between the cast in place concrete columns and beams. No shear walls will be provided.

Expansions joints will be provided in wash building and parking garage to accommodate the buildings movements. A system of double columns and double beams will be used at the expansion joints locations.

**18.6.2.5 Outdoor Support Facilities**

The west wall of the parking deck and a small portion of the south wall will consist of retaining walls that will step down from approximately 20’ high to 5’ high.

**18.6.3 Lateral Force Resisting System**

The force resisting system for the wash building is provided in the transverse direction by the moment frames and in the longitudinal direction by cross bracing in some bays along the perimeter and interior of the building as possible.

The lateral resisting system of the office building will only consist of cross bracing along the perimeter and interior of the building as no moment connection will be permitted.

The lateral resisting system of the parking garage will consist of moment frames in the longitudinal and transverse directions. All beams and columns comprising the structural system of the parking garage are cast in place.

**18.6.4 Design Loads**

The listed loads below are minimum design loads and may be increased depending on specific conditions.

<b>Soil</b>	
Assumed Soil Bearing Capacity (psf)	2000 psf until receipt of approved Geotechnical Report.
<b>Live Load</b>	
<b>Live Load (IBC &amp; Chapter 9: Structural – Design Criteria)</b>	
All Floor Spaces (Office, locker, toilet, training, conference, and other support type areas)	See Chapter 9: Structural – Design Criteria, Section 9.2.2.2.19

Electrical Rooms	See Chapter 9: Structural – Design Criteria, Section 9.2.2.2.1
Floor Miscellaneous Utility Loading	10 psf
Roof Live Load	20 psf
Partition Live Load	15 psf
Stair	See Chapter 9: Structural – Design Criteria, Section 9.2.2.2.18
Corridor	Same as All floor spaces
Mechanical Equipment Load	as required by basis of design selected equipment
<b>Dead Load</b>	
Mechanical Equipment Load	as required by basis of design selected equipment
Structural System Dead Load	As calculated per weights in MTA Red/Purple Light Rail Design Criteria, Chapter 11 – Table 4
<b>Snow Load (IBC)</b>	
Ground Snow Load ( $p_g$ )	25 psf (IBC) 30 psf (Montgomery County)
Flat Roof Snow Load (if applicable) ( $p_f$ )	30 psf (Prince George’s County minimum requirement) plus snow drift if applicable.
Exposure Factor ( $C_e$ )	1.0 – Terrain Category C – Partially Exposed
Thermal Factor ( $C_t$ )	1.0
Occupancy Category	III
Importance Factor ( $I_s$ )	1.1
Frost Depth	Assume 30” and confirm with approved Geotechnical report.
<b>Wind Load (IBC)</b>	
Basic Wind Speed ( $V$ )	110 MPH
Occupancy Category	III
Exposure Category ( $C_e$ )	C
Design Wind Pressure Main Wind Force Resisting System (MWFRS) and Components and Cladding	To be determined as design progresses
Internal Pressure Coefficients (+/-)	+0.55/-0.55
Enclosure Level Assumptions	Partially Enclosed



<b>Seismic (IBC &amp; Chapter 9: Structural – Design Criteria)</b>	
Occupancy Category	IV
Importance Factor ( $I_E$ )	See Chapter 9: Structural – Design Criteria, Section 9.2.18.1.1
Site Classification	Assume D, to be confirmed by Geotechnical Report
$S_s$	0.16
$S_1$	0.05
$S_{ds}$	0.17
$S_{d1}$	0.08
Seismic Design Category	B
Seismic Response Coefficient	To be determined as design progresses
Seismic Modification Factor (R)	To be determined as design progresses

## 18.6.5 Materials

### 18.6.5.1 Structural Steel

See Chapter 9: Structural – Design Criteria, Section 9.3.3

### 18.6.5.2 Concrete

See Chapter 9: Structural – Design Criteria, Section 9.3.5

### 18.6.5.3 Reinforcing Steel

See Chapter 9: Structural – Design Criteria, Section 9.3.

## 18.7 Mechanical

### 18.7.1 General Description

Heating and ventilation systems for the various shop areas, as well as cooling, heating and ventilation of the administrative areas will be selected based on 20-year life cycle costs as well as sustainable measures required to achieve desired LEED Version 3 Silver Certification. Geothermal system will be evaluated in conjunction with partial DX or chilled water cooling where adequate space for the geothermal well-field is available. After evaluating three systems on a life cycle cost basis, a variable air volume (VAV) system with DX cooling and hot water heating was selected. Gas heat will be used as fuel for gas-fired boilers for the hot water system and heating system.

### 18.7.2 Codes, Standards and References

A draft Code Compliance Report has been submitted, and the current design conforms to that draft Code Compliance Report. As the design progresses, the design will be continuously coordinated with the current version of the Code Compliance report.

### **18.7.3 HVAC Systems**

#### **18.7.3.1 Central Plant System**

Building heating, cooling and ventilation systems will be designed to achieve the indoor comfort conditions and maintain air quality described by the Design Criteria. The systems for the most part will follow the MTA design guidelines: Inspection Shops, Repair Bays, Storage areas will be provided with ambient air ventilation during summer and heating in winter. Heating in smaller repair shops and storage rooms will be provided with suspended unit heaters. The administrative areas will be provided with large heating-cooling air handling units with DX cooling coils, ducted to offices, conference rooms, break rooms etc., via VAV boxes for individual space temperature control. The Operators Area will be served by a VAV air handling unit and constant volume backup system. Remote offices such as the shipping offices and shipping supervisor's office will be air-conditioned using local ceiling mounted DX heat pump fan-coil units. A central hydronic plant is proposed to serve the heating needs for the most part, utilizing a hot water piping distribution system.

The central heating plant will be located in the second floor Mechanical Room.

The Heating Plant will comprise of three gas-fired, direct-vented, condensing type hot water boilers, for maximum efficiency and optimizing energy usage. Preliminary heating load is estimated at 350 MBH. Each boiler will be sized for 300MBH of the maximum demand load and capable of modulating down to one-third of the rated capacity. The hot water will be circulated as a closed loop throughout the building with variable flow pumps to save pumping energy during low heating loads. Two 100% capacity pumps will be provided, with one as standby to automatically switchover in case of failure of main operating pump. The invert duty motors shall be controlled using variable frequency control drives.

Cooling will be provided with DX coils and air-cooled condensing units. Air Handling Unit number 1 (AHU-1) and Air handling Unit number 3 (AHU-3) will each have two compressor-condensing units and four refrigerant circuits for greater control as air volumes vary. Air Handling Unit number 2 (AHU-2) will have a single compressor-condensing unit. The use of direct expansion coils will reduce energy wastage compared to a chilled water system because pipe distribution losses are reduced.

#### **18.7.3.2 Air Distribution System**

IT closets/IDF rooms will be provided with dedicated individual ductless split-system air-conditioning irrespective of building cooling systems. This will ensure that data-communication lines remain uninterrupted if the building air-conditioning systems happen to shut down. These units will be powered by the emergency generator and other uninterruptible power units.

Smaller maintenance and assembly shops will be provided with suspended unit heaters to maintain winter space temperatures. Ventilation air will be provided by means of wall mounted air intake louvers and side wall exhaust fans where possible. Shops without exterior exposures will be provided with ducted exhaust systems and in-line fans, and ducted air intakes from wall or roof.

Storage rooms and closed inspection shop areas will be provided with hot water unit heaters. Ventilation in these spaces will be achieved by exhausting air with exhaust fans and providing air intake louvers. Automatic dampers will control the air intakes during winter-summer changeovers. The ventilation will be devised using multi-speed or variable-speed exhaust fans. General ventilation will be designed at 0.5 cubic feet per minute per square foot as a minimum. The maximum air intakes will be designed to bring in 1.5 CFM/sf. The automatic control will be achieved using NOx and CO sensors to increase the ventilation rates for increase in levels of contaminants. The high ventilation rates and

combustion contaminant sensors are being designed with the expectancy of diesel powered units being brought in for maintenance in the future.

The Administration and Operations section of the building, comprising of offices, conference rooms, training classrooms, operators and drivers rooms, locker rooms, break rooms, toilets, etc., will be heated and air-conditioned using ducted air-handling systems. Double-walled modular AHU's with heating water and DX cooling coils, high efficiency filters, and variable speed supply fans, will be located in mechanical rooms. Air distribution will be zoned based on usage, occupancy and wall exposures. Each zone will be served by a VAV terminal box with hot-water reheat coil. Each zone temperature will be controlled by a space thermostat to vary air-flow between minimum and maximum set-points as well as hot water re-heat control valve.

Based on the sizing of air-handling units, the larger units will be provided with enthalpy-controlled economizer operation capability, to save chiller energy usage during periods of moderate outdoor temperatures.

Ductwork will be galvanized G90 steel. Generally, rectangular ductwork will be used in all areas, other than in finished administrative areas where the ductwork would be visible. Exposed ductwork in occupied administrative areas will be double-walled spiral-welded round or flat-oval.

#### **18.7.3.3 Water Distribution System**

Heating Hot Water will be distributed through the building with large mains piped in reverse-flow configuration. Heating hot water will be maintained at an average of 140° F during normal operations but will be automatically resettable as low as 110° F.

Water in smaller branch circuits will be balanced using circuit setters. Large piping over 2-1/2" inches will be Schedule 40 steel with welded fittings and butterfly valves. 2-1/2" inch and smaller piping will be Copper Type L, with threaded or soldered fittings, unions, and ball valves.

#### **18.7.3.4 Ventilation Distribution System**

Generally, exhaust and outdoor air will be provided through louvered wall openings, sidewall exhaust fans, and motorized dampers. In the assembly and repair shops, with no exterior walls, the exhaust and makeup air will be ducted, with duct-mounted grilles distributed over the ceiling for even circulation and to prevent short-circuiting of the air-flow. Ductwork material will be the same as described for Air Distribution systems above.

**18.7.4 Design Criteria**

The following MTA Design Criteria will be used for developing the heating and cooling loads:

Outside Conditions			
Summer Air Dry Bulb/Wet Bulb Temperature, deg F	91/75		
Winter Air Dry Bulb Temperature, deg F	12		
Inside Conditions			
Space	Summer Dry Bulb, deg F	Relative Humidity	Winter Dry Bulb, deg F
Administrative Areas & Offices	76	50%+5%	70
Break Rooms, Lockers Rooms	76	50%+5%	70
IT Closets (MDF/IDF Rooms)	72	30% to 50%	72
Storage Rooms	85	-	65
Maintenance Shop Areas	Ambient	-	60
Mechanical/Electrical/Utility Rooms	Ambient	-	55

**18.7.5 Controls**

Direct Digital Control (DDC) type micro-processor based energy management system (EMS) will be provided. The DDC system shall be non-proprietary open-source using BACnet protocol, and be accessible via the Internet and operable using any Web browser. The EMS will provide monitoring and control of all HVAC systems per ASHRAE 90.1 and LEED requirements. Metering of energy sources and for energy usage by each piece of equipment will be provided, and the EMS will provide capability for monitoring the energy trends in addition to detecting and controlling any problems related to operations.

**18.7.6 Energy Conservation**

All the large fans will be variable speed type with electronic variable frequency drives. This will reduce the energy usage during low load conditions. Use of variable speed pumps in the Hydronic systems will also provide energy savings. Economizer operation of large Air Handling units will reduce energy usage during shoulder seasons. Use of energy recovery wheels on the exhaust systems will provide further fuel savings.

Continuous metering and monitoring of various systems will enable the operating staff to observe trends in energy usage. The results and observations can be interpreted and used to fine-tune the operations on a daily basis as necessary, to identify and correct any problematic areas and to curb energy waste.

## **18.8 Plumbing**

### **18.8.1 General Description**

A complete system of plumbing shall be provided throughout the building to comply with the requirements set forth in the program, and be installed in strict accordance with all applicable codes and regulations, including ADAAG.

The plumbing systems shall consist of but not be limited to:

- Domestic Cold Water and Hot Water with Hot-water Recirculation
- Low-flow high-efficiency type plumbing fixtures –
- Sanitary Drainage and Vent
- Storm Water Drainage including Foundation Ground Water Drainage
- Natural Gas
- Fire Suppression (Described separately under Fire Protection Systems)
- Compressed Air

### **18.8.2 Plumbing Fixtures**

Plumbing fixtures will be provided in accordance with the occupancy requirements, with adequate number of ADA compliant fixtures, such as water closets, urinals, lavatories, showers and electric water coolers.

Water closets will be wall mounted high efficiency type 1.28 gpf sensor operated flush valves, and urinals will be ultra-low flow 1/8 gpf sensor operated flush valves.

All lavatories will have automatic sensor-operated faucets that will include laminar flow-restricting devices to limit the flow at 0.5 GPM maximum.

All fixtures will be “barrier-free” where required in accordance with ADA.

Shower stalls will be fiberglass prefabricated type. ADA compliant showers shall have integral folding seat and handheld shower head with 5’ hose. Shower heads shall be low flow 1.8 gpm maximum.

Electric water coolers will be bi-level recessed type, with all stainless steel construction.

Kitchenette sinks in break rooms will be provided with hot-cold water faucets with 1.5 GPM laminar flow-restricting devices, and disposal units.

Janitors closets will be provided with floor mounted mop sink basins. Service faucets will have ¾” hose-end threads.

ANSI compliant emergency shower/eyewash stations will be provided in all mechanical rooms and in maintenance bays per ANSI and OSHA requirements. These fixtures will be provided tepid water (85 deg F) via ANSI/ASSE 1017 hot and cold water mixing thermostatic valves.

### **18.8.3 Domestic Water Systems**

Water service will be brought in from the WSSC water supply mains in the area. The service will be split inside the Water Service room between fire suppression system piping and domestic cold water piping. Back-flow preventers will be provided in both the lines per WSSC requirement to protect the city water

supply from contamination. Alternately, a dedicated metered water supply line can be brought inside the Water Service Room. Fire Protection piping shall be as described under separate section.

All make-up water to HVAC systems and the packaged train wash system will be provided through individual back-flow preventers to prevent cross-contamination of potable water in the building.

Digital output water meters shall be provided for incoming main water service (master meter), for sub-metering of make-up water for HVAC systems and other non-sewer usages and for interfacing with the building EMS.

Domestic hot water for the lavatories, service sinks, kitchenette sinks and showers will be provided by a central water heating system. Two 80-gallon storage, gas-fired condensing type, direct-vented water heaters piped in parallel will be provided, along with an expansion tank and a recirculation pump to maintain hot water temperature in the building loop.

The water will be stored at 140°F to prevent bacterial growth (specifically Legionella bacteria that thrives below 120°F). ASSE 1017/1070 thermostatic mixing valves will be provided to provide tempered water at 110°F to the lavatories, kitchenette sinks, and showers.

Water piping 2-1/2" and smaller will be copper type L with lead-free soldered joints and fittings. Larger piping will be galvanized steel with welded fittings. Ball valves and globe valves will be provided as required.

#### **18.8.4 Sanitary System**

All toilet fixtures, kitchenette sinks, mop sinks, floor drains, and trench drains from the shops will be connected to the sanitary drainage system and extended out to the WSSC sewer system.

Floor drains in the mechanical rooms and toilets will be deep seal type and provided with trap priming connections. Automatic electronic trap primers will be provided for mechanical room and shop floor drains, and fixture supply trap primers will be provided for the restroom and locker floor drains.

The high-bays will be provided with trench drains. Water from the trench drains and shops will be collected in multiple oil-water interceptors. Water from each of the oil-separators will then be collected in sumps and pumped out to the gravity sewer systems.

Trench drains in the Train Wash bays will be connected to the packaged reclaim unit for recycling the waste water. The treated overflow and backwash from the reclaim unit will be drained into the sanitary system per MSDE and other code requirements.

Vent piping from the fixtures and floor drains will be extended up through walls, pipe chases, or along columns, connected at ceilings and extended through the roof. Vent piping will be terminated 24" above the roof surface in vent caps or fittings

Below grade/under slab piping will be extra heavy cast iron hub and spigot type. Above grade piping will be all no-hub cast iron.

Vent piping will be service weight cast iron or DWV piping material.

### **18.8.5 Storm Water System**

Rain water from the sloped roofs will be directed into gutters and drained via external downspouts, piped below grade to the site stormwater system. This will be covered under civil site work. All condensate from the HVAC units will be piped to discharge into the stormwater system.

Foundation drainage will be provided at the footings, especially under the Inspection Pits. The foundation drainage will be piped to the stormwater system under civil. Depending on the inverts available, it may need to be piped to a sump and pump system.

Elevator pits will be provided with sump-pump systems with oil-sensor probes. If oil is detected the pumps will be shut-off and an alarm will be sounded.

Extra heavy cast Iron hub and spigot will be used for below slab piping and cast iron no-hub piping for above slab piping.

Foundation drainage will be Schedule 40 PVC perforated piping.

### **18.8.6 Compressed Air Systems**

A central compressed air system will be located in the Compressor Room. The system will be comprised of two receiver mounted duplex rotary compressors, one operating and another full-sized standby, and a refrigerated air-dryer. The system will be sized for the number of drops and the pressure required.

Compressed air will be distributed to all the high-bays and shops. Drops will be provided in each of the shops and around the perimeter of high-bays, with a combination oil-water filter and regulator at each drop.

### **18.8.7 Oil and Lubrication Systems**

Lubricants and other oil storage and pumping systems will be provided under separate division. Oil/Lubricant distribution system will be piped to various stations in the maintenance bays. The piping will run in the ceiling structures, and pipe drops and retracting hose reels will be provided at each station.

### **18.8.8 Water Conservation**

Use of ultra-low flow flushing valves and flow-limiting devices in the lavatory, sink faucets and shower heads will achieve much higher savings over the 1991 Water Conservancy Act requirements.

Sensor operated flush valves and faucets will ensure optimum usage of water.

Harvested rain water can also supplement city water for irrigation purposes thereby contributing to water conservation.

## **18.9 Fire Protection**

### **18.9.1 General Description**

Design will provide fire protection system for Lyttonsville Shop. The scope will include provision of wet pipe sprinkler system, dry pipe sprinkler system, preaction sprinklers system and stand pipes with hose valves in accordance with NFPA 13 and NFPA 14, applicable national, state and local authorities having jurisdiction codes.

## **18.9.2 Fire Suppression System**

### **18.9.2.1 Wet Pipe Sprinkler System**

A sprinkler system shall employ automatic sprinklers attached to a piping system that contains water and connected to a water supply so that water discharges immediately from sprinklers open by heat from the fire. Areas will be defined as per their occupancy and hazard classifications.

Light Hazard occupancy shall be defined as occupancy or portion of other occupancies where the quantity and / or combustibility of contents is low and fire with relative low rates of heat released are expected.

Ordinary Hazard Group-1 occupancy shall be determined as occupancy or a portion of other occupancies where combustibility is low, quantity of combustion is moderate, stockpiles of combustibles do not exceed 8', and fire with moderate rates of heat release are expected.

Ordinary Hazard Group-2 occupancy shall be determined as occupancies or a portion of other occupancies where the quantity and combustibility of contents are moderate to high, where stockpile of contents with moderate rates of heat release do not exceed 12' and stockpiles of contents with high rates of heat release do not exceed 8'.

Extra Hazard occupancy shall be determined as occupancies or portion of other occupancies where the quantity and combustibility of contents are very high.

### **18.9.2.2 Dry Pipe Sprinkler System**

A preaction sprinkler system will employ open sprinklers that are attached to a piping system that is connected to a water supply through a valve that is opened by the operation of a detection system installed in the same areas as the sprinklers. When this valve opens, water flows into the piping system and discharges from all sprinklers attached thereto. This system shall cover mostly the areas which are not heated to prevent freezing of wet piping. Hazard classifications shall be same as that of wet pipe sprinkler system.

### **18.9.2.3 Preaction Sprinkler System**

A sprinkler system shall employ automatic sprinklers that are attached to a piping system that contains air that might or might not be under pressure, with a supplemental detection system installed in the same areas of sprinklers. This system will protect against false alarm / false detection to operate sprinkler system, for area such as electrical / electronic systems installed. Pre-action has interlocked system to achieve higher safety to protect electrical / electronic equipment. Hazard classifications shall be same as that of wet pipe sprinkler system.

### **18.9.2.4 Fire Alarm System**

The fire alarm system shall be microprocessor based and will be class A, supervised, addressable type. The fire alarm shall comprise of: Fire Alarm Control Panel (FACP), a Remote Annunciator Panel (FAAP), manual pull stations, smoke detectors (photoelectric type), duct smoke detectors, heat detectors, and audible and visual alarm devices. The FACP will be located in the 1st floor main electric room with a 60-hour battery back-up system. Detectors will be located in appropriate spaces including the following rooms:



- Elevator Lobby (Smoke)
- Elevator Machine Room (Smoke and Heat)
- Elevator Shaft (Smoke and Heat)
- Telecom Room (Smoke)
- Dispatcher Room (Smoke)
- Electric Rooms (Heat)
- Mechanical (Heat)

The system will monitor and control the building sprinkler system, tamper switches and pressure switches. The fire alarm system will be connected to security and access system control panels. Fire alarm annunciator panels will be provided in the main entrance lobby of the buildings. The fire alarm system will report to the County's security command center and be compatible with the County's existing system.

#### **18.9.2.5 Classifications**

All materials used for fire protection shall be UL listed and FM certified, which will include piping, piping supports, sprinklers, valves and instrumentations. System components shall be rated for the maximum system working pressure to which they are exposed but shall not be rated less than 175 PSI for components installed above ground and 150 PSI for components installed underground.

Sprinklers shall be permanently marked with one or two English uppercase alphabetic characters to identify the manufacturer, immediately followed by three or four numbers, to uniquely identify a sprinkler as to K-factor or orifice shape, deflector characteristic, pressure rating and thermal sensibility.

All control, drain, and connection valves shall be provided with permanently marked weatherproof metal or rigid plastic identification signs.

Fire department connection shall be in accordance with NFPA 1963, Standard for fire hose connections and authorities having jurisdiction shall be permitted to designate the connection to be used.

All alarm apparatus shall consist of listed alarm check valve or other listed water flow detecting alarm devices with the necessary attachments required to give alarm.

Fire pumps shall be provided in order to meet the water flow demand / the pressure requirements for the system, if not available through the city fire hydrant water flow / pressure. A hydrant flow test will be requested to determine the availability.

Fire pump sets shall be complete with pressure maintenance pump and controller for fire pump drivers.

A packaged pump house and /or skid unit shall include detailed design information acceptable to the authorities having jurisdiction.

All electric components, clearances, and wiring shall meet the minimum requirements of the applicable NFPA 70, National Electric Code, articles.

For all pump installations, including jockey pump, each controller shall have its own individual pressure sensing line.

Centrifugal fire shall be of the overhung impeller design, and the impeller between bearing design.

Fire pump shall be tested for not less than 150 percent of the rated capacity at not less than 65 percent of total rated head.

#### **18.9.2.6 System Design**

Water demand shall be determined from the following:

- Occupancy hazard fire control approach
- Storage design approach
- Special occupancy approach

The minimum water demand requirements for a sprinkler system shall be determined by adding the hose stream allowances to the water demand for the sprinklers.

For systems with multiple hazard classifications, the hose stream allowance and water supply duration shall be in accordance with one of the following:

- The water supply requirements for the highest hazard classification within the system
- The water supply requirements for each individual hazard classification shall be used in the calculations for the design area for that hazard.

A water allowance of 100 GPM for a multiple hose connection installed shall be added to the sprinkler requirements.

Design shall be based on Density / Area Curves as follows:

- Light Hazard – Density =0.10 GPM/SF and 1500 SF area of sprinkler operation.
- Ordinary Hazard Group-1 – Density =0.15 GPM/SF and 1500 SF area of sprinkler operation.
- Ordinary Hazard group-2 – Density =0.20 GPM/SF and 1500 SF area of sprinkler operation.
- Extra Hazard shall be designed base on occupancy and hazard classifications.

NB Sprinkler systems shall be designed per NFPA 13, applicable national, state or local authority having jurisdiction codes.

#### **18.9.2.7 Plans and Calculations**

Working plans shall be prepared and submitted for approval to the authorities having jurisdiction before any installation work commences.

Design shall provide general layout starting from fire water main incoming, double check valve back flow preventer, riser valve arrangements and main runs for the sprinkler piping. It will also include the provision of fire hose valves / standpipe at egress stairs. The detailed sprinklers layout shall be designed and provided by sprinkler contractor.

Fire Hydrant flow test report shall be requested to establish the requirement for fire pump to meet the demand and pressure requirements if not meet by fire main water supply.

#### **18.9.2.8 System Acceptance**

The sprinkler contractor shall notify the authorities having jurisdiction and the property owner the time and date the testing shall be performed.

## 18.10 Electrical

### 18.10.1 General Description

The electrical system will consist of a power system, lighting, grounding/bonding and lightning protection system, fire alarm, public address system, access control, security, CCTV system and raceway system for security and communication system.

In order to conserve energy and reduce the carbon footprint, the electrical system will follow LEED strategies. The goal will be to go beyond the minimum requirements demonstrating good sustainable design, and produce a truly high energy efficient building. Occupancy sensors and wall sensors shall be used whenever possible to take advantage of energy conservation. Lighting power density reduction, controllability of lights and low mercury lighting fixtures will also be considered for LEED compliance.

### 18.10.2 Codes, Standards and References

National – The electrical design will be done in accordance with the most current version of the following codes, standards, and references:

- NFPA 70 – National Electrical Code
- NEPA 70E – Electrical Safety in the Workplace, 2009
- ANSI C2 – National Electrical Safety Code
- NEMA – National Electrical Manufacturer’s Association
- UL – Underwriters Laboratory
- ASTM – American Society for Testing and Materials
- IEEE – Institute of Electrical and Electronic Engineers
- IESNA – Illuminating Engineering Society of North America
- NETA ATS – National Electrical Testing Association Acceptance Testing Specifications
- ICEA – Insulated Cable Engineers Association
- AEIC – Association of Edison Illuminating Companies
- OSHA – Occupational Safety and Health Administration
- NFPA – National Fire Protection Association
- ANSI/NFPA 70 – Electrical Equipment Maintenance
- ANSI/NFPA 101 – Life Safety Code
- NFPA 13 – Installation of Sprinkler Systems
- NFPA 72 – National Fire Alarm Code
- NFPA 75 – Standard Protection of Electronic Computer/Data Processing Equipment
- NFPA 110 – Standard for Emergency and Standby Power Systems
- IBC – International Building Code
- ASHRAE 90.1

A. State of Maryland – applicable State of Maryland Codes:

- Electrical Code – NFPA 70 – National Electrical Code 2011
- Building Code IBC – 2012

- Energy Code – IECC 2012
- B. Maryland Transit Administration – latest revisions of the following Standards shall apply:
- Drawing and CADD Standards for Microstation V\*XM
  - Design Development Manual
- C. County of Prince George’s – applicable County of Prince George’s Code will be
- Electrical Code – NFPA 70 – National Electrical Code 2008
  - Building Code – IBC 2006

#### **18.10.2.1 Code Compliance**

The electrical design will be done in accordance with the most current version of the NEC (NFPA70) as stipulated in the Code Compliance Report previously submitted.

#### **18.10.3 Electrical Service**

The utility company has existing overhead power lines in the vicinity of the proposed Purple Line light rail maintenance facility.

The electrical system at the proposed site will consist of medium voltage outdoor unit substation. The medium voltage main distribution switchgear will have dual incoming utility feeders for redundancy.

A new ductbank system will be required for feeders. The ductbank system will have concrete encased conduits and manholes. Coordination will be required with MTA and Utility Company to determine the size of ductbank.

#### **18.10.4 Power Systems**

In the new building, power will be required for the following type of loads:

- 120 VAC Receptacles
- Special Receptacles
- Welding Receptacles
- Vehicle maintenance equipment (hoists, crane, etc.)
- 480/208/3 phase/ 60hz VAC for heat, ventilation and air-conditioning (HVAC) equipment
- Lighting
- Fire Alarm System
- Security System
- Elevators
- Signaling
- Communications and computer networks

##### **18.10.4.1 Capacity of Electrical Service**

The estimated square foot area of the new building is 70,000 sq. ft.

The following estimated capacities are assumed:

- |                    |               |            |
|--------------------|---------------|------------|
| • Lighting         | 1.0 VA/sq.ft. | 107.84 KVA |
| • Receptacle Power | 1.0 VA/sq.ft. | 107.84 KVA |
| • HVAC             | 4.5/sq.ft     | 485.27 KVA |
| • Miscellaneous    | 1.0 VA/sq.ft. | 107.84 KVA |

Total estimated power is 808.79 KVA with 25% future capacity added; the total estimated power is 1010.9 KVA.

A 1000 KVA outdoor unit transformer will be needed to provide power for the new building. The transformer primary voltage shall be medium voltage while the secondary voltage shall be 480 VAC, 3-phase, 4-wire.

#### **18.10.5 Maintenance Facility Distribution**

The maintenance facility will utilize dual unit substations to step down the medium voltage to 480V/277V 3 phase, 4 wire system to feed a main-tie-main switchgear configuration. All unit substation primaries shall have a means of disconnect via a manual load disconnect switch. The unit substations will be located outdoors behind the shop building, while 480V switchgear shall be placed on the 1st floor of the maintenance facility. Proper coordination of the branch power circuit breakers (480V) would be obtained by properly adjusting the settings in a coordination study.

The spaces required for main electrical, emergency and UPS rooms are:

- Main Electrical Room - 20' x 20' = 400 sq.'
- Emergency Electrical Room -18' x 10' = 180 sq.'
- UPS Room - 18' x 10' = 180 sq.'

The switchboard shall utilize the power circuit breakers in an auto-transfer scheme during power loss. All downstream loads will have power failure recylcers. All downstream loads will follow these guidelines:

- All motors 1/2 HP and larger will be fed by 480 Volts 3 phase power. Motors rated below 1/2 HP shall be 208V, 3 phase or 120 Volts single phase power.
- Receptacles and shop equipment will be supplied via dedicated 208/120 Volt panels.
- All telecommunication and office equipment will be supplied from a 208/120 Volts, 3 phase, 4 wire, 200 percent rated neutral system. All 200% neutral panels will be fed from K-rated transformers.
- Special power requirements will be provided for shops as required via mini power zones. Shops require mini power zones to satisfy the shops needs for various voltages for welding receptacles (480V, 240V, 208V single and 3 phase), and will be provided as required.
- Lighting will be fed by 277 Volts, single phase power.

##### **18.10.5.1 Neutral Overloads**

Due to the larger number of outlets and shop equipment in the design, special considerations must be given to harmonic neutral currents generated by electronic equipment and nonlinear loads, such as single phase welders. The requirements are as follows:

- Provide #10 neutral conductors (minimum) on all 120 Volts receptacle circuits sharing a neutral.
- Provide 200% neutral capacity for branch panels serving computer and telecommunications equipment.
- Provide 200% neutral capacity for feeders serving 200% rated panels.

#### **18.10.5.2 Raceway System**

Raceway types will be Polyvinyl Chloride (PVC), Intermediate Metallic Conduit (IMC), Electrical Metallic Tubing (EMT), Flexible Metallic Tubing (FMC), Liquid Tight Flexible Metallic Tubing (LFMC) and Rigid Galvanized Metallic Conduit (RGS).

- Use EMT for all interior systems not subject to physical damage.
- RGS conduits will be used for interior applications for areas subject to severe physical damage.
- Use FMC or LFMC for connections to motors, transformers, machinery, and other equipment subject to vibration. Length should not exceed 3'.
- Use RGS and IMC for all exterior installations and wet locations.
- PVC conduits will be used for wiring underground concrete encased, direct buried and in ground floor slab. Use schedule 80 PVC for direct buried conduits and schedule 40 for concrete reinforced encased in ductbank.

#### **18.10.5.3 Conductor Types**

- Conductors for interior use will be 600 Volts, type THHN/THWN insulation.
- Conductors for exterior use will be 600 Volts, type RHH/RHW or XHHW-2 insulation.
- Conductor size will be minimum #12 AWG for power circuits and #14 for control circuits.
- Insulated equipment grounding conductor for all feeders and branch circuits should be provided.
- All conductors will be installed in raceway.
- All service entrance feeders for each building will be XHHW-2 type.

#### **18.10.5.4 Voltage Drops**

- Branch Circuits: 3 percent maximum.
- Motor Circuits: 5 percent maximum.
- Combined Feeder Plus Branch Circuits: 5 percent maximum.

#### **18.10.5.5 Receptacles**

- Offices and shop rooms will be provided with wall receptacles. Conference rooms will have a floor mounted receptacle, under the main desk. Additional requirements are to be verified by owner.
- Mechanical rooms, electrical rooms, and bathrooms will be provided with ground fault interrupting type receptacles.
- Maintenance bays will be provided with wall mounted receptacles, protected by GFI breakers. Welding receptacles shall not be GFI protected.

- Maintenance bays will be provided with special outlets as required.
- Outdoor receptacles will be GFI and weatherproof in-use type.

#### **18.10.5.6 Emergency Power Systems**

Emergency power requirement for life safety systems is estimated at 15% of power for the building, which is 150 KVA. With the inclusion of a 100 KVA uninterruptible power source the capacity of the emergency generator becomes 250 KVA. Thus requiring a generator rated at 200KW, 480V/3phase/60Hz with a power factor of 0.8. Thus, an emergency stand-by diesel generator of 200 KW shall be provided.

- Generator will be provided with a critical grade muffler.
- There will be a sound attenuated and weather proof enclosure to reduce noise level to 73dB(A) at 3 meters.
- The generator will be loaded in steps.
- The generator will be rated for stand-by application, sound attenuated per NFPA 110, type 10, class 96.
- Generators will be provided with brushless revolving field and permanent exciter.

An automatic transfer switch with isolation bypass will feed an emergency distribution panel. The emergency distribution panel shall feed all life safety, telecom, security and dispatcher loads via sub-panels. The dispatcher room shall utilize an uninterruptible power supply (UPS) to maintain operation of the dispatcher center during an outage until the generator is online.

#### **18.10.5.7 Uninterruptable Power Supply (UPS)**

The UPS with back-up batteries will provide at least 30 minutes of emergency power. The UPS will meet the following requirements:

- A 100kva UPS will be a double on line conversion rated for 480V/277V input and output.
- A modular type sealed lead acid batteries. These modular batteries shall minimize upkeep and can be expanded.
- UPS will be a double on line conversion rated 480V/277V input and output.
- UPS will have maintenance and static bypass switches.
- Battery control panel and charger as recommended by battery manufacturer.

#### **18.10.6 Motor Controllers**

##### **18.10.6.1 Motor Control Center**

- Comply with NEMA ICS 18 and UL 845. Provide 100% neutral and ground bus.
- NEMA Class 1 Type B wiring and NEMA 12 enclosure.
- Starter Size: NEMA 1 minimum.
- Provide motor control centers in mechanical rooms and other “multi-motor” locations.

#### **18.10.6.2 Motor Starter**

- NEMA size 1, non-reversing and across the line for small motors.
- Variable frequency drives shall be provided with all output filters, required line side inductors and hands off automatic (HOA) switches. Pre-packaged mechanical systems utilizing a VFD shall provide a complete system described above and supply a harmonic study to ensure code compliance for all 480V based systems.
- Reduced voltage starter for all constant speed motors with a nameplate running load amps (RLA) 100A or above.

#### **18.10.7 Disconnect Switches**

- Disconnect switches will be heavy duty lockable type and are horse power rated. Provide integral factory ground bar.
- All disconnects located outdoors or in wet environments shall be NEMA 4X lockable type.
- Provide non-fusible safety switches for equipment disconnecting means. All out of sight motors will be provided with disconnect switches.
- Provide fusible safety switches for feeder disconnect, where applicable.

#### **18.10.8 Panel Boards**

- Comply with NEMA PB1.
- All panelboards will be main-circuit-breaker type, 42 circuit and 25% spare capacity.
- Surface mount, NEMA 12 housing.
- Copper bus.
- Fully short circuit rated- series rated not allowed.
- Molded case inverse-time bolt-on circuit breakers. Circuit breakers above 250A will have adjustable instantaneous settings.
- Surge Protection Device (SPD) for main switchboard.
- Panel boards in all telecom rooms shall contain shunt tripped breakers to be controlled by an emergency power off (EPO) switch located within each telecom room.
- All spaces will have bus work and terminal connections for connection of new breakers.
- Each panelboard will have clear designation label indicating panel ID voltage, ratings and source.
- Each panelboard will have machine printed director.

#### **18.10.9 Secondary Transformers**

- Step-down secondary transformer 480-208/120 and 480-240/120V.
- Copper windings.
- All secondary transformers will be ventilated dry type.
- Minimum insulation rating of 220 degree C or better. Temperature rise 80 degree centigrade.
- All ventilated dry type transformer shall have +/-22.5% voltage taps.
- K-13 rated type transformer for 200% rated panel.
- BIL ratings based on available short circuit current.



## **18.10.10 Grounding System and Lightning Protection Systems**

### **18.10.10.1 Grounding System**

The ground system will comply with NFPA 70 National Electrical Code, 2008-Article 250, as a minimum design standard. Only copper conductors will be used for the grounding system. Separate safety and signal grounding system will be provided which will be connected together at the end. The following grounding requirements will ensure an adaptable design, suitable for this building.

- A ground loop consisting of buried (30" below grade) copper conductor (#4/0) and interconnected ground rods (5/8" diameter x 8' long). Copper conductor will be bare copper soft drawn type.
- Provide a grounding bus bar in the maintenance facility electrical and telecommunications rooms. Each bus bar should have 2 connections to the building ground loop and 1 connection with another remote ground bus bar.
- Provide a separate equipment grounding conductors for the following:
  - Lighting Circuits
  - Receptacles and Appliance Branch Circuits
  - Motor Circuits
  - Telecommunications Equipment Branch Circuits
  - Mechanical Equipment
  - Shop Equipment

### **18.10.10.2 Lightning Protection System**

A lightning protection system complying with NFPA 780 and UL96, will be provided consisting of the following components.

- Lightning Arrestors
- Copper conductors for interconnections of lightning arrestors
- Copper down-lead conductors
- Copper ground ring

Lightning arrestors will be provided for roof mounted equipment and all roof mounted equipment will be connected to the lightning protection system. The lightning protection system will have an Underwriters Laboratories (UL) lightning protection inspection certificate upon completion.

## **18.10.11 Telephone/Data Systems**

A PBX local telephone system shall be provided with intercom capabilities throughout the shop building. A computer data network will also be provided.

Each office will have a telephone and data drops. Additional drops will be provided in the conference room, parts storage areas, training rooms, classroom, enclosed shops and break rooms. The tele/data system shall comply with the following requirements:

- A separate voice and data system cabling will be installed. Voice and data system will comply with TIA/EIA 568-B.

- The cable distance from each outlet to patch panel will not be more than 295’.
- Optical fiber and copper trunk lines will be coordinated with MTA and local exchange carrier (LEC).
- CAT 6 four pair cable for both voice and data application will be used. Each communication outlet will have one voice and one data jack as a minimum.
- 12 strand single mode fiber cable and 12 strand multimode fiber from each closet to main telecommunication room will be provided.
- 50 pair telephone exchange cable from main telecom room to each telecom closet and a 25 pair telephone exchange cable to telecom closet to security closet (without a dedicated security network) will be provided.

#### **18.10.12 Public Address Systems**

Multi-zone communication will be provided via a public address (PA) system with intercom. The system will have the capability of making announcements from microphone and telephone system. All speakers will be provided with 15 dB(A) level as minimum above the average ambient sound level. The PA system will consist of the following components:

- The main console shall be front and rear accessible for servicing.
- Main PA shall consist of a free standing rack with AM/FM tuner, cd or tape player, intercom and program control panel, room selector panels with switch banks, PA amplifier, tone generator, microphones and paging adapters. A terminal cabinet with punch blocks shall be installed to receive all incoming wires. Rooms shall have recessed ceiling speakers. Hallways shall have two way speakers facing opposite directions.
- Weather-proof speakers located outside, will be terminated at Surge Protection Device (SPD) device prior to being terminated at the head end equipment. Speakers shall be mounted on exterior walls.
- Paging and a call back switches shall be provided in the training room, conference room, classroom and selected areas to be verified by the owner.

#### **18.10.13 CCTV System**

The security system will consist of a combination of internet protocol (IP) cameras, door contacts, glass breaks, magnetic locks, request to exit buttons and motion sensors. The security system shall have its own security network. All security & security network equipment should have a 48 hour backup battery. The security system shall not utilize the buildings telecom infrastructure to ensure the network will not be compromised. IP cameras are the best system because they can handle long distances with the use of media converters. The second reason for using IP cameras is that video can consume massive bandwidth and IP cameras can have motion sensing alarms with output contacts. This gives the security system vast capabilities to a security integrator. Lastly, the best reasons to utilize IP camera is that the access controls systems will also utilize a network, so provide 1 dedicated security network. The security system shall require additional contacts to indicate:

- Power failure
- Battery is discharging

These features will eliminate incidents at other MTA sites with a power failure. The security control panel will report to the County's security command center and shall be compatible with the County's existing system.

#### **18.10.14 Card Access System**

The site entry system will be controlled via an access control system that is integrated with the security system. It shall act as an automatic system for employees and shall be manually operated for non-employees. Automatic access control system will have the following components:

- Proximity Card readers and keypads for entry
- Ground loops for exit
- Cables, Conduits and junction boxes
- Access control head-end equipment

The site entry will be controlled for non-employees. Manual access control system will have the same components previously listed plus an intercom system at applicable doors with additional requirements to be verified with the owner.

#### **18.10.15 Lighting**

##### **18.10.15.1 General Lighting Guidelines**

- ASHRAE 90.1 guidelines will be complied with, but the minimum requirement will be to achieve 15% reduction in the power density.
- Damp location light fixtures will be provided for all unfinished space below grade.
- T-5-HO or T-5 regular lamps with 400K color temperature for all fluorescent lamps will be provided. Ballast will be electronic type with class A sound ratings.
- Pulse start metal halide light fixtures will be used for parking lots and outdoor applications.
- LED type exit lights will be used.

Red LED exit signs with integral 90 minute battery packs and self-test options will be provided along egress pathways and each exit door and where required throughout the facility per life safety NFPA 101. Site lighting shall provide 0.5fc (minimum) in selected areas such as around the building and parking lots, with walkways being 5fc. All lighting poles shall be round/tapered and be able to withstand 110 mph wind pressure. All wall pack and pole mounted fixtures will be 70-250W full cutoff metal halide fixtures. Full cutoff fixtures shall be Dark Sky compliant and provide a LEED light pollution credit. The outdoor lighting shall be controlled via photocells, contactors and the energy management system.

Proposed illumination intensities are provided below.

Space Type	Proposed Illumination (FC)
Offices, classrooms, break areas, enclosed shop areas	30
(Task lighting to be used if the FC level required > 30)	
Storage areas	20
Mechanical and electrical rooms	30
Parking lot with walkways	5
General site lighting	0.5

**18.10.15.2 Systems**

The lighting in the new building shall be controlled by a dedicated energy management system for power reduction and LEED credits. The energy management system should complement the natural light brought into the space by the light monitors and story windows. The system will have various motion control and photo sensors throughout the space to detect lighting levels and control the lighting within that space to the programmed light level. The dimming ballasts must be capable of incremental changes 1-5% dimming to negate the effect of a cloud temporarily blocking sunlight from affecting the space. The system will also be capable of adjusting the light level by request using multi-level switching or wall dimmer.

The entire first floor shop area will utilize a fluorescent T-5 high bay fixture. Selected fixtures shall contain an emergency battery pack for emergency egress lighting. In the body repair bay and wash bay a gasketed fluorescent high bay fixture similar to the high bay fixtures located in the repair bays will be utilized.

Paint booth lighting will be provided by the booth manufacturer. Areas with a drop ceiling such as offices, restrooms, enclosed shops, training rooms, classrooms and other selected areas will have multi-level switching and will be activated by dual technology motion sensors. Dual technology motion sensors eliminate the individual failures of a single technology motion sensor (infrared or ultrasonic). These areas shall utilize a recessed 2x4 T5 fixture available with emergency battery pack for egress lighting.

Rooms without a drop ceiling such as electrical/mechanical areas shall utilize an industrial parabolic T8 strip fixture which is also activated via motion sensor and controlled by the energy management system for scheduling.

Fixtures throughout all corridors and the first floor shop area shall have night lights. The night lights provide egress lighting in case a zone is deactivated. This will allow an occupant to reactivate the zone and help security monitor the building. The energy management system may also be linked to the security system to reduce the amount of motion sensors needed throughout the building.

## **18.11 Equipment**

### **18.11.1 Equipment Manual**

The maintenance and train wash equipment required for this facility will be provided. An updated equipment manual has been developed which defines recommended equipment for the facility.

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