REQUEST FOR PROPOSALS
FOR THE
AUTOMATED PEOPLE MOVER
LANDSIDE ACCESS MODERNIZATION PROGRAM
AT
LOS ANGELES INTERNATIONAL AIRPORT

PART 2B
DESIGN AND CONSTRUCTION
TECHNICAL REQUIREMENTS
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1. APM GUIDEWAY STRUCTURE

1.1 General

The APM Guideway Structure is a grade-separated and dedicated structure that supports the APM running surfaces. The APM alignment extends east from the Central Terminal Area (CTA), crossing over several LAWA, City of Los Angeles and Caltrans roadways and terminates at the ConRAC APM Station located east of Aviation Boulevard. The APM connects three (3) CTA Stations (West, Center, East), two (2) Intermodal Transfer Facilities (West and East), a Maintenance and Storage Facility (M&SF), and the ConRAC APM Station.

The overall plans and alignment envelope for the APM Operating System is shown in Part 5, Contract Drawings/Engineering Data.

1.2 Standards and Specifications

The Developer shall comply with the requirements listed in Part 4, Standards and Specifications.

1.3 Performance Requirements

1.3.1 Design and Construction

1.3.1.1 General Requirements

The Developer shall establish a structure that:

A. Accommodates dual APM running lanes with additional width at switching locations, as necessary, to support normal and failure management operations.

B. Provides walkways to support emergency evacuation of passengers and maintenance personnel access. See Part 2B, Section 11.3.5.1.6.

C. Accounts for any non-composite dead load, such as leveling courses, a secondary running surface and utilities.

D. Closure pours shall be detailed and constructed to minimize their appearance and provide smooth continuous surfaces.

1.3.1.2 Technical Requirements

The Developer shall comply with the following technical requirements:

A. At the interfaces between Stations and the APM Guideway Structure, design for supplemental loading as necessary.

B. Design visible portions of the APM Guideway Structure with a consistent architectural theme and uniformity of appearance.

C. Utilities, drainage, and cabling shall not be located on the exterior of columns or on the sides or underside of the superstructure and shall not be visible to the public. For APM Operating System equipment installation requirements refer to Part 2B, Section 11.3.16.6.7.B.1.

D. The column support spacing surrounding the historic Theme Building shall have a minimum distance of approximately 120 feet.

E. The minimum vertical clearance between top of roadways and bottom of APM Guideway Structure shall be in accordance with AHJ (Caltrans Highway Design
For APM clearance envelope requirements, refer to Part 2B, Section 11.3.7.1.

Design the APM Guideway Structure for loading of the specific APM Operating System chosen. Refer to Part 2B, Section 11 for APM Operating System requirements. The dynamic load allowance shall be calculated per ASCE 7.

Design the APM Guideway Structure to meet live load deflection criteria as determined by the Operating System selected.

Seismic Design: Design the seismic performance of the Guideway Structure and its main structural members, including those within the stations as follows:

1) Operating Design Earthquake (ODE): The probabilistic ODE has an average return period of one-hundred fifty (150) years. Design the structure to remain essentially elastic and for damage to be none to minimal and cosmetic in nature. The structure shall remain fully operational immediately after the ODE level earthquake. The following shall be used to achieve the above performance objectives:
   a) Steel strain shall be limited to onset of strain hardening $\varepsilon_{\text{inh}}$ per Section 3.2.3 of Caltrans SDC, but not less than 0.01.
   b) Concrete strain shall be limited to 0.004.
   c) The analytical plastic hinge length (LPA) shall be taken as $\frac{1}{2} \text{LP}$ as defined in Section 7.6.2 of Caltrans SDC.

2) Maximum Design Earthquake (MDE): The probabilistic MDE has an average return period of 2,500 years. The Guideway Structure may not be fully operational immediately after the seismic event, but damage is controlled and limited to elements that are easily accessible and that can be readily repaired with limited disruption to service. The following shall be used to achieve the above performance objectives:
   a) Steel strain shall be limited to $\frac{2}{3}$ of the reduced ultimate tensile strain $\varepsilon_{\text{u}}^R$ per Section 3.2.3 of Caltrans SDC
   b) Confined concrete strain shall be limited to $\frac{2}{3}$ of the ultimate compressive strain for confined concrete $\varepsilon_{\text{cu}}$ per Section 3.2.6 of Caltrans SDC using Mander’s stress-strain model for confined concrete.

3) For portions of the Guideway Structure near S. Sepulveda Blvd, with Caltrans as an AHJ, additionally design using Caltrans Deterministic and Probabilistic Acceleration Response Spectra. This deterministic and probabilistic spectra has an average return period of 975 years. The Guideway Structure may not be fully operational immediately after the seismic event, but damage is controlled and limited to elements that are accessible and that can be readily repaired with limited disruption to service. Caltrans SDC limits on the concrete and steel strains shall be used.
4) Live load shall be considered for both the ODE and MDE and shall use a single Train loaded at the AW1 weight specified in Section 11.3.1.2 with a load factor ($\gamma_{EQ}$) per AASHTO LRFD Section 3.4.1 taken as 1.0. The mass of the trains need not be added to the seismic mass.

L. Wind Design: Aeroelastic force effects shall be taken into account in the design of bridges and structural components apt to be wind-sensitive. Bridges with a span to depth ratio, and structural components thereof with a length to width ratio, exceeding 30.0 shall be deemed to be wind-sensitive.

M. Foundation Design: The Developer shall perform all Site specific investigations and develop all supplemental information to provide a final geotechnical engineering report which shall identify recommended soil properties to be used in design, including densities, strengths, compressibility, environmental conditions and any other data necessary for the successful execution of the design to be performed by the Developer. Refer to Part 2B, Section 14, Geotechnical, for Foundation Design.

N. Stormwater: Direct any stormwater accumulating along the guideway to inlets, then to drain pipes located within pier columns and bents and transmitted into the existing or new storm drainage system or natural surface-level water courses. Such drainage provisions shall not be visible to the public and shall not point discharge onto any streets or roadways. See Part 2B, Section 8 for additional Guideway Structure drainage requirements.

O. Existing Structures: Support existing structures as necessary to avoid loading and/or settlement as a result of the construction of the APM Guideway Structure.

P. Within the design, provide access for routine and special bridge inspections that minimizes disruption to APM operations below the Guideway Structure.

Q. Provide the design loads and other information pertinent to the structural design on the Release for Construction Documents (RFCD) plans.

R. Prepare designs, plans and specifications under the direction of a registered Professional Engineer in the State of California.

S. Provide accommodations for a grounding system in accordance with Part 2B, Section11, APM Operating System. Include grounding cables at all column locations and electric power cables as necessary.

T. APM Guideway Structure foundations and columns at approximately APM Guideway Structure station 104+00 at the intersection of the Metro Crenshaw/LAX Line (near West 96th Street.) will be provided for use by the Developer. Maximum design loads, design assumptions, calculations, plans and specifications are provided in Part 5, Contract Documents / Engineering Data.

U. Locate APM Guideway Structure foundations and columns to minimize impacts to driveway access and egress, turning radii and sight distance requirements.

V. Coordinate APM Guideway Structure design and construction requirements with the ConRAC developer to ensure an integrated system. See Part 2A, Section 21.2 for further description of the Interface and to Exhibit 10 to the Agreement for Interface obligations.
1.3.2 APM Structures and Guideway Structure Inspection Plan

The Developer shall prepare an APM Structures and Guideway Structure Inspection Plan (Inspection Plan) in accordance with the requirements of Part 2B Section 25. The Developer shall perform baseline inspections during the D&C Period. Subsequent inspections are described in Part 3, Section 5.4.2.

1.4 Summary of Submittals

At a minimum, the Developer shall provide submittals as indicated in Part 2A, Section 6.
2. **APM STATIONS**

2.1 **General**

The Developer shall provide Station facilities and equipment necessary for passenger handling and train operations at six (6) Stations. Five (5) Stations are complete with Platform, vertical circulation and APM Operating System components: three (3) CTA Stations (West, Center and East); and two (2) Intermodal Transportation Facilities (ITF West and ITF East Stations). At the ConRAC Station, the Developer shall provide the APM Operating System (OS) to be interfaced with Station construction by others.

Stations shall be integrated with the APM Operating System components as described in Part 2B, Section 11. Stations shall be sized in accordance with the requirements of the Contract Documents and at a minimum to accommodate passenger loads reflected in the 95 MAP demand forecast under normal and peak operations, as shown in Part 2B, Section 2.5.

2.2 **Standards and Specifications**

The Developer shall comply with the requirements listed in Part 4, Standards and Specifications. The Developer shall follow the structural design standards and specifications per Part 2B, Section 1 for the major load carrying elements of the APM Stations including, but not limited to, foundations, columns supporting the APM Guideway, bent caps, APM Guideway superstructure, Station Platform slabs and girders, and mezzanine slabs and girders.

2.3 **Performance Requirements**

2.3.1 **General**

The Developer shall design visible portions of the Stations with a consistent architectural theme and uniformity of appearance. All Stations shall be weather and corrosion resistant environments in which the Platforms, interiors and support spaces are protected from wind-driven rain and other windblown debris. All Stations shall be naturally ventilated.

The Developer shall provide at a minimum:

A. Station facilities, whose overall appearance, interior and exterior finishes, wayfinding, annunciation and lighting are similar in general form and function.

B. Platform areas shall be kept clear of obstructions that impede passenger flows, queuing and clear sight lines. These obstructions shall include vertical conveyance, stairways, structural columns and floor mounted wayfinding. Station furniture will be allowed on the platform provided it does not impede passenger flow.

C. Trash cans and other receptacles installed at the Developer’s discretion shall be blast proof and of an appropriate design to make it difficult to deposit explosives and incendiary devices.

D. The Developer shall provide vertical conveyance systems, at a minimum, as indicated in Part 2B, Section 24.

E. Station design shall facilitate convenient, direct and safe access to Station entrances, and shall ensure that all Station public facilities are universally accessible.
F. Roof form and size shall be sufficient to prevent windborne water intrusion to the Platform, Station equipment and vertical cores.

G. Station design shall allow for an abundance of natural light into the Station but is configured with sun-shading devices to prevent heat gain and glare from direct sun exposure.

H. Platform edge walls shall be impervious and sufficiently tall to prevent water intrusion to the Platform and designed to accommodate Platform edge doors, knock-out panels and dynamic signage.

I. Sustainable design strategies shall be employed per the Developer's APM System Sustainability Compliance Plan as described in Part 2A, Section 9.1.

J. Utilities, rain water leaders and conduits shall be concealed from public view.

K. Safety and security measures are addressed in Part 2A, Section 8.

L. Stormwater collection and drainage system shall be routed to an existing or new storm drainage system. Such drainage provisions shall not be visible to the public and shall not discharge onto any streets or roadways.

M. Each Station shall have, at a minimum, two independent exits to grade for egress.

N. Adequate queuing areas shall be provided in front of stairs and escalators per the Transit Capacity and Quality of Service Manual, 3rd Edition (Level of Service A). The length of the queuing areas, the queuing distance, shall not be less than 15-feet. Distances are measured from the leading edge of the escalator balustrade or the leading edge of a stairway handrail, to the edge of the vehicle door openings, any obstructions, or other queuing areas.

O. The Developer shall provide appealing and convenient pedestrian access from the APM System to the Theme Building. The access shall be highlighted by wayfinding and visual line of sight of the Theme Building. The access to the Theme Building shall be from the APM System to existing grade, and shall not be through any parking garage space.

P. The Developer shall provide infrastructure to support the possible inclusion of sound, digital media and light installations for digital advertising within each Station mezzanine. Such infrastructure shall include an interface with the APM public address system such that emergency announcements override the audio; 120 volt, 20 amp dedicated circuits at 20 foot intervals to the nearest normal power panel(s); 2” conduit, fiber, empty 24 square j-box for possible fiber connection; and consolidation points connected directly to the LAWA IT room for the head end data devices.

Q. The Developer shall provide infrastructure to support the possible inclusion of sound, digital media and light installations for art on each Station mezzanine. Such infrastructure shall include an interface with the APM public address system such that emergency announcements override the audio; 120 volt, 20 amp dedicated circuits at 20 foot intervals to the nearest normal power panel(s); 2” conduit, fiber, empty 24 square j-box for possible fiber connection; and consolidation points connected directly to the LAWA IT room for the head end data devices.
R. The Developer shall provide a LAWA IT equipment room at each Station. For specific requirements, refer to Part 2B, Section 17.

2.3.2 CTA West Station
The CTA West Station shall be a multi-story infill structure constructed between Parking Garages P3 and P4 that includes:

A. An APM Guideway with two, at a minimum 30'0" wide, passenger Platforms and associated vertical cores. The northern Platform shall be dedicated to passenger boarding and the southern Platform shall be dedicated to passenger alighting;

B. A new infill parking garage whose floor plates match those of P3 and P4 and that provides open vehicular and ADA compliant pedestrian access between P3 and P4; and,

C. Un-programmed space providing approximately 50,000 sf multi-use, fully enclosed, conditioned, sprinklered, fire-separated core and shell building constructed at the Pedestrian Walkway Level to accommodate future assembly and office uses. The un-programmed space shall:

1) Provide a minimum 18-foot clear ceiling height. Where other APM facility elements such as the APM Platform/Guideway structures, stairs and escalators interrupt the proposed building volume, a minimum 12-foot clear, unobstructed ceiling height is permissible.

2) Include clerestory glazing to introduce natural lighting where applicable.

3) The un-programmed space shall be a one-story space.

4) Provide a minimum 24-foot wide east-west public concourse connecting TBIT and T3 and T4 Pedestrian Walkway(s).

5) Provide two (2) sets (men, women and single accommodation "family") public restroom facilities, including janitorial closets and mop sinks, adjoining the 24-foot public concourse. Restroom facilities must be sized in accordance with the LABC assuming 100% of the un-programmed space and 24-foot wide public concourse is an assembly use.

6) Provide independent means of egress to grade for the entire un-programmed space in accordance with the LABC assuming 100% of the un-programmed space and 24-foot wide public concourse is an assembly use. All required exit stairs shall be equally distributed on the building floor plate to accommodate future program flexibility. Means of egress from any adjoining APM Platform/Station shall be separate and independent.

7) Provide mechanical and ventilation systems infrastructure to support a multi-tenant, core and shell building with a minimum of 5 independent zones. Roof mounted infrastructure shall be screened such that it is not visible to users of the CTA West Station or the un-programmed space.

8) Provide power and data infrastructure to support a multi-tenant, core and shell building with independent zones and metering capabilities; and
9) Provide other utility infrastructure, as required, to support a multi-use, core and shell building.

On the Platform’s east end, two (2) vertical cores consisting of stairs, elevators and escalators shall convey passengers to and from the Station’s Platforms to the un-programmed space level from which passengers can access Pedestrian Walkways that connect to Terminal Vertical Cores 3.0 and 4.5 and to the new West Way curb. On the Platform’s west end, two (2) sets of vertical cores consisting of stairs, elevators and escalators shall convey passengers to and from the Platform level to the un-programmed space from which passengers can access a TBIT Pedestrian Walkway and a Pedestrian Walkway to P4 and Garage Vertical Core at P3. Provide escalators and elevators from the un-programmed space level to the new West Way curb. The elevators shall also connect to Level 1 and Level 2 of the CTA West parking garage. The Garage Vertical Core at P3 shall have stairs and an elevator. Emergency egress stairs shall provide access to grade.

2.3.3 CTA Center Station

Located south of new parking garage P2A, the CTA Center Station shall have a single, at a minimum 45’4” wide and 200’0” long, center Platform and associated vertical cores. The two vertical cores located at the Platform’s ends shall convey passengers to a mezzanine level beneath the Guideway from which to access Pedestrian Walkways leading to:

A. Terminal Vertical Cores 1.5, 2.5, 5.5; and,

The mezzanine shall permit unobstructed passenger access from the Station’s east end to the west end with a minimum clear width of 10’0”. Emergency exit stairs shall provide access to grade. The mezzanine, in addition to connecting to the Pedestrian Walkways, shall contain support spaces for APM Operating System components, electrical service, fire protection systems, housekeeping and vertical circulation.

2.3.4 CTA East Station

Located between existing parking garages P1 and P7, the CTA East Station shall have a single, at a minimum 45’4” wide and 200’0” long, center Platform and associated vertical cores. The two vertical cores located at the Platform’s ends shall convey passengers to a mezzanine level beneath the Guideway from which to access Pedestrian Walkways leading to:

A. Parking Garage P1 Vertical Core and to future Terminal Vertical Core 0.5 (the Walkway from the Garage to the Terminal Vertical Core to be constructed by others); and
B. A rehabilitated/upgraded Garage Vertical Core at P7 that will require replacement of a Pedestrian Walkway connector between the existing P7 Vertical Core and the existing pedestrian bridge connecting P7 to Terminal 7.

The mezzanine shall permit unobstructed passenger access from the Station’s east end to the west end with a minimum clear width of 10’0”. Emergency exit stairs shall provide access to grade. The mezzanine, in addition to connecting to the Pedestrian Walkways, shall contain support spaces for APM Operating System components, electrical service, fire protection systems, housekeeping and vertical circulation.

2.3.5 ITF West Station

Located north of 96th Street and centered over the existing Jenny Street, the ITF West Station shall provide access to the CTA from a new ground transportation center, including a new parking garage (by others), to be constructed in the area of the current Lot C and the Avis
Rental Car facility. Refer to Part 2B, Sections 6 and 7 for additional requirements regarding the ground transportation center at ITF West. The Station shall have a single, at a minimum 45’4” wide and 200’0” long, center Platform serving both boarding and alighting passengers with vertical circulation cores on both Platform ends providing access to a mezzanine beneath the Guideway with Pedestrian Walkways(2) to the parking garages and to grade at the ground transportation center. Emergency exit stairs shall provide access to grade. The mezzanine shall permit unobstructed passenger access from the Station’s east end to the west end with a minimum clear width of 10’0”.

2.3.6 ITF East Station

This Station shall interface with the Airport Metro Connector (AMC) (by others). Located east of Aviation Boulevard, this Station shall provide access to the CTA from a ground transportation center, a future ITF East parking garage (by others) and an AMC transit center. The Developer shall provide structural accommodation at the mezzanine level to accommodate a future Pedestrian Walkway connecting from the Station to the future ITF East Garage Vertical Core. Refer to Part 2B, Section 7 for additional requirements regarding the ground transportation center at ITF East. The Station shall have a single, at a minimum 45’4” wide and 200’0” long, center Platform serving both boarding and alighting passengers with vertical cores on both Platform ends. The west vertical core provides access to a mezzanine that connects to the AMC transit facility’s vertical cores (by others) and to the ground transportation center located beneath the Station. The mezzanine shall permit unobstructed passenger access from the Station’s east end to the west end with a minimum clear width of 10’0” and shall contain support spaces for APM Operating System components, electrical service, fire protection systems, housekeeping and vertical circulation.

2.3.7 ConRAC Station

This Station, designed and constructed by others, is an integral part of the overall LAMP program and shall, in its interior functionality, aesthetic forms, interior and exterior finishes and operations, appear and perform similarly to the other five (5) APM Stations. The ConRAC Station shall consist of two (2) Platforms, minimum 30’0” wide. The northern Platform dedicated to passenger alighting and the southern Platform dedicated to passenger boarding. The Developer shall coordinate the installation of all APM Operating System and related Work within the ConRAC Station enclosure and any other equipment structures located at Level 4 of the ConRAC by others. See Part 2A, Section 21.2 for further description of the interface and to Exhibit 10 of the Agreement for interface obligations.

2.3.8 Seismic Design

Seismic Performance Requirements: For elements not applicable to Part 2B, Section 1.3.1.2 (I), the Developer shall design for seismic performance as follows:

A. ASCE 7;
B. Risk category III;
C. Occupancy Category III; and
D. Use mechanical, electrical and plumbing systems that have been seismically certified. Refer to http://www.oshpd.ca.gov/fdd/pre-approval/index.html.
2.3.9 Station Materials and Construction Assemblies

A. Provide Station interior materials and construction assemblies that are durable, water and corrosion resistant, low maintenance and vandal-resistant. The interior public area shall be open and illuminated to ensure clarity of circulation, wayfinding, access, and safety and security.

1) Finish materials for interior walls shall be corrosion and vandal resistant and shall be easy to clean; and

2) Glazing, if used, shall be of clear glass, tinted on the west and south facades to reduce glare and heat gain.

B. Door hardware shall comply with barrier free design requirements and fire-rated door assemblies, where required. Keying and room numbering shall comply with LAWA standards.

C. Ceiling Systems shall include acoustical panels to maintain specified noise level per Part 2B, Section 11.

D. Terrazzo floor materials shall be used in public areas (Stations and Pedestrian Walkways).

E. Utilities and conduits shall be concealed from public view.

F. Wayfinding: Provide wayfinding signage conforming to LAWA standards.

G. Provide two Automatic Exterior Defibrillators (AED) on each Station’s Platform and one at the mezzanine level. Locate the AED’s within the public’s reach. (See Part 2B, Section 17.)

H. Exposed spray on fire proofing shall not be visible to the public. Intumescent coatings, if used, shall have a smooth architectural finish.

2.4 Summary of Submittals

At a minimum, the Developer shall provide submittals as indicated in Part 2A, Section 6.

2.5 Rolling Hour APM Passenger Volumes

(See Table on the following page)
### Rolling Hour APM Passenger Volumes - 95 MAP Base Scenario 1

#### Arriving Passenger Peak at Each Station

<table>
<thead>
<tr>
<th>Peak Time</th>
<th>CTA East</th>
<th>Center</th>
<th>West</th>
<th>Outside of CTA East</th>
<th>Center</th>
<th>West</th>
<th>ConRAC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>From Terminal</td>
<td>To Terminal</td>
<td>From Terminal</td>
<td>To Terminal</td>
<td>From Terminal</td>
<td>To Terminal</td>
<td>From Terminal</td>
</tr>
<tr>
<td>11:50 AM</td>
<td>11:05 AM</td>
<td>9:30 AM</td>
<td>8:30 PM</td>
<td>11:19 AM</td>
<td>11:30 AM</td>
<td>8:09 PM</td>
<td>11:15 AM</td>
</tr>
<tr>
<td>1,299</td>
<td>966</td>
<td>1,101</td>
<td>877</td>
<td>1,185</td>
<td>955</td>
<td>1,031</td>
<td>959</td>
</tr>
<tr>
<td>Surge</td>
<td>1,949</td>
<td>1,208</td>
<td>1,062</td>
<td>2,465</td>
<td>1,916</td>
<td>1,185</td>
<td>1,144</td>
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<tr>
<td>Total</td>
<td>3,157</td>
<td>2,747</td>
<td>4,381</td>
<td>2,972</td>
<td>2,502</td>
<td>2,397</td>
<td>1,334</td>
</tr>
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</table>

#### Departing Passenger Peak at Each Station

<table>
<thead>
<tr>
<th>Peak Time</th>
<th>CTA East</th>
<th>Central</th>
<th>West</th>
<th>Outside of CTA East</th>
<th>Central</th>
<th>West</th>
<th>ConRAC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>From Terminal</td>
<td>To Terminal</td>
<td>From Terminal</td>
<td>To Terminal</td>
<td>From Terminal</td>
<td>To Terminal</td>
<td>From Terminal</td>
</tr>
<tr>
<td>10:07 AM</td>
<td>10:07 AM</td>
<td>7:47 AM</td>
<td>8:17 PM</td>
<td>9:51 AM</td>
<td>10:00 AM</td>
<td>10:00 AM</td>
<td>10:00 AM</td>
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<tr>
<td>969</td>
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<td>341</td>
<td>1,075</td>
<td>1,096</td>
<td>2,408</td>
<td>2,137</td>
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<tr>
<td>Surge</td>
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<td>1,472</td>
<td>511</td>
<td>1,343</td>
<td>1,208</td>
<td>1,235</td>
<td>1,834</td>
</tr>
<tr>
<td>Total</td>
<td>2,926</td>
<td>1,854</td>
<td>4,350</td>
<td>2,823</td>
<td>2,398</td>
<td>2,859</td>
<td>3,859</td>
</tr>
</tbody>
</table>


#### Surge:
- Outbound: 1.5
- Inbound: 1.25

### APM Passenger Volumes by Minute - 95 MAP Base Scenario 1

#### Arriving Passenger Peak at Each Station

<table>
<thead>
<tr>
<th>Peak Time</th>
<th>In CTA East</th>
<th>Central</th>
<th>West</th>
<th>Outside of CTA East</th>
<th>Central</th>
<th>West</th>
<th>ConRAC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>From Terminal</td>
<td>To Terminal</td>
<td>From Terminal</td>
<td>To Terminal</td>
<td>From Terminal</td>
<td>To Terminal</td>
<td>From Terminal</td>
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<tr>
<td>11:59 AM</td>
<td>11:09 AM</td>
<td>9:46 AM</td>
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<td>23</td>
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</tr>
</tbody>
</table>

#### Departing Passenger Peak at Each Station

<table>
<thead>
<tr>
<th>Peak Time</th>
<th>In CTA East</th>
<th>Central</th>
<th>West</th>
<th>Outside of CTA East</th>
<th>Central</th>
<th>West</th>
<th>ConRAC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>From Terminal</td>
<td>To Terminal</td>
<td>From Terminal</td>
<td>To Terminal</td>
<td>From Terminal</td>
<td>To Terminal</td>
<td>From Terminal</td>
</tr>
<tr>
<td>11:30 AM</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>11:30 AM</td>
<td>11:30 AM</td>
<td>11:30 AM</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>20</td>
<td>-</td>
<td>16</td>
<td>-</td>
<td>28</td>
<td>-</td>
</tr>
</tbody>
</table>
3. MAINTENANCE AND STORAGE FACILITY (M&SF)

3.1 General

Functional requirements for the M&SF are described in Part 2B Section 11.3.13.1.

The M&SF shall house the Central Control Facility (CCF), and may, at the Developer’s discretion, also house administrative offices, training facilities, and staff support areas. The M&SF shall provide employee and visitor parking, including bicycle parking. The Developer shall design visible portions of the M&SF with a consistent architectural theme and uniformity.

The M&SF shall be located on a parcel generally bounded by Airport Boulevard on the west and 96th Street on the south, new “D” Street on the east and Arbor Vitae on the north; the site is east of the ITF West. The M&SF site development area, including the yard, is approximately 4.4 acres. The Developer shall equip the roof of the M&SF with solar panels.

The M&SF shall accommodate at a minimum the following:

A. Maintenance bays (light and heavy);
B. Vehicle storage;
C. Vehicle exterior washing / interior cleaning;
D. Open floor work area (adjacent to maintenance bays);
E. Machine and HVAC shops;
F. Mechanical, electronic and electrical shops;
G. Battery and Hazardous Material storages;
H. Tire shop and storage;
I. Tools and equipment storage;
J. Parts and expendables storage (inventory); and
K. Parts receiving area (loading dock).

In addition, support spaces shall include a public / visitor entrance, mechanical equipment room, main electrical distribution room, fire pump room, LAWA IT room, and air compressor room. Egress stairs shall be distributed within the facility and shall be code compliant.

3.2 Standards and Specifications

The Developer shall comply with the requirements listed in Part 4, Standards and Specifications.

3.3 Performance Requirements

3.3.1 Technical Requirements

The Developer shall size the M&SF to accommodate the maintenance and storage requirements of the APM fleet, as sized to meet the system Line Capacity, plus ten percent additional fleet and as described in Part 2B, Section 11. The M&SF building and all its associated features, such as storage guideway and parking, shall be located within the boundaries of the D&C Limits.

The M&SF building is industrial in scale and size and the facility’s massing, architectural character, detailing and exterior finish materials shall be visually compatible with its surrounding...
context. The architectural character of the M&SF shall be consistent with the design of the APM Stations. In addition:

A. Minimum roof slope shall be as required by code, but in no case shall the slope be less than one-quarter (1/4”) inch per foot.

B. Minimum wind design loads shall be determined in accordance with California Building Code using a minimum Exposure Category C.

C. Safety and security shall be addressed by providing:
   1) Clear sight lines;
   2) Appropriate lighting levels;
   3) CCTV coverage of the M&SF for safety and security purposes;
   4) Landscaping that does not block CCTV cameras and does not provide areas of concealment;
   5) Trash cans and other receptacles that are blast proof and of an appropriate design to make it difficult to deposit explosives and incendiary devices;
   6) Employ LAWA ACAMS for access control and intrusion detection systems to prevent unauthorized access to designated areas and provide alarm notification to a CCF and LAWA Telecom Building in coordination with AHJ if unauthorized entry is detected. The access control system shall include, but not be limited to, video cameras located in secure areas as necessary. Systems shall be compatible with LAWA standards and coordinated with the Developer and LAWA. Intrusion alarms shall be provided at all gates and building entrances and provide notification to a central location upon detection of unauthorized entry. (See Part 2B, Section 17); and
   7) The M&SF and related parking areas shall be fenced. The fence shall be security fencing as approved by AHJ with unobstructed clear view zones. All gates shall be lockable and ACAMS activated for entrance. The Developer shall ensure that when opened, gates shall be staffed or otherwise monitored to ensure the security of the facility.

D. Landscaping: Landscaping shall provide a green buffer between M&SF and the surrounding area. Tree types and sizes require design coordination, see Part 2B Section 13. All service areas shall be screened from public view. All mechanical equipment, on-grade mechanical units, electrical transformers, trash dumpsters, and above-ground storage tanks shall likewise be screened. At-grade screen walls and landscaping shall be submitted as part of the Basis of Design Report.

E. Sustainability: The M&SF shall achieve LEED Silver Certification.

F. Seismic Design: Design for the seismic performance as follows:
   1) ASCE 7;
   2) Risk category III;
   3) Occupancy Category III; and
   4) Use mechanical, electrical and plumbing systems that have been seismically certified. Refer to http://www.oshpd.ca.gov/fdd/pre-approval/index.html.
3.3.2 Building Components

All finish materials for the M&SF shall be selected to provide resistance to predictable physical impacts including normal usage, weather, vandalism, air pollution, and deterioration due to other forces.

A. Exterior Walls: Provide wall assemblies that are durable, weather and vandal resistant. Utilize materials to minimize sound and light transmission from the shop areas where work will occur throughout the night.

B. Door Hardware: Keying and room numbering shall comply with LAWA standards.

C. Glazing, including glazing for doors, glazed entrances, interior borrowed lights, storefronts and skylights shall be clear and tinted on the south and west building facades to prevent glare and heat gain.

D. Interior Walls: Walls in maintenance areas shall be constructed and finished to effectively resist potential impacts and abrasions from the movement and maintenance of vehicles and equipment.

E. Ceilings: Ceiling system shall minimize the transmission of disruptive noises from one space to another.

F. Floors: Floor surfaces shall meet the slip resistance requirements of code; provide special floor finishes where appropriate.

G. Cathodic Protection: Protect the facility piping from corrosion with a cathodic protection system. Similarly provide cathodic protection of rebar, if determined necessary by soil conditions and stray current.

H. Elevators: Provide, at a minimum, two (2) elevators, one (1) passenger and one (1) freight, as follows:

   1. Freight elevator shall be sized to transport the largest and heaviest line replaceable unit that will be required in the maintenance of vehicles and other equipment; and

   1. Passenger elevator located in the building lobby at ground level shall serve all levels of the maintenance facility.

I. Storm Drainage System: Collect all rainfall through roof drains, overflow drains, and downspouts located periodically along exterior columns. Storm drains shall be routed to a point of connection with the site civil storm drainage system.

J. Domestic Water System: Provide domestic water service.

K. Sanitary Sewer System: Connect toilet rooms, employee facilities, and floor drains to the sanitary sewer system.

L. Fire Protection: Provide and install a complete fire suppression system throughout the facility.

M. Lighting: Provide adequate illumination for the functions within the facility and storage yard.

N. Public Address System: Accommodate a public address system which shall cover the entire area with speakers for notification of emergency operations and general announcements. The public address system shall include an interface such that emergency announcements override the audio. (See Part 2B, Section 17.)
3.3.3 Inspection Requirements

Baseline inspections are required to be performed during the D&C Period. O&M Period inspections are in Part 3 Section 5.4.2.

3.4 Summary of Submittals

At a minimum, the Developer shall provide submittals as indicated in Part 2A, Section 6.
4. PEDESTRIAN WALKWAYS

4.1 General

The Developer shall provide elevated Pedestrian Walkways to provide access from the Stations in the CTA to the Terminal Vertical Cores and Garage Vertical Cores. At ITF West Station, the Developer shall provide two walkways to the ITF West garage. At ITF East Station mezzanine level, the Developer shall provide provisions for a future Pedestrian Walkway (by others). Pedestrian Walkways shall be naturally ventilated and open for air circulation, provide unimpeded views, and shall be weather and corrosion protected from windblown rain and debris. Pedestrian Walkways shall contain moving walkways as required in Part 2B, Section 24.

Pedestrian Walkways shall be connected to the Terminal Vertical Cores and Garage Vertical Cores as follows:

Table 4.1-1 Vertical Core Responsibility

<table>
<thead>
<tr>
<th>VERTICAL CORE</th>
<th>RESPONSIBLE PARTY FOR VERTICAL CORE CONSTRUCTION</th>
<th>RESPONSIBLE PARTY FOR PEDESTRIAN WALKWAY CONSTRUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>TERMINAL VERTICAL CORES</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 0.5 | Airlines | Airlines (between Garage P1 and Terminal Vertical Core)  
Developer (between the CTA East Station and Garage P1) |
| 1.5 | Airlines | Developer |
| 2.5 | Airlines | Developer |
| 3.0 | Airlines | Developer |
| TBIT | LAWA | Developer |
| 4.5 | Airlines | Developer |
| 5.5 | LAWA | Developer |
| GARAGE VERTICAL CORES | | |
| 7.0 | Developer (retrofit) | Developer |
| ITF GARAGES | | |
| ITF West | ITF West Garage Design/Builder | Developer |
| ITF East | ITF East Garage contractor | ITF East Garage contractor - Pedestrian Walkway  
Developer shall provide provisions for a future pedestrian walkway at the mezzanine level. |

Pedestrian Walkways shall extend to a designated vertical core point of structural interface. The Developer shall coordinate with the parties responsible for the construction of the Terminal Vertical Cores. Coordination shall include structure, curtain wall removal, reconstruction and waterproofing, fire-life-safety, electrical, storm drainage, plumbing and special systems connections at the vertical core interfaces. Within the CTA, the Pedestrian Walkway structural support shall be installed by the Terminal Vertical Core parties. The fire-life-safety, electrical,
plumbing and other systems contained within the Terminal Vertical Core shall not connect with the Pedestrian Walkways. The Pedestrian Walkway systems shall be completely independent of the terminals and supported by the APM. Refer to Part 2A, Section 21.2 for further description of the Interface and to Exhibit 10 of the Agreement for Interface obligations.

The Developer shall provide Pedestrian Walkways, at a minimum that:

A. Facilitate convenient, direct and safe access to Station entrances, Garage Vertical Cores and the Terminal Vertical Cores or points of interface.

B. Allow natural illumination and incorporate sun-shading devices to prevent heat gain and glare from the sun on the west and southwest sides.

C. Avoid the transfer of any load to existing structures, except as coordinated at terminal point-of-interface indicated in Part 2B, Sections 4.3.3.

D. Address safety and security by providing:
   1) Clear sight lines;
   2) Appropriate lighting levels;
   3) Security systems as described in Part 2B, Section 17; and,
   4) Ease of access to and from Stations and terminal point-of-interface.

E. Are partly enclosed and permit views into and out of Pedestrian Walkway areas.

F. Are considered as Pedestrian Walkways for code standards and specification requirements unless otherwise noted in Part 2B, Section 4.2.

G. Are considered as separate structures from the terminals for code standards and specification requirements.

H. Are at least 50% open.

I. The Pedestrian Walkway underside finish shall conceal the structure and all equipment and shall have a smooth finish.

4.2 Standards and Specifications

The Developer shall comply with the requirements listed in Part 4, Standards and Specifications.

4.3 Performance Requirements

4.3.1 General

For all Pedestrian Walkways, the Developer shall:

A. Provide sufficient openings to permit evenly distributed natural air circulation throughout the Pedestrian Walkway’s length. Such openings shall be sized to provide protection from wind driven rain and debris. The Developer shall analyze any structural impact of the Pedestrian Walkway on the existing garages (e.g. Pedestrian Walkway column penetrations at parking structure P7).

B. Locate columns supporting Pedestrian Walkways to avoid interference or conflicts with roadways, ingress/egress of adjacent existing structures, future facilities, and other program elements. Columns shall not be located on sidewalks adjacent to terminal buildings or on World Way.
C. Install structures that are considered Pedestrian Walkways for code standards and specification requirements unless otherwise noted in Section 4.2.

D. Install structures considered as separate structures from the terminals for code standards and specification requirements.

E. Provide acoustical panel ceilings.

F. Provide slip resistant flooring. Terrazzo floor materials shall be used in public areas (Stations and Pedestrian Walkways).

G. Provide wayfinding signage to direct passengers from Stations to terminals; to direct passengers from Stations to parking garages; and within parking garages to direct passengers to the Pedestrian Walkways. Signage shall conform to LAWA Wayfinding standards.

H. Provide moving walkways in accordance with Part 2B, Section 24.

I. Collect stormwater and route into the existing or new storm drainage system or natural surface-level water courses. Such drainage provisions shall not be visible to the public and shall not point discharge onto any streets or roadways.

J. Not locate the utilities, drainage, and cabling on the exterior of columns or on the sides or underside of the superstructure visible to the public.

K. The minimum vertical clearance between top of roadways and bottom of Pedestrian Walkways shall be fifteen feet (15'0") minimum and in accordance with AHJ requirements.

L. Provide fire sprinklers internally beneath the ceiling and externally below the walkway.

M. Pedestrian Walkway dimensions:
   1) Provide a minimum 10'6" interior height clearance to structure, lighting and finished ceiling.
   2) Provide a minimum clear interior width of the Pedestrian Walkway structure shall be 26'0".
   3) Provide a maximum exterior width of 30'0".

N. Provide Automatic External Defibrillators (AED), readily accessible to the public, at no more than 500 foot intervals along the Pedestrian Walkways. (See Part 2B Section 17.)

O. Provide automatic sliding glass doors at Terminal Vertical Cores on the Pedestrian Walkways. The doors shall have automatic monitoring equipment that shall report status and alarm data to CCF. The doors shall maximize the opening area and shall be single track, narrow-stile sliding glass doors. Sliding doors must be enclosed in a pocket or become the rear enclosure of a window. All sliding door tracks are to be recessed with the top track mounted flush with the Pedestrian Walkway head and the bottom track flush with the finished floor. All glass must be tempered or safety glass capable of withstanding impacts from baggage carts. The Developer shall coordinate the doors with the Terminals and AHJ’s.

P. The Developer shall provide infrastructure to support the possible inclusion of sound, digital media and light installations for digital advertising along each Pedestrian Walkway. Such infrastructure shall include an interface with the APM
public address system such that emergency announcements override the audio; 120 volt, 20 amp dedicated circuits at 20 foot intervals to the nearest normal power panel(s); 2” conduit, fiber, empty 24 square j-box for possible fiber connection, consolidation points connected directly to the LAWA IT room for the head end data devices.

Q. The Developer shall provide infrastructure to support the possible inclusion of sound, digital media and light installations for art along each Pedestrian Walkway within the CTA. Such infrastructure shall include an interface with the APM public address system such that emergency announcements override the audio; 120 volt, 20 amp dedicated circuits at 20 foot intervals to the nearest normal power panel(s); 2” conduit, fiber, empty 24 square j-box for possible fiber connection, consolidation points connected directly to the LAWA IT room for the head end data devices.

R. Exposed spray on fire proofing shall not be visible to the public. Intumescent coatings, if used, shall have a smooth architectural finish.

4.3.2 Seismic Design

Seismic Performance Requirements: the Developer shall design for seismic performance of the Pedestrian Walkway elements as follows:

A. ASCE 7;
B. Risk Category III;
C. Occupancy Category III; and
D. Use mechanical, electrical and plumbing systems that have been seismically certified. Refer to http://www.oshpd.ca.gov/fdd/pre-approval/index.html.

4.3.3 Pedestrian Walkways to Terminal Vertical Cores and CTA Parking Garages

The approximate locations of Pedestrian Walkways within the CTA are described below. See Part 2A, Section 21.2 for descriptions of the interfaces and to Exhibit 10 to the Agreement for Interface obligations:

A. T0.5: Future Terminal Vertical Core and Pedestrian Walkway from parking garage P1 to Terminal Vertical Core installed by others. The Developer shall provide a Pedestrian Walkway from CTA East Station to northeast corner of parking garage P1. Developer to provide a structural support at the northeast corner of parking garage P1 for future Pedestrian Walkway installed by others.

B. T1.5: On the south side of World Way, the Pedestrian Walkway shall be parallel to the east face of P2A, with an approximate distance between P2A and the Pedestrian Walkway of 13’0”. The Terminal Vertical Core will be placed to support the Pedestrian Walkway continuing along that line, or up to a 30 degree angle to the east from that line.

C. T2.5: On the south side of World Way, the Pedestrian Walkway shall be parallel to the east face of P2B, with an approximate distance between P2B and the Pedestrian Walkway of 13’0”. The Terminal Vertical Core will be placed to support the Pedestrian Walkway continuing along that line, or up to a 30 degree angle to the west from that line.
D. **T3.0**: On the south side of World Way, the Pedestrian Walkway shall be parallel to the east face of P3, with an approximate distance between P3 and the Pedestrian Walkway of 13’0”. The Terminal Vertical Core will be placed to support the Pedestrian Walkway continuing along that line, or up to a 30 degree angle to the west from that line.

E. **TBIT**: The Pedestrian Walkway shall be perpendicular to the face of the CTA West Station. The Terminal Vertical Core supporting the Pedestrian Walkway will be centered at grid-line 49 of TBIT. The face of the Terminal Vertical Core will extend out approximately 29 feet from the existing face of TBIT.

F. **P4**: Parallel to the west side of P4, the Pedestrian Walkway shall connect the TBIT Pedestrian Walkway with Level 4 of P4. The Walkway shall an approximate distance between P4 of 10’3”.

G. **T4.5**: On the north side of World Way, the Pedestrian Walkway shall be parallel to the east face of P4, with an approximate distance between P4 and the Pedestrian Walkway of 13’0”. The Terminal Vertical Core will be placed to support the Pedestrian Walkway continuing along that line, or up to a 30 degree angle to the east from that line.

H. **T5.5**: On the north side of World Way, the Pedestrian Walkway shall be parallel to the east face of P6, with an approximate distance between P6 and the Pedestrian Walkway of 13’0”. The Terminal Vertical Core will be placed to support the Pedestrian Walkway continuing along that line, or up to a 30 degree angle to the west from that line.

I. **P7**: On the north side of World Way, the Pedestrian Walkway shall interface with, and may require replacement of, the existing pedestrian bridge from P7 to Terminal 8 and a rehabilitated/upgraded Garage Vertical Core.

### 4.3.4 Pedestrian Walkways to ITF Garages

A. **ITF West**: The Developer shall provide two (2) Pedestrian Walkways from the ITF West Station mezzanine to ITF West Garage Vertical Cores.

B. **ITF East**: The Developer shall design the mezzanine level with provisions to accommodate a future Pedestrian Walkway, to be installed by others.

### 4.4 Summary of Submittals

At a minimum, the Developer shall provide submittals as indicated in Part 2A, Section 6.
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5. PARKING GARAGES AND GARAGE VERTICAL CORES

5.1 General

5.1.1 Garage P2A, P2B and CTA West Station Parking Structure

Existing parking garages P2A and P2B shall be demolished and replaced with two new parking structures. To accommodate the construction of the CTA West Station and its related parking garage, existing at-grade parking, the existing access ramp to existing West Way and the existing exit plazas located between existing parking structures P3 and P4 shall be demolished and a new parking structure consisting of two elevated parking decks plus grade-level parking shall be constructed.

Entrance access for the new P2A garage shall be from World Way at the arrivals level. Entrance to the new P2B garage shall be from the relocated West Way at the departures level and from World Way at the arrivals level. Access to existing P5 from the departures level of West Way shall be demolished and re-established; access to P5 at the arrivals level shall be re-established from the relocated West Way via a new at-grade access driveway. Patrons using garages P2A and P2B shall exit via grade level exit plazas onto Center Way. Exiting for garage P5 shall remain as it currently exists through adjacent garage P6.

The Developer shall also coordinate with LAWA the relocation of the existing parking access and revenue control equipment located at existing garage P2B.

5.1.2 Garage Vertical Cores

Garage Vertical Cores shall be provided to convey pedestrians within the various levels of the parking garages to and from the Pedestrian Walkways connecting the Stations and Terminal Vertical Cores.

The Developer shall provide Garage Vertical Cores at these locations: P1, P2A, P2B, P3 (2), P4 and P6. These Garage Vertical Cores shall contain two elevators and one stair connecting all levels of the garages except for the Garage Vertical Core on the west side of P3, which shall contain one elevator and one stair. (Refer to Section 24.) The Garage Vertical Core located in P7 directly across World Way from T7 shall be rehabilitated and upgraded to meet building code requirements so that it can serve as egress for the new Pedestrian Walkway from the CTA East Station.

5.2 Standards and Specifications

The Developer shall comply with the requirements listed in Part 4, Standards and Specifications.

5.3 Performance Requirements

5.3.1 Garages P2A, P2B and CTA West Station Garage

A. Site Planning:

1) Parking garages P2A and P2B shall maintain a minimum distance of 10' from the APM Guideway Structure. The footprint of the structures and required distance to the APM Guideway Structure shall be coordinated. The CTA West Station garage shall be designed to incorporate the APM Guideway Structure columns penetrating the structure.

2) The parking garages shall have sufficient size and spacing of perimeter openings to classify as Open Parking Structures per the CBC. Construction
shall be Type II, Occupancy Group S-2 for parking structures as defined in the CBC. Garages shall be concrete.

3) The P2A and P2B parking garages shall have grade level parking plus five (5) elevated levels. The third level finished floor elevation of P2A shall match the elevation of upper World Way to allow for vehicular access. The third level finished floor elevation of P2B shall match the elevation of upper West Way to allow for vehicular access.

4) The CTA West Station garage shall have three (3) levels; grade plus two (2) elevated decks. In addition, both elevated decks shall connect with the finished floor elevations of existing garages P3 and P4 to allow for vehicular circulation between the three (3) structures.

B. Vehicular Access:

1) Two (2) entry lanes shall be provided at the following locations:
   a) Level 1 of P2A from World Way;
   b) Level 1 of P2B from World Way;
   c) Level 3 of P2B from West Way;
   d) Level 1 of P5 from West Way; and
   e) Level 3 of P5 from West Way.

2) There shall be no direct access from upper World Way to the West CTA Station garage; access shall be provided from parking garages P3 and P4. One (1) new entry lane shall be provided from lower West Way to existing parking structures P3 and P4.

3) Three (3) exit lanes shall be provided from P2A and P2B to Center Way at each exit plaza location.

4) All exiting from the CTA West Station garage and from existing parking garages P3 and P4 shall be at the lower level of relocated West Way. Four (4) exit lanes shall be provided at this location and shall be configured to accommodate the peak hour exiting volume without significantly impacting traffic flow within the garages.

C. Vehicle Space Requirements for Parking Garages:

   Table 5.3.1-1 Parking Garage Space Requirements

<table>
<thead>
<tr>
<th>Parking Garage P2A</th>
<th>Parking Garage P2B</th>
<th>CTA West Station Parking Garage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of Vehicle Spaces</td>
<td>775 Spaces</td>
<td>380 Spaces</td>
</tr>
<tr>
<td>Accessible Spaces (included in Total)</td>
<td>16 Spaces</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
D. Reconfigured parking garages P3 and P4 shall not be reduced by more than sixteen (16) spaces in P3 and fifteen (15) spaces in P4.

E. For all new parking garages:
   1) Provide electrical vehicle charging stations for 6% of parking spaces with infrastructure for expanding to 10%;
   2) Provide designated parking for clean air vehicles per AHJ requirements;
   3) Provide designated motorcycle parking, twenty (20) parking spaces; and
   4) Place AED’s and Blue Light Stations, as detailed in Part 2B, Section 17, at each garage level adjacent to vertical circulation.

F. Striping and Directional Arrows: provide white colored striping as required. The striping shall denote parking spaces, protected pedestrian zones, and accessible parking spaces. Directional arrows shall identify direction of travel.

G. Security:
   1) The facility shall be designed to provide an optimum level of lighting at night and clear sight lines that promote the perception and reality of safety and security.
   2) Visibility from surrounding areas, walks, streets, etc. shall be provided to the maximum extent possible. Stairs shall be developed to be as open as possible, and shall be well lit.
   3) The facility security requirements are addressed in Part 2A, Section 8.
   4) Blue Light Emergency Phones shall be provided in every pedestrian vertical core and stair tower; one on every floor. (See Part 2B, Section 17).
   5) All light fixtures, plumbing items, signs and other equipment shall be installed in a manner that deters vandalism and theft.

H. Building materials and finishes shall be chosen for durability and ease of maintenance. Graffiti resistant materials or treatments shall be used on all vertical surfaces for Non-O&M Facilities. The extent of graffiti resistant materials or treatments for O&M facilities shall be at the discretion of the Developer.

5.3.2 General – Wayfinding Signage

The Developer shall provide wayfinding signage for parking garages P1, P2A, P2B, P3, CTA West Station parking garage, P4, P6 and P7:

A. Wayfinding signage directing parkers to Garage Vertical Cores connected to Pedestrian Walkways shall be provided for all garage floors for the safe and secure flow of pedestrians. Signage shall be illuminated and follow LAWA signage standards.

B. The main destination of parkers is toward Garage Vertical Cores, connecting pedestrians to the Pedestrian Walkways which, in turn, connect the Parking garages to the APM Stations and to the Terminal Vertical Cores. The Developer shall provide primary wayfinding signage directing pedestrians to these cores and identifying the terminals served.
C. Signage illumination shall be designed based on industry standards, shall be a uniform light level across the entire sign face, and shall use LED fixtures. Refer to Part 2B, Section 23 for additional lighting requirements.

5.3.3 General - Garage Vertical Cores

Architectural Design Requirements: The vertical cores at new and existing garages shall include two multi-stop elevators and a stairway. Elevators shall be sized to accommodate up to four (4) passengers with baggage carts per trip per elevator, and meet accessibility requirements. The core envelope and fenestration design shall promote a high degree of openness for visual security and natural ventilation. The landing areas of the vertical cores shall be integrated to the surrounding streetscape and connected to existing sidewalks or walkways where available.

A. Aesthetics: The vertical cores architectural character shall be consistent with the design of the APM Stations.

B. Safety and Security: The interior public area shall be visually open fenestration with nighttime illumination and clear sight lines that promote safety and security. Safety and security shall be further enhanced by providing:
   1) CCTV cameras with recording capabilities as detailed in Part 2B, Section 17;
   2) Landscaping that does not block CCTV cameras and does not provide areas of concealment;
   3) Elevators with glass and glazing to allow clear sight line to deter crime, and;
   4) Ease of access to and egress from the Garage Vertical Cores.

C. Core Interiors:
   1) Finish materials for interior walls shall be corrosion and vandal resistant and shall be easy to clean;
   2) Ceiling Systems: Ceiling systems shall include acoustical panels;
   3) Flooring: Finish flooring materials for public areas shall meet the following minimum requirements:
      a) Slip and chemical resistant; and
      b) Dimensional stability to minimize cracking.

5.3.4 Parking Access and Revenue Control System

LAWA anticipates installing a new Parking Access and Revenue Control System (PARCS) in all CTA parking garages including those constructed by the Developer. The Developer shall coordinate its activities for the construction of parking garages P2A, P2B and the CTA West Station parking garage with PARCS design builder to be procured separately by LAWA. The Developer shall coordinate and construct portions of the PARCS system in these structures as outlined in Exhibit 10 to the Agreement.

5.4 Summary of Submittals

At a minimum, the Developer shall provide submittals as indicated in Part 2A, Section 6.
6. SITE CIVIL WORK

The Site civil work is comprised of clearing and grubbing, removal of construction debris and surface roadway improvements within the D&C Limits. The work area includes at-grade pedestrian access, grade-level station plazas at the ITFs, site development for the Maintenance and Storage Facility (M&SF) and the Traction Power Substations (TPSS), and other locations within the D&C Limits.

Existing Site features not impacted by the construction within the D&C Limits shall be protected in place or the construction impact minimized to the maximum extent practicable. If any existing site feature is impacted by the construction activities, the Developer shall be responsible for restoring such feature to its pre-construction state.

The Developer shall design and construct all site civil work in accordance with the requirements set forth in the Contract Documents.

6.1 General

6.2 Standards and Specifications

The Developer shall comply with the requirements listed in Part 4, Standards and Specifications.

6.3 Performance Requirements

6.3.1 Site Preparation

The Developer shall prepare and submit a demolition plan in accordance with the requirements of the AHJ. Site preparation includes, but is not limited to:

A. Clearing and grubbing;
B. Removal of curbs and sidewalks,
C. Removal of pavement and pavement markings;
D. Removal of vegetation and landscaping;
E. Removal of objects and obstructions;
F. Removal of abandoned utilities;
G. Removal of mechanical and electrical equipment; and
H. Removal of all miscellaneous materials.

Any damages, whether inadvertent or not, caused by the Developer's actions shall be repaired by the Developer at no expense to LAWA and / or adjacent property owners.

Any removal of survey monuments and markers shall be limited to those set by the project and/or other temporary construction benchmarks. Survey monuments, centerline ties and all other permanent survey markers shall not be removed; unless, however, such monuments are specifically noted to be removed on a mapping plan, signed by a licensed surveyor, relocating such marker. All other survey markers encountered during construction and removal shall be protected in place. If a survey marker is damaged during construction, such marker shall be reset by a licensed surveyor in accordance with the requirements of AHJ.
6.3.2 Items to Remain and Protect In Place

A. Objects, surfaces, and underground utilities to remain shall be carefully avoided and left undisturbed. Any damage to these items shall be immediately corrected by the Developer to the satisfaction of the AHJ.

B. All active services shall be maintained throughout the duration of construction except for those systems being proposed by the Developer for disconnection, removal, abandonment, or modification. The Developer shall, through his own site investigation prior to the design process, be responsible for removal of all conflicting items identified or implied in the Developer’s design throughout the D&C Limits.

C. Structures and associated items to be protected in place include, but are not limited to, the following:

1) DWP industrial stations between parking structure P2A and P2B;
2) Central Utility Plant (CUP);
3) CUP ventilation towers on World Way and Center Way;
4) 5th feeder (5th LADWP power feed to the CTA);
5) Air Traffic Control Tower (ATCT);
6) Theme Building and associated landscaping;
7) Clifton A. Moore Administration; and
8) The Air Traffic Control Tower co-located with the existing Clifton A. Moore Administration Building.
9) FAA fiber under parking garage 2A.

Refer to the Final Environmental Impact Report (FEIR) and D&C Limits for other structures not listed above that are to be protected in place.

6.3.3 Construction Waste Disposal

All materials and debris which are to be discarded shall be disposed of by the Developer in accordance with requirements of the AHJ. The Developer shall also refer to Part 2A Section 7 for environmental compliance, remediation and disposal requirements.

6.3.4 Existing Facilities Demolition and Dust Control

The Developer shall perform a Phase I and Phase II Assessment of any existing facilities prior to demolition. If found to contain asbestos or other Hazardous Materials, Developer shall subsequently develop the required Phase III Remediation Plan for review and approval by the AHJ.

The Developer shall schedule and administer meetings among stakeholders or other Authorities Having Jurisdiction (AHJ) affected by the work prior to any demolition activities. Demolition work shall not start unless authorized in writing by the AHJ.

The Developer is advised that dust control is the Developer’s sole responsibility and is of the utmost importance in the safe operation of the airport. Airborne dust and Foreign Object Debris (FOD) can cause hazards to operating jet aircraft in addition to passengers and pedestrians. Adequate use of water trucks or other methods of dust control shall be utilized at all times.
6.3.5 Site Improvements

The Developer shall provide the following site improvements:

A. Sidewalks and landings as shown or described in the Contract Documents.
C. Driveways, sidewalks, fire access lanes, fire hydrants, site signage, parking, landscaping, and security fencing designed and constructed in accordance with the requirements of the AHJ. The M&SF shall be accessed from New "D" Street on the east side of the parcel and shall be at least one (1) lane in each direction, with a minimum width of 10 feet for each lane.
D. Exterior Site Lighting: Lighting shall not be directed skyward or in a manner that interferes with the safe operation of aircraft.
E. Transformer and maintenance pads shall be grounded in accordance with the requirements of the AHJ.
F. Earthwork includes, but is not limited to, excavation, disposal of excess or unsuitable excavated materials, fill, backfill and borrow materials, preparation of subgrade for foundation of structures, placement of materials in backfills and embankments, compaction, protection of excavated and backfilled areas and embankments, water control, tolerances, testing, and acceptance in accordance with the requirements of the AHJ.

6.3.6 ITF West Circulation Site Design Requirements

The Developer shall configure the roadways, driveways, intersections, and short-term parking for ITF West circulation site per the requirements of this Section. The Developer shall also provide a new driveway between 96th Street and 98th Street. The Developer's design shall not preclude the future installation of large-scale, site specific ground level artwork or sculpture and shall include light installation infrastructure at ground level to support such artwork.

ITF West circulation site design shall:

A. Maximize the total length of curb frontage subject to minimum requirements in Table 6-1;
B. Two-lane wide curb areas shall be permitted for private vehicle drop off only;
C. Provide exclusive and physically separate curb fronts for private vehicle and commercial vehicle areas;
D. Provide the appropriate traffic controls at all at-grade crossings;
E. Provide wayfinding signage;
F. Minimum curb frontage depths shall be twelve (12) feet;
G. The geometry of all roadways and driving aisles shall be designed to accommodate a BUS-40 design vehicle;
H. Provide lighting for all roadways, driveways, parking areas, and pedestrian walkways within ITF West circulation site per the following:
   1) Sidewalks, pick-up/drop-off curb fronts, and the plaza under the station:
      a) Average illumination level of 2.5 Foot-candles;
b) Minimum horizontal illuminance level of 1.0 Foot-candles; and  
c) Uniformity ratio of 3:1 or better.

2) Roadways, driveways, commercial vehicle staging parking, and meet-and-greet parking:
   a) Average illumination level of 2.0 Foot-candles;
   b) Minimum horizontal illuminance level of 0.5 Foot-candles; and
   c) Uniformity ratio of 3:1 or better.

6.3.7 ITF East Circulation Site Design Requirements

The Developer shall configure the roadways, driveways, intersections, and short-term parking for ITF East circulation site per the requirements of this Section. The Developer's design shall not preclude the future installation of large-scale, site specific ground level artwork or sculpture and shall include light installation infrastructure at ground level to support such artwork.

ITF East circulation site design shall:

A. Maximize the total length of curb frontage subject to minimum requirements in Table 6-1;

B. Provide exclusive and physically separate curb fronts for commercial vehicles, with independent entrances/exits to and from Aviation Boulevard and Concourse Way. The design of the commercial vehicle curb front and pedestrian access to the ITF East Station shall be coordinated with the private vehicle curb front south of the station designed and constructed by others;

C. Maintain connectivity between both Aviation Boulevard and Concourse Way per the following:
   1) Provide right turn entrances/exits to and from Aviation Boulevard only. No left turn entrances/exits along Aviation Boulevard are allowed. Exit movements shall be stop controlled; and
   2) Provide full access entrances/exits along Concourse Way. Exit movements shall be stop controlled.

D. Provide the appropriate traffic controls at all at-grade crossings;

E. Provide wayfinding signage;

F. The minimum curb frontage depth shall be twelve (12) feet;

G. The geometry of all roadways and driving aisles shall be designed to accommodate a BUS-40 design vehicle;

H. Provide commercial vehicle parking spaces within ITF East circulation site to accommodate vehicles of 35 feet and 50 feet in length subject to the requirements in Table 6-1;

I. Lighting shall be provided for all roadways, driveways, parking areas, and pedestrian walkways within ITF East circulation site per the following:
   1) Sidewalks, pick-up/drop-off curb fronts, and the plaza under the station:
      a) Average illumination level of 2.5 Foot-candles;
      b) Minimum horizontal illuminance level of 1.0 Foot-candles; and
c) Uniformity ratio of 3:1 or better.

2) Roadways, driveways, commercial vehicle staging parking, and meet-and-greet parking:
   a) Average illumination level of 2.0 Foot-candles;
   b) Minimum horizontal illuminance level of 0.5 Foot-candles; and
   c) Uniformity ratio of 3:1 or better.

6.4 Summary of Submittals

At a minimum, the Developer shall provide submittals as indicated in Part 2A, Section 6.
<table>
<thead>
<tr>
<th>Mode</th>
<th>Vehicle Length (ft.)</th>
<th>Minimum Accommodations</th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ITF West</td>
<td>ITF East</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Peak Hour Vehicle</td>
<td># of Stalls</td>
<td>Curb Length</td>
<td>Peak Hour Vehicle</td>
<td># of Stalls</td>
<td>Curb Length</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Volume (ft.)</td>
<td></td>
<td>(ft.)</td>
<td>Volume (ft.)</td>
<td></td>
<td>(ft.)</td>
</tr>
<tr>
<td>Private Vehicle - Pick up¹</td>
<td>25</td>
<td>52</td>
<td>34</td>
<td>---</td>
<td>52</td>
<td>34</td>
<td>---</td>
</tr>
<tr>
<td>Private Vehicle - Drop off¹</td>
<td>25</td>
<td>117</td>
<td>---</td>
<td>125</td>
<td>117</td>
<td>---</td>
<td>125</td>
</tr>
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<td>LAWA Surface Lots (Busses) - Combined Pick up/Drop off</td>
<td>50</td>
<td>10</td>
<td>---</td>
<td>200</td>
<td>9</td>
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<td>200</td>
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<tr>
<td>Off-Airport Private Parking (Shuttles) - Combined Pick up/Drop off</td>
<td>35</td>
<td>75</td>
<td>---</td>
<td>245</td>
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<tr>
<td>Charter Van - Combined Pick up/Drop off</td>
<td>35</td>
<td>129</td>
<td>---</td>
<td>210</td>
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<td>210</td>
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<tr>
<td>Taxi - Pick up ²</td>
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<td>41</td>
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<td>Taxi - Drop off</td>
<td>25</td>
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<td>---</td>
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<td>4</td>
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<td>Paid Ride - Pick up</td>
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<td>175</td>
<td>235</td>
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<td>175</td>
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<td>Paid Ride - Drop off</td>
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<td>---</td>
<td>325</td>
<td>402</td>
<td>---</td>
<td>325</td>
</tr>
<tr>
<td>Limo/Town Car - Pick up</td>
<td>30</td>
<td>116</td>
<td>---</td>
<td>150</td>
<td>116</td>
<td>---</td>
<td>150</td>
</tr>
<tr>
<td>Limo/Town Car - Drop off</td>
<td>30</td>
<td>80</td>
<td>---</td>
<td>120</td>
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<td>---</td>
<td>120</td>
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<tr>
<td>Shared Ride Van - Combined Pick up/Drop off</td>
<td>35</td>
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<td>---</td>
<td>---</td>
<td>53</td>
<td>---</td>
<td>490</td>
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<tr>
<td>Hotel Shuttle - Combined Pick up/Drop off</td>
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<td>204</td>
<td>---</td>
<td>560</td>
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<tr>
<td>Flyaway Bus - Pick up</td>
<td>50</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>4</td>
<td>---</td>
<td>100</td>
</tr>
<tr>
<td>Charter Bus - Pick up</td>
<td>50</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>3</td>
<td>---</td>
<td>100</td>
</tr>
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<td>Private Vehicle Total</td>
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<td></td>
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<tr>
<td>Commercial Vehicle Total - Pick up</td>
<td>169</td>
<td>34</td>
<td>125</td>
<td>169</td>
<td>34</td>
<td>125</td>
<td></td>
</tr>
</tbody>
</table>

¹ Provided by others south of the ITF East Station.

² Assumed to be a maximum of four (4) taxicabs queued along the curbside of both ITF West and ITF East. Taxicabs will be available for pick-up similar to current conditions along the existing LAX terminal curbs where taxis are dispatched from their holding lot to accommodate passenger demand as required.
<table>
<thead>
<tr>
<th>Mode</th>
<th>Vehicle Length (ft.)</th>
<th>ITF West</th>
<th>ITF East</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Peak Hour Vehicle Volume</td>
<td># of Stalls</td>
</tr>
<tr>
<td>Commercial Vehicle Total - Drop off</td>
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<td>486</td>
<td>---</td>
</tr>
<tr>
<td>Commercial Vehicle Total - Combined Pick up/Drop off</td>
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<td>418</td>
<td>---</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td></td>
<td>1,465</td>
<td>34</td>
</tr>
</tbody>
</table>

**TABLE 6-1 (continued)**
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7. STREETS AND ROADWAYS

7.1 General

To accommodate Project construction, the Developer shall reconfigure roadways as required by the Contract Documents. The work includes design, permitting and regulatory approval, and modification and reconstruction of existing streets and roadways and construction of new roadways included in the Work.

The Street and Roadway scope includes, but is not limited to: subgrade, paving, signing and striping; curbs, gutters and medians; curb ramps and curb cuts; sidewalks; driveways; on street parking; bus pads and loading zones; streetlights; traffic signs and striping; traffic signals and signal communications and surveillance; noise barriers, settlement and vibration mitigation as required.

All roadway work shall be performed within the existing or proposed City of Los Angeles Rights of Way (ROWs), within Los Angeles World Airports (LAWA) ROW or CALTRANS ROW.

The following streets are included in the Work and are shown in Part 5, Contract Drawings / Engineering Data:

A. Upper and Lower West Way shall be reconstructed adjacent to the West CTA Station garage. Upper West Way shall be a two (2) lane southbound-only roadway with an additional drop off lane located on the west side and an additional lane on the east side for ingress into parking garage P2B. Lower West Way shall be a two lane southbound only roadway with parking on the east side. In addition, the Developer shall provide for access to existing garage P5 at Upper and Lower West Way.

B. Center Way shall be partially reconstructed from relocated West Way to west of East Way and shall be reconstructed from east of East Way to east of Sky Way.

C. A new street called A Street shall be constructed from Century Boulevard to north of 96th Street with at-grade intersections at Century Boulevard, 98th Street and 96th Street.

D. A new street called D Street shall be constructed from 96th Street to the south side of Arbor Vitae Street.

E. 96th Street shall be reconstructed from Bellanca Avenue to east side of Airport Boulevard and from the west side of the Airport Boulevard to A Street. Provide a bus stop for public transit proximate to ITF West Station. Coordinate with LA Metro for the final location and length.

F. Aviation Boulevard shall be reconstructed and widened to six lanes from north of 98th Street to the south side of Arbor Vitae Street. Aviation Boulevard shall provide access to ITF East on the east side.

G. Century Boulevard shall be widened on the south side, including eastbound dual left turn lanes to A Street, from east of Sepulveda Boulevard to west of Avion Drive.

H. Alley between Arbor Vitae Street and 93rd Street west of the M&SF facility including a new t-shaped turnaround on 93rd Street, shall be reconstructed;

I. New connector roadway (ITF East Driveway) shall be constructed between Aviation Boulevard and Concourse Way north of ITF East.
7.2 Standards and Specifications
The Developer shall comply with the requirements listed in Part 4, Standards and Specifications.

7.3 Performance Requirements

7.3.1 Functional Requirements
The Developer shall provide all street and roadway elements in accordance with, at a minimum, the following functional requirements:

A. Meet or exceed the lane configurations and street classifications shown in the typical sections and roadway layouts in Part 5, Contract Drawings / Engineering Data;

B. Maintain ingress and egress to all private properties;

C. Accommodate for bus services;

D. Provide pedestrian and bicycle facilities, meeting or exceeding the widths shown in the typical sections and City of Los Angeles Mobility Plan; and

E. All elements shall be provided in accordance with the requirements of the Authority Having Jurisdiction. (AHJ). LAWA owned streets and roadways are private and will be owned and maintained by LAWA after Construction. LAWA owned streets and roadways shall be designed to City of Los Angeles Bureau of Engineering Standards, and include: all roadways within the CTA, A Street from Century Boulevard to just north of 96th Street, 96th Street from A Street to just west of Airport Boulevard including the ITF West circulation site roadways, D Street and the ITF East circulation site roadways and B Street from A Street to Airport Boulevard. Table 7-1 contains Roadway Design Data for the streets described in section 7.1.
### TABLE 7.3.1-1: ROADWAY DESIGN DATA

<table>
<thead>
<tr>
<th>Road Name</th>
<th>Begin</th>
<th>End</th>
<th>Condition</th>
<th>Street Classification</th>
<th>Operation Speed</th>
<th>No. of Lanes In Each Direction</th>
<th>Median</th>
<th>Parking Yes or No</th>
<th>Ped Park-Way/Sidewalk Width (Ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New ’A’ Street</td>
<td>96th Street</td>
<td>North of 96th Street</td>
<td>New</td>
<td>Boulevard II</td>
<td>35 mph</td>
<td>2</td>
<td>Yes</td>
<td>No</td>
<td>15</td>
</tr>
<tr>
<td>New ‘A” Street</td>
<td>Century Blvd</td>
<td>96th Street</td>
<td>New</td>
<td>Boulevard II</td>
<td>35 mph</td>
<td>2</td>
<td>Yes</td>
<td>No</td>
<td>13</td>
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<tr>
<td>New ’D’ Street</td>
<td>96th Street</td>
<td>Arbor Vitae St</td>
<td>New</td>
<td>Industrial Collector</td>
<td>25 mph</td>
<td>1</td>
<td>No</td>
<td>Yes</td>
<td>13/10</td>
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<tr>
<td>Aviation Boulevard</td>
<td>98th Street</td>
<td>Arbor Vitae St</td>
<td>Widening</td>
<td>Boulevard II</td>
<td>35 mph</td>
<td>3</td>
<td>Yes</td>
<td>No</td>
<td>12/12</td>
</tr>
<tr>
<td>96th Street</td>
<td>Airport Blvd</td>
<td>400’ East of Airport Blvd</td>
<td>Widening</td>
<td>Avenue III</td>
<td>25 mph</td>
<td>1</td>
<td>No</td>
<td>Yes</td>
<td>13/10</td>
</tr>
<tr>
<td>96th Street</td>
<td>400’ East of Airport Blvd</td>
<td>New ’D” Street</td>
<td>Widening</td>
<td>Avenue III</td>
<td>25 mph</td>
<td>1</td>
<td>No</td>
<td>Yes</td>
<td>13/13</td>
</tr>
<tr>
<td>96th Street</td>
<td>New ’D” Street</td>
<td>Bellanca Ave</td>
<td>Reconstructed</td>
<td>Industrial Collector</td>
<td>25 mph</td>
<td>1</td>
<td>No</td>
<td>Yes</td>
<td>20/10</td>
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<tr>
<td>West Way</td>
<td>World Way North</td>
<td>World Way South</td>
<td>Relocated</td>
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<td>2*</td>
<td>N/A</td>
<td>No</td>
<td>***</td>
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<tr>
<td>Center Way</td>
<td>West Way</td>
<td>World Way South</td>
<td>Reconstructed</td>
<td>N/A</td>
<td>20 mph</td>
<td>3**</td>
<td>N/A</td>
<td>No</td>
<td>***</td>
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<tr>
<td>Century Blvd</td>
<td>Sepulveda Ramp</td>
<td>Avion Dr.</td>
<td>Widening</td>
<td>Boulevard I</td>
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<td>New</td>
<td>N/A</td>
<td>15 mph</td>
<td>Varies</td>
<td>No</td>
<td>Varies</td>
<td>Varies</td>
</tr>
</tbody>
</table>

Notes:
- * One-way southbound
- ** One-way eastbound
- *** Provide sidewalk on west side/east side
7.3.2 Design Requirements

A. Roadway Geometry: The Developer shall design and construct all roadway geometric elements in accordance with AHJ requirements. The Developer shall conform to B-Permit requirements and obtain voluntary B-Permit approval for the design of private streets outside of the CTA.

B. Roadway Alignments shall be designed for the City of Los Angeles functional classifications and design speeds specified in Table 7-1 – Roadway Design Data.

C. For any roadway functional classification and design speeds not specified in Table 7-1, the Developer shall determine the required functional classification, posted speed and design speed and submit the Proposed Roadway Design Data for Review and Comment.

D. The Developer shall provide clear zones and horizontal clearances to obstructions in accordance with AHJ requirements. Bridge abutments, falsework or associated non-traversable slopes or piers, excluding median piers shall be located outside the clear zone. Where Project ROW is not sufficient to allow use of clear zones, protection shall be in accordance with AHJ requirements. The Developer shall provide vertical clearances in accordance with the requirements of the AHJ of the facility being crossed, whichever is more restrictive.

E. Typical Sections: Typical sections of each street are shown in Part 5, Contract Drawings / Engineering Data.

F. Resurfacing: The Developer may match existing cross slopes when resurfacing (or milling and resurfacing) existing roadways that are not reconstructed provided there are no existing drainage or safety issues and the cross slope is a minimum of 1.5 percent or meet requirements of the AHJ.

G. Modification to existing streets: The Developer shall identify the necessary limits of Work on roadways and street to meet the requirements of the Project. The localized limits of the Work shall conform to the following:

1) Widening or reconstruction of any portion of a roadway shall require that the entire roadway width be, at a minimum, resurfaced within the longitudinal limits of the widening or reconstruction.

2) The Developer shall resurface the entire width of roadway after any portion of the roadway has been subject to eradication of permanent or temporary pavement markings for a longitudinal distance of ten (10) feet beyond the last eradicated marking.

7.3.3 Signing and Striping

The existing striping on streets to be altered, or altered due to construction of the Project, shall be removed by sandblasting or grinding.

The Developer shall comply with the signing and striping standards as set forth and approved by the AHJ prior to commencement of any signing and striping work.

The Developer shall work with the AHJ to review the existing signs, proposed replacements and additional signs required along the route alignment. The Developer shall prepare a signing package for each intersection along the route alignment, and obtain approvals from the AHJ before installing signs.

Signs, striping, signals and safety plans shall be reviewed and approved by the AHJ.
7.3.4 Additional Requirements

The Developer shall meet the following additional requirements:

A. Removal of Existing Pavement: Where striping is removed from existing asphalt pavement, the Developer shall treat the existing asphalt with a fog seal coat after complete removal of the striping.

B. Bike Lanes and Sidewalks: The Work includes design and construction of bike lanes, sidewalks, sidewalk connections, driveway aprons and approaches, alley intersections, and curb ramps along applicable roadways.

C. Sidewalk and driveway approach interfaces shall be graded to conform to adjacent private property facilities at Project ROW. Reconstruction of adjacent land owner property may be required. The Developer is responsible to determine if additional permanent or temporary ROW is needed in order to meet applicable code requirements.

D. The Developer is responsible to design and accommodate for all currently planned future connections to bike lanes and sidewalks.

E. If there is no existing sidewalk at affected intersections, provide curb ramps at that intersection to comply with ADA requirements.

F. Street Lighting: All new street light poles are to match style and type of the local jurisdictional requirements outside of the CTA, the Developer shall work with the Los Angeles Bureau of Street Lighting to review the existing lighting levels along the route alignment, and determine which lights shall require replacement or relocation and where new lights need to be added.

G. New continuous street lighting shall be provided within the CTA for all roadways being reconstructed, modified, or newly constructed. All lower level roadway lighting shall conform the City of Los Angeles requirements. The Iconic Light Pole Lighting currently along upper World Way shall be continued along the relocated upper West Way. The manufacturer of these light poles is Penwal and the following is a partial parts list:
   1) Light Standard Fixture Type 2F.1 (long arm)
   2) Light Standard Fixture Type 2F.2 (short arm)
   3) Light Standard Fixture Type 2F.3 (Upright pole)

H. The light band that currently wraps around Upper World Way shall not be continued along relocated West Way.

I. Street lighting shall illuminate all crosswalks.

J. Bus Stops: The Developer shall submit Bus Stop Relocation Plans (both temporary and permanent) to the AHJ for approval.
   1) All new or modified bus pads shall be concrete; and
   2) Security lighting is required at bus pad areas.

K. Drainage: Roadway drainage shall be in accordance with AHJ.

L. Traffic Control: (Refer to Part 2A, Section 16)

M. Roadway Pavement: Design and construction of the roadway pavement structural section shall meet requirements of AHJ. The Developer shall provide an analysis
of the TI value to be approved by the AHJ for all new or modified roadway pavement. The Developer shall use a minimum TI value of twelve (12) in areas the AHJ does not require an analysis.

N. Concrete curbs, gutters, walks, and equipment pads, including the requirements for materials, installation, tolerances, testing, and acceptance criteria shall conform to the requirements of the AHJ.

O. Detailed specifications for concrete materials, appurtenances and construction for the Project to be provided by the Developer shall be based on accepted Industry practices and standards, to achieve the required performance, durability, appearance and finish of the concrete structures and components, and to achieve performance goals and service life of the structures under the expected in-place conditions of service.

P. Curb Ramps: Curb ramps shall be provided at all corners of intersections affected by new construction. All curb ramps shall include truncated dome tactile warning strips and have detectable warning surface strips that extend the full length and width of the ramp. The Developer shall ensure that there are no pull boxes or access items (e.g., electrical, signal, water, etc.) within ramp areas. If new ramps are required on the nearside of an intersection and the ramps on the opposite corners do not meet current AHJ standards, the Developer shall be responsible for the replacement or modification of such non-compliant ramps.

Q. Parking Lot Pavement: The Developer shall be responsible for the design and construction of the paving of parking facilities. New pavement shall be based on recommendation from the Developer’s Geotechnical Engineer, shall match existing pavements and shall meet current standards of the AHJ. The Developer shall obtain design approval for pavements from AHJ. Rubberized asphalt shall be prohibited.

R. Driveways: All driveways affected by construction shall be restored to their previous condition, or to the current standards of the AHJ.

S. Curb return radii shall be constructed/modified as required by the AHJ.

T. Future Roadway Plans: Developer shall provide designs compatible with other projects within the overall Landside Access Modernization Program (LAMP). Developer shall not preclude the future roadway plans in anyway, to include the placement of columns, foundations, utilities, retaining walls, drainage, limiting roadway vertical and horizontal design clearances, and future constructability. Developer shall provide adequate designs of the Project and future roadways showing the two designs are compatible.

7.4 Summary of Submittals
At a minimum, the Developer shall provide submittals as indicated in Part 2A, Section 6.
8. DRAINAGE

8.1 General
The Developer shall design, furnish and install storm drain collection systems capable of accommodating the site drainage and area runoff and also provide connections to existing storm drainage facilities. Surface runoff calculations shall follow Los Angeles County Hydrology Manual requirements and methodologies. Street and pipe hydraulic design shall comply with City of Los Angeles or Authority Having Jurisdiction (AHJ) design criteria and requirements, depending on the facilities' ownership.

8.2 Standards and Specifications
The Developer shall comply with the requirements listed in Part 4, Standards and Specifications.

8.3 Performance Requirements

8.3.1 Drainage Systems and Design
A. The Developer shall ensure that the proposed drainage design conforms to the existing drainage pattern. If any downstream receiving drainage system is found to be deficient, the Developer shall limit the site discharge per the requirements of the AHJ such that the existing downstream drainage condition cannot be worsened by increased quantity, velocity or duration of proposed flows.

B. All new drainage systems around all Fixed Facilities and parking lots shall be designed, furnished and installed by the Developer. Site runoff shall drain to the nearest street, or be intercepted and conveyed to the nearest public storm drain system. Roof and surface runoff shall be drained away from the proposed facilities, collected and intercepted per the requirements of the AHJ.

C. All water requiring treatment within the CTA shall be routed to the Hyperion Treatment Plant in accordance with the Memorandum of Understanding (MOU) between LAWA and the City of Los Angeles. For facilities outside of the CTA, east of Sepulveda Blvd, stormwater treatment and any other additional drainage are subject to this Section.

D. All Guideway drainage, including the portion within Station areas, shall be designed, furnished and installed by the Developer. Elevated Platform surfaces shall include the installation of grate inlets conforming to ADA requirements to intercept any surface flow. As sump conditions may occur on the Guideway Structure deck, drainage provisions within the Guideway shall comply with either Los Angeles County Capital Flood Protection fifty (50) year design policy or the design precipitation requirements described in Part 2B, Section 11.3.4.8, whichever results in the greater runoff quantity. The proposed drainage system on the Guideway Structure shall be of sufficient size and capacity to ensure APM Operating System operations, as well as drain the Platforms and Station canopies as required.

E. The Station canopy and Guideway drains shall eventually discharge the flow into a collector system. All flows from the collector system shall be treated before discharging into the receiving downstream public storm drain system.

F. Crossfall shall be provided for the APM Guideway. Sufficient drainage inlets shall be provided to drain efficiently the Guideway of stormwater and effectively...
eliminate standing water. See Part 2B, Sections; 11.3.4.8, and 11.3.11.7 for additional requirements.

8.3.2 Design Requirements

A. The Developer shall design all drainage facilities in accordance with the requirements of the AHJ.

B. Stormwater Quality: Stormwater shall be treated using Best Management Practices (BMPs) in accordance with the requirements of the AHJ.

C. Drainage facilities shall be provided to prevent water from dripping or running onto conductors, overtopping surfaces and Guideway equipment, and accumulation of freestanding or water.

8.4 Summary of Submittals

At a minimum, the Developer shall provide submittals as indicated in Part 2A, Section 6.
9. **EROSION CONTROL**

9.1 **General**

The Developer shall implement temporary and permanent erosion control measures during the Term to control water pollution, soil erosion, and siltation in accordance with the requirements of the AHJ.

The Developer shall develop a Temporary Erosion and Sediment Control (TESC) Plan in accordance with the AHJ and shall implement such measures during the D&C Period.

The Developer shall provide a Stormwater Pollution Prevention Plan (SWPPP) in accordance with the requirements of the AHJ and shall implement SWPP measures in accordance with the plan.

9.2 **Standards and Specifications**

The Developer shall comply with the requirements listed in Part 4, Standards and Specifications.

9.3 **Performance Requirements**

The Developer shall incorporate all permanent erosion control features into the Project as required by AHJ. Temporary erosion and pollution control measures as outlined in the Temporary erosion and Sediment Control plan shall be used to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion during normal construction practices, but which are not associated with permanent control features on the Project.

9.4 **Summary of Submittals**

At a minimum, the Developer shall provide submittals as indicated in Part 2A, Section 6.
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10. TRAFFIC SIGNALS

10.1 General
The work specified in this Section consists of:

A. Removal and modification of existing traffic signal facilities;
B. Installation of temporary traffic signal facilities;
C. New and/or modification of existing Automated Traffic Surveillance and Control System (ATSAC) for works within the City of Los Angeles; and
D. Furnishing and installing new traffic signal facilities.

10.2 Standards and Specifications
The Developer shall comply with the requirements listed in Part 4, Standards and Specifications.

10.3 Performance Requirements

10.3.1 Functional Requirements

A. The traffic control field equipment shall control traffic using fixed time or actuated timing as specified by the design, and under central control where specified. The Developer shall provide vehicular signals which use standard red-yellow-green indications. Design and operation shall be in conformance with the MUTCD and CA MUTCD to optimize efficiency and safety.

B. The traffic control field equipment shall include wiring for emergency vehicle preemption (EVP).

C. The traffic control field equipment shall include a local interface that provides operational status to field personnel of fault data for connected field equipment.

D. The traffic control field equipment shall include a local interface that allows field personnel to conduct diagnostic tests on connected field equipment.

E. The traffic control field equipment design shall address requirements of the Americans with Disability Act Accessibility Guidelines (ADAAG).

F. The Developer shall provide pedestrian signals and push buttons for all pedestrian crossings.

G. As specified by the design, the traffic control field equipment shall include Traffic Signal Coordination (TSC) that allows the signal to be sequenced and timed with adjacent signals to provide progressive traffic movement.

H. The Developer shall provide capability to remotely monitor and control traffic signal controllers.

I. The Developer shall implement control plans to coordinate signalized intersections, based on data received from sensors and from surveillance which monitors traffic conditions, incidents, emergency vehicle preemptions, transit signal priority, the passage of commercial vehicles with unusual loads, equipment faults, pedestrian crossings, etc.
TABLE 10-1: INTERSECTION SIGNAL IMPROVEMENT SUMMARY

<table>
<thead>
<tr>
<th>ID</th>
<th>Location/Intersection</th>
<th>Work</th>
<th>Approval Jurisdiction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Existing West Way and Center Way</td>
<td>Removal</td>
<td>LAWA</td>
</tr>
<tr>
<td>2</td>
<td>New West Way and Center Way</td>
<td>New</td>
<td>LAWA</td>
</tr>
<tr>
<td>3</td>
<td>Existing World Way and West Way Upper</td>
<td>Removal</td>
<td>LAWA</td>
</tr>
<tr>
<td>4</td>
<td>Existing World Way and West Way Lower</td>
<td>Removal</td>
<td>LAWA</td>
</tr>
<tr>
<td>5</td>
<td>New World Way and West Way Upper</td>
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</tr>
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<td>96th and Neutrogena Pedestrian Crossing</td>
<td>Modification</td>
<td>City of LA</td>
</tr>
</tbody>
</table>

10.3.2 Design Requirements

A. Traffic signal design, for those signals to be maintained by the City of Los Angeles, shall conform to the LADOT traffic signal design guidelines, including requirements for light emitting diode (LED) for signal indicators, internally illuminated street name signs (IISNS), including CA MUTCD requirements for letter sizes, and safety lights, and battery backup system. All permanent traffic signals within the CTA will be maintained by the City of Los Angeles.

B. Operations of existing traffic signal systems at the impacted intersections shall be maintained throughout the duration of the work. At a minimum, new signalized intersections and modified traffic signals that require work include those shown in Table 10-1.

C. At intersections that will be modified or will undergo only minor improvements, the Developer shall review the adequacy of existing traffic signal equipment including but not limited to signal controller cabinets, signal poles, traffic signal heads, pedestrian signal equipment, detectors, conduits, conductors and electrical services and coordinate with the AHJ in accordance with any existing or new municipal maintenance agreements. Where existing equipment no longer meets the traffic needs or latest design criteria, the Developer shall provide new equipment for intersections impacted by the Project.

D. At intersections where improvements call for new signals, install new traffic signal poles, controllers and cabinets, service meters, battery backup systems, detection
pull boxes, conduit, wiring, mast arm signs, pole-mounted signs, illuminated street name signs, and all appurtenances in accordance with the requirements of the AHJ of the facility.

E. The Developer shall provide temporary signal installations, if required, to maintain operations at all times. The Developer shall maintain all existing communications for and to traffic signals throughout the performance of the D&C Work, and shall maintain existing signal interconnect systems and extend such systems in kind to new signals installed as part of the Project.

F. The Developer shall coordinate the review, approval, inspection, and acceptance of the traffic signal work with the AHJ.

G. The reuse of existing equipment is subject to the applicable AHJ’s approval. Signal poles rated below 100 mph wind load shall not be reused.

10.3.3 Construction Requirements

A. For City of LA maintained traffic signals, the Developer shall notify LADOT ten (10) working days prior to starting traffic signal work for all coordination and inspection services requirements.

B. The Developer shall coordinate with the AHJ in accordance with SSPWC, 2008 LADOT SPECIAL PROVISIONS and Standard Drawings for the Installation and Modification of Traffic Signals, and related Amendments, to maintain and protect pedestrian traffic from open excavations and/or pull boxes, and shall, through the use of barricades, delineators, and construction tape and/or other approved methods, protect and maintain vehicular traffic traveling adjacent to the work area. The Developer shall develop for approval by the AHJ, all required traffic control measures, detour plans, traffic signal shutdowns, work area set-up procedures, and hours of operation.

C. The Developer shall protect in place any existing Automated Traffic Surveillance and Control System (ATSAC) conduits and cables, underground telephone, telegraph and City communications and ATSAC Facilities.

D. The Developer shall coordinate the Work with the work of other contractors and utilities to effectively control traffic through the work zone.

E. All materials and installation shall be in accordance with the latest Special Provisions and Standard Drawings for the Installation and Modification of Traffic Signals, and Amendments.

F. For City of Los Angeles maintained traffic signals, the Developer shall notify the LADOT Signal Inspector and provide Inspector with its proposed signal construction schedule three days prior the start of signal work.

G. The Developer shall ensure final testing of signal systems in accordance with Special Provisions and Standard Drawings for the Installation and Modification of Traffic Signals. Such testing shall be performed and witnessed by AHJ. Results shall be recorded and submitted to AHJ for Review and Approval.

H. The Developer shall install pre-formed inductive traffic signal loops prior to paving installation. The Developer shall contact the AHJ for confirmation of exact loop locations ten (10) working days prior loop installation.
I. The Developer shall remove traffic signal foundations or remove top of the foundation that will not be reused when removing traffic signal equipment, furnish and install backfill material sufficiently compacted in accordance with Red book and Green book requirements, restore surface to match adjacent surface, remove wires from abandoned conduits and remove or crimp stub-outs of abandoned conduit within all pullbox locations.

J. The Developer shall complete all traffic signal work for its concurrent operation with the completion of striping and pavement marking installation/modification, and complete “Restoration” traffic signal work for its concurrent operation with mark-out of final traffic striping.

K. The Developer shall protect and maintain existing traffic signal equipment in place. Traffic signal equipment interfering with construction may be relocated only with prior approval by the AHJ. The Developer shall maintain traffic signal detector loops in operation at all times, and immediately replace traffic signal detector loops damaged by construction. In the event of damage to traffic signal equipment, the Developer shall immediately notify the AHJ and repair/replace damaged equipment. Repaired or replaced traffic signal equipment shall be inspected by the AHJ before signal circuits are energized.

10.4 Summary of Submittals

At a minimum, the Developer shall provide submittals as indicated in Part 2A, Section 6.
11. APM OPERATING SYSTEM

11.1 General

These Part 2B, Design & Construction Technical Requirements describe the technical requirements for the fully automated, driverless, fixed-Guideway transportation APM Operating System that will connect the Los Angeles International Airport (LAX) Central Terminal Area (CTA) with remote ground transportation hubs located at the West Intermodal Transportation Facility (ITF-West), the East Intermodal Transportation Facility (ITF-East) and a Consolidated Rent-A-Car (ConRAC) Facility. There will be three (3) Stations (the West, the Central and East Stations) in the Central Terminal Area (CTA).

Specific references are made to the American Society of Civil Engineers (ASCE) Automated People Mover Standards (ASCE 21). These documents are available from ASCE.

11.1.1 Developer's Responsibilities

The Developer shall perform all of the project management, quality assurance and quality control, design, analysis, documentation, manufacture, supply, fabrication, shipping, expediting, storing of materials, installation, erection, debugging, testing and demonstration required to deliver an operable, safe and reliable APM System and ancillary equipment and spare parts in conformance with all the requirements of the Contract Documents. The Developer shall be solely responsible for delivering all aspects of the Work, and integrating the APM Operating System and the APM Fixed Facilities into an APM System. The Developer shall be responsible for coordinating activities and interface with the Related Projects, especially at the ConRAC Station where the APM System will be incorporated into the ConRAC building and in the Central Terminal Area.

11.1.2 APM System Configuration

The APM System alignment, equipment and facilities shall be located and configured to meet the performance requirements of the Contract Documents for the APM System.

11.1.2.1 Basic Characteristics of the APM System

The layout of the APM System is depicted in Part 5, Contract Drawings/Engineering Data and features approximately 11,800 feet of dual lane Guideway, six passenger Stations and an off-line Maintenance and Storage Facility (M&SF). The Station platforms will be configured to accommodate up to the maximum length Train. At all Stations except the CTA West and ConRAC Stations, passengers will board and deboard the Trains from a center platform. At the CTA West and ConRAC Stations, passenger deboarding and boarding will be from different platforms during normal operations. The M&SF will house the APM Operating System maintenance functions, the APM Operating System Central Control Facility (CCF) and at the Developer’s discretion, the APM Operating System administration offices. The Part 5, Contract Drawings/Engineering Data establish key relationships between the APM Operating System and the APM Fixed Facilities. The Developer, as part of its APM Operating System Work, is required to coordinate and adjust its designs to fully accommodate and integrate the APM Operating System with the APM Fixed Facilities as they undergo design, construction and completion.

The Developer will provide a Vehicle fleet sufficient to accommodate the required level of passenger capacity defined in the Contract Documents for the APM System. The APM Operating System will operate in a pinched loop mode between the CTA West and ConRAC Stations during peak and off-peak periods and other modes during limited demand periods as defined in the Contract Documents.
The design of the M&SF shall be modular such that changes to operating configuration of the trains can be accommodated without replacement of the existing equipment. If the Developer’s design includes the ability to provide passenger capacity above the Line Capacity, the APM System shall demonstrate the ability to utilize this reserve capacity.

11.2 Standards and Specifications

The Developer shall comply with the requirements listed in Part 4, Standards and Specifications.

11.3 Performance Requirements

11.3.1 APM Operating System Description

11.3.1.1 APM Operating System Technology Maturity

The requirements of this Section apply to any changes/derivatives from the Developer’s proposed APM Operating System technology that was previously determined to be eligible. The APM Operating System must be technically mature. The technical maturity is a measure of the degree of the technology’s readiness for deployment for the Project and can range from the highest level of maturity, i.e. service-proven as defined in Part 2B, Section 11.3.1.1.1, to a lesser level of maturity as defined in Part 2B, Section 11.3.1.1.4.

Definitions used in this Part 2B, Section 11.3.1.1 are as follows:

**Major Subsystems** - Those subsystems that comprise the most important functional elements of the APM Operating System. For the purposes of this Part 2B, Section 11.3.1.1, the major subsystems are:

A. Vehicles - Refer to Part 2B, Section 11.3.7.
B. Power distribution, Power Rail (and signal rail if appropriate) and Vehicle power collector assemblies and interfaces - Refer to Part 2B, Section 11.3.7 & 11.3.8.
C. Automatic Train Control - Refer to Part 2B, Section 11.3.9.
D. Vehicle running gear/guidance assemblies and interface - Refer to Part 2B, Sections 11.3.7.9 and 11.3.11.1.
E. Vehicle/Train switching - Refer to Part 2B, Section 11.3.11.6.
F. Automatic Station platform doors - Refer to Part 2B, Section 11.3.12.1.1.1.
G. O&M Equipment - Refer to Part 2B, Section 11.3.13.

**APM Operating System Technology** - The Major Subsystems, when appropriately and successfully combined with other APM System components to form an integrated, functioning whole, constitute the APM Operating System technology.

**Technology Modification** - With respect to a Major Subsystem of the Developer’s existing service-proven APM Operating System technology, the term Technology Modification means a changed design for the major subsystem. The change may be progressive, as evidenced by incremental changes to a previous design and/or a previous generation of the subsystem, or a new subsystem to be used as a replacement for a Major Subsystem in a first-time implementation as part of this Project. A radical design change or incorporation into the APM Operating System technology of technically immature (without analysis, performance and test data documentation) or experimental processes, components, or materials does not qualify as a Technology Modification.
11.3.1.1.1 Service-Proven APM Operating System Technology

Except as otherwise provided in Part 2B, Sections 11.3.1.1.1.1 and 11.3.1.1.1.2 below, the Developer’s APM Operating System technology, including its major subsystems shall have been successfully proven in current, daily, year-round passenger service operation for a period of two (2) years prior to the Setting Date. Such time period is deemed by LAWA to be the minimum period sufficient to demonstrate satisfactory operation. The two-year time period is significant in that it provides time to:

A. Detect any technological or design deficiencies that occur during service conditions;
B. Make adequate corrections for any deficiencies; and
C. Attain steady state performance. Additionally, successful operation of the APM Operating System shall be determined by LAWA to be attainable by the Developer by documented evidence that the proposed APM Operating System technology can meet the specified operational performance and the APM OS Availability requirements specified in Part 2B, Section 11.3.6.

11.3.1.1.1.1 Use of Technology Modifications

In determining compliance with the service-proven requirement of Part 2B, Section 11.3.1.1.1, LAWA will permit Technology Modifications to be implemented as part of the APM Operating System, but only under the following conditions:

A. No more than one Major Subsystem and one Technology Modification shall be accepted.
B. Integrated operation of the replacement subsystem in a similar APM Operating System technology shall have been successfully proven in current passenger service operation for two (2) years or if the replacement subsystem was not operated in continuous service the sum of the operating period shall total a duration of two years. Further, such passenger service shall approximate the APM System operations specified in these Contract Documents.
C. The Developer presents design documentation as evidenced by analysis, performance and/or test data documentation, that the replacement subsystem has been integrated into the Developer’s APM Operating System technology design.
D. The Technology Modification meets all other requirements of the Contract Documents.

11.3.1.1.1.2 Requirements for Replacement Subsystems

In determining compliance with the service-proven requirement of Part 2B, Section 11.3.1.1.1, LAWA will permit a major subsystem, as defined in Part 2B, Section 11.3.1.1 above, to be replaced with another in a first time implementation as part of the APM Operating System, but only under the following conditions:

A. No more than two (2) major subsystem replacements shall be accepted.
B. Integrated operation of the replacement subsystem in a similar APM Operating System technology shall have been successfully proven in current passenger service operation for two (2) years or if the replacement subsystem was not operated in continuous service the sum of the operating period shall total a duration of two years. Further, such passenger service shall approximate the APM Operating System operations specified in these Contract Documents.
C. The Developer presents design documentation as evidenced by analysis, performance and/or test data documentation, that the replacement subsystem has been integrated into the Developer’s APM Operating System technology design.

D. The replacement subsystem meets all other requirements of the Contract Documents.

11.3.1.1.1.3 Evaluation of Technology Modifications

All Technology Modifications will be evaluated by LAWA. Any Technology Modification that does not meet the criteria specified in Part 2B, Section 11.3.1.1.1 is unacceptable.

Additionally, LAWA will evaluate issues related to the integration of multiple Technology Modifications to assess the technical and schedule related risk associated with their simultaneous deployment.

The provisions of this Part 2B, Section 11.3.1.1.1.3 shall be in addition to the provisions of Part 2B, Sections 11.3.1.1.1.1 and 11.3.1.1.1.2.

11.3.1.1.2 Successful Passenger Service Operation

Successful passenger service operation, for the purpose of qualifying the Developer’s APM Operating System technology under Part 2B, Section 11.3.1.1, means that an owner or owners of the Developer’s APM Operating System technology, that is offered by the Developer to comply with the requirements of these Contract Documents, is satisfied that such APM Operating System technology has met original expectations as indicated by a letter from the senior management executive(s) of the system owner(s). Additionally, the Developer shall provide evidence, from at least one passenger service-proven application, documenting that the APM Operating System technology is technically mature and has been satisfactorily and appropriately integrated into a functional whole. Documented evidence shall clearly show that the preceding features and components are capable of satisfying the requirements of these Part 2B, Design & Construction Technical Requirements.

11.3.1.1.3 Operation and Maintenance

The Developer shall also demonstrate: (1) its organization’s capability to successfully operate and maintain an APM Operating System of the same or equivalent magnitude and complexity, and (2) that the proposed key personnel for the APM Operating System possess sufficient professional capability and experience to operate and maintain the APM Operating System in accordance with the requirements of the Contract Documents.

11.3.1.1.4 Non-Service Proven Technology

LAWA may make exceptions to any of the requirements of Part 2B, Section 11.3.1.1 and accept an APM Operating System technology that is not service-proven but deemed, in LAWA’s sole opinion, to be technically mature for deployment.

11.3.1.2 APM Operating System Equipment and Operations

The APM Operating System shall consist of fully automated Trains, without the need of drivers or attendants on board to control the Trains, operating on a dual lane Guideway with on-line Stations. The APM Operating System shall operate as a pinched loop with the potential for operations on single Guideway sections when and if required for failure management. The APM Operating System operating mode shall be selected at Central Control, both automatically and by Central Control Operator (CCO) overrides.

For all operating modes, it shall be possible to operate Trains up to the maximum-length Train, including concurrent operations of any combination of Trains of different lengths from smallest
operating unit to maximum length Train. Normal operations shall be in the counter-clockwise direction within the APM Operating System.

Train movements shall be automatically controlled to prevent “bunching,” and to assure that Trains arrive at Stations at regular intervals (headways). After leaving a Station, Trains shall accelerate to the allowable cruise speed and decelerate to a Station stop within ride comfort limits of the Contract Documents. At Stations, the Trains shall stop so that the Vehicle doors are in precise alignment with the Station platform doors as defined in Part 2B, Section 11.3.9.2.1. Vehicle and Station doors shall then automatically open together in a synchronized operation to permit passengers to deboard and board the Train. After a prescribed dwell time, the doors shall close and the Train shall proceed to the next Station on the route. On board and in-Station static and dynamic signage and announcements shall inform passengers about APM System use and Train destinations.

For passenger safety, Stations shall have Station platform edge walls including emergency egress doors (breakaway panels) to enclose the Station public areas, and prevent access to the Guideway. Automatic Station platform doors in these walls shall operate in coordination with the Train doors to permit passenger deboarding and boarding.

Emergency egress doors shall be provided in the platform walls to allow access between the Station platform and the Guideway. Emergency walkway doors shall be provided to allow access between the Station platform and the emergency walkway and vice versa.

The APM Operating System and its Vehicles shall be fully bi-directional with equal performance in either direction throughout the operating areas of the APM Operating System. (See definition of “Vehicle” in the Agreement.) Vehicles shall be capable of carrying standing, seated and wheelchair-borne passengers either as a single operating unit or in combination with other Vehicles in a Train up to the maximum length Train required to satisfy the requirements for the APM System Line Capacity. The Vehicles shall be of identical design and interchangeable. Vehicles shall have a heating, ventilation and air conditioning system for passenger comfort. Vehicles shall be equipped for manual operation, and shall feature Vehicle audio address/intercom capabilities (including automatic playback of prerecorded messages) which shall be interfaced with Central Control.

Normally Trains shall automatically stop on-line in each Station on a route; open the appropriate doors to permit passengers to leave and enter, close the doors, and proceed to the next Station.

On board and in-Station information devices shall inform passengers about APM Operating System use and Train destinations.

The power for operating all APM Operating System equipment shall be derived from substations as shown on the Part 5, Contract Drawings/Engineering Data. Electric power shall be conditioned and distributed from Developer-provided substation equipment. Train propulsion shall be provided by on-Vehicle electric motors energized by applied electric power, and shall not utilize contained consumable fuels. Back-up power supplies shall power essential equipment in the event of primary power loss. Batteries onboard the Vehicles shall support non-propulsion essential loads in the event of the loss of wayside power in accordance with Part 2B, Section 11.3.7.8.2.2. Emergency backup power for propulsion at reduced performance shall be provided in the event of a total loss of utility power per Part 2B Section 11.3.3.1.7.CC.

An Automatic Train Control system, based on fail-safe design principles, shall provide safe, reliable, and frequent service to users, and allow for CCO interface, automatic storage of Trains, and other capabilities described herein. A Central Control Facility located at the M&SF shall serve as the base of operation for the entire APM Operating System.
A dedicated communications network shall be part of the APM Operating System. This network shall include: two-way Vehicle communications; wayside public address; passenger Station telephones; an operations and maintenance radio system; internal telephones; and closed circuit television monitoring of the APM Operating System Vehicles, Stations and Guideway. All of these services shall be integrated with Central Control. The communications network shall enhance APM Operating System security, provide an effective interface between Central Control and passengers, and facilitate failure mode recovery and emergency response operations.

The Guideway for the APM System will be designed and constructed to accommodate the Developer-specified operations by the maximum length Train envisioned for the APM System defined herein. The Guideway structure will accommodate all Guideway equipment needed for the APM System.

Facilities, spare parts and equipment, tools, and test and maintenance equipment shall be provided for APM Operating System maintenance and test activities, and for the storage and cleaning of Trains. Storage facilities and an inventory control system for the control and distribution of spares and materials needed to operate and maintain the APM Operating System shall also be provided. Office equipment, supplies, and procedures shall be provided for use during the subsequent operation and maintenance of the APM Operating System.

In addition to the APM Operating System elements described above, the APM System will utilize various fixed facilities, including the Stations and the Maintenance and Storage Facility. The locations are depicted on the Part 5, Contract Drawings/Engineering Data.

11.3.1.3 APM System Reserve Line Capacity

The required Line Capacity is specified in Part 2B, Section 11.3.3.1.5.1. Depending upon the specific characteristics of the APM System, it may be possible to operate the system at a shorter headway than is needed to provide the specified Line Capacity. In other words, the Minimum Operational Headway shall be the same as or shorter than the Operational Headway needed to provide the Line Capacity. The reserve line capacity is the additional capacity higher than the specified Line Capacity and the line capacity provided at the Minimum Operational Headway.

The Developer shall provide a complete APM System design that is modular in nature, such that if reserve line capacity beyond the specified Line Capacity is available, the APM System shall accept additional equipment without replacement of equipment provided under the Contract Documents. Additional equipment shall be incorporated into the Work without significant disruption to the operations. The APM System shall be designed such that no total system shutdown is required to change the operational characteristics to provide the additional reserve line capacity.

Line Capacity that can be provided by the Developer’s specific Technology including reserve line capacity identified in Part 2B, Section 11.3.1.3.1 shall be accommodated without any changes to Guideway, Stations, Power Distribution System, Automatic Train Control or Maintenance & Storage Facility; the APM System reserve line capacity shall be met by increasing the operating fleet, inserting additional Trains, running longer Trains up to the maximum Train length, and/or operating at the Minimum Operational Headway capability instead of the Operational Headway per Part 2B, Section 11.3.3.1.2.

11.3.1.3.1 APM Modularity of Design

It is a requirement of the Contract Documents that the designs and equipment provided for the APM System be capable of use with equipment provided at a later time without modification of the equipment provided under the Contract Documents. During the various subsystem and equipment design audits, the Developer shall be required to describe exactly how this will be
accomplished. While there is no specific requirement to provide Line Capacity greater than specified in Part 2B, Section 11.3.3.1.5, the Developer shall disclose any reserve line capacity above this limit as part of their System Design Audit Submittal.

The APM System shall be provided with spare conduits and space capacity within conduits and wire ways of the APM System as required in Part 2B, Section 11.3.16.6.7.

11.3.1.3.2 Vehicles

All Vehicles furnished under the Contract Documents and any future fleet purchases (as applicable) must be capable of entrainment, in either orientation, with the Cars provided under the Contract Documents. Maximum Length Trains shall be demonstrated as part of the APM Operating System acceptance activities of the Contract Documents. Further, all of the Vehicles furnished under the Contract Documents must comply with the applicable requirements of Part 2B, Section 11.3.3.1.8. Refer to Part 2B, Section 11.3.7 for detailed Vehicle requirements.

Vehicles shall be modular in design such that any additional Cars or Vehicles provided to meet reserve line capacity do not require replacement of the fleet provided under the Contract Documents.

11.3.1.3.3 Power Distribution System

The Power Distribution System provided under the Contract Documents shall be designed, supplied, and installed to operate Trains of sufficient length, quantity and frequency to meet the requirements of the APM System as identified in Part 2B, Sections 11.1.2, 11.1.2.1, 11.3.1.2, 11.3.1.3 and in accordance with Part 2B, Section 11.3.8.

The Power Distribution System shall be modular in design, or shall include sufficient reserve capacity such that any operational changes made to meet reserve line capacity do not require replacement of the PDS equipment provided under the Contract Documents.

11.3.1.3.4 Automatic Train Control and Communications

All Automatic Train Control systems provided under the Contract Documents shall be designed, supplied and installed to operate Trains of sufficient length, quantity and frequency to meet the requirements of Part 2B, Section 11.3.3.1.8. The Automatic Train Control system shall be modular in design such that any operational changes made to meet reserve line capacity of the APM System shall be accomplished without replacing or destroying any of the APM System. It shall be accomplished by adding equipment and modifying software, all of which shall be modular in design such that the incorporation of this equipment or software shall not disrupt normal peak operations. Space and access requirements for the APM System Automatic Train Control and communications equipment shall be clearly defined in the Design/Construction Interface Documents. Refer to Part 2B, Sections 11.3.9 and 11.3.10 for detailed Automatic Train Control and communications equipment requirements.

11.3.1.3.5 Guideway and Guideway Equipment

Guidance devices, Guideway-mounted equipment, overtravel buffers, switches, wayside equipment, and Guideway structure provided under the Contract Documents shall accommodate and satisfy all requirements of Part 2B, Section 11.3.3.1.8. The APM System shall be provided with sufficient spare conduits and space capacity within conduits and wire ways to facilitate Developer required changes to the System; replacement of failed conductors or operation at the minimum operational headway capability to meet reserve line capacity.

11.3.1.3.6 Station Equipment

The Station equipment shall be designed and provided under the Contract Documents to meet the requirements of Part 2B, Section 11.3.1.3.1. All Station equipment provided under the
Contract Documents shall be designed and provided to meet the requirements of Part 2B, Section 11.3.3.1.8, with the exception of Station platform doors and graphics, as described below.

All Station platform doors and related mechanical, electrical and control equipment shall be installed and fully operable to accommodate the maximum length Trains. All Station equipment shall be modular in design to facilitate the transition to meet reserve line capacity.

All graphics and dynamic signs that are specifically associated with individual platform doors shall be installed and fully operable to accommodate the maximum length Trains. Refer to Part 2B, Section 11.3.12 for detailed Station equipment requirements.

11.3.1.3.7 Maintenance and Storage Facility and Equipment

The Maintenance & Storage Facility (M&SF) equipment provided under the Contract Documents for APM Operating System maintenance, Vehicle testing and storage shall accommodate the maximum length Trains. The M&SF shall be sized to accommodate the Developer’s maintenance requirements and the storage yard and M&SF combined shall be sized to accommodate the fleet for the APM System plus an additional ten percent of the fleet without disrupting ongoing APM passenger operations. The M&SF and M&SF equipment shall be modular in design such that any additional equipment added to meet reserve line capacity does not require replacement of the facility or equipment provided under the Contract Documents.

11.3.1.3.8 Stations

The Station platforms are shown on the Part 5, Contract Drawings/Engineering Data.

The stopping positions at each Station platform shall be as indicated in Part 2B, Section 11.3.9.2.1. Station platform doors for maximum length Trains shall be provided and shall be located such that they will not have to be relocated to accommodate any operational changes made to meet reserve line capacity.

11.3.1.3.9 Central Control Facility

The Central Control Facility (CCF) for the APM Operating System shall be of sufficient size to accommodate the Central Control equipment, staff and functions required for the APM System operations. A console for LAWA Police Department shall also be located at Central Control and space shall also be allotted for this console.

11.3.1.3.10 Corrosion Control and Grounding

All corrosion control and grounding equipment provided under the Contract Documents shall be designed and installed so as to accommodate and properly protect the APM System equipment, structures, public, and employees. Refer to Part 2B, Section 11.3.14 for detailed corrosion control and grounding requirements.

11.3.1.4 Accessibility

In order to provide an APM System that is accessible to and usable by all people, the Developer shall comply with all standards and requirements as specified in the Contract Documents.

The passenger information system shall be designed with the goal that all passengers are considered in communicating information. The information system shall be re-affirming, and it shall maintain the orientation of the passengers throughout the trip on the APM System. Passenger information devices, such as signs, symbols, announcements and other information cues shall be reinforced and repeated. All announcements and static and dynamic signs shall be in the English and Spanish languages. Audio announcements in each Car and on each Station platform, static and dynamic signs, and other passenger information to assist mobility impaired or
disabled passengers shall meet the requirements of Part 2B, Sections 11.3.7.6.4, 11.3.7.13.3, 11.3.9.10.1, and 11.3.12.1.2.

11.3.1.5 Design Lives

Operating System Equipment shall have a design life as specified in Part 2A, Section 5.13. The design lives and service lives of the Vehicles and its subsystems are specified in Part 2B, Section 11.3.7.5.

11.3.2 APM System Interfaces and Coordination

Specific Interfaces for the APM Operating System are included in Part 2B, Section 11.3.17. Interface Obligations for the APM System are defined in Exhibit 10.

11.3.3 APM Operating System Operating Criteria

This section defines the criteria and requirements for APM System operations. These shall apply to all parts of the APM System.

11.3.3.1 Passenger Service Characteristics

11.3.3.1.1 APM Operating System Operating Hours

The operating periods for the APM System shall be as follows:

- **Night Mode**: 0:00 to 02:59 hours
- **Off Peak 1**: 03:00 to 08:59 hours
- **Peak**: 09:00 to 22:59 hours
- **Off-Peak 2**: 23:00 to 23:59 hours

Transitions of the operating fleet size, i.e., insertion or removal of Trains from passenger-carrying Guideway sections, for changes in the operating periods shall be made only in that period requiring the smaller fleet size.

All scheduled APM Operating System maintenance that would interfere with or require reduced passenger service shall be accomplished during the night or off-peak periods, unless otherwise authorized by LAWA.

11.3.3.1.2 Headway

Headway is the elapsed time between the same part of consecutive Trains operating in the same direction on the same Guideway, measured at any given point on the Guideway. During all normal operations, all Trains on the same route shall operate at continuously and nominally equal headway and all Trains on different routes that share a common Guideway track section shall also operate at continuously and nominally equal headway; both conditions shall meet the requirements of Part 2B, Section 11.3.9.3.3.1.

Special case definitions of headway are:

**Safe Separation Headway** - A two-Train minimum headway based on Automatic Train Control, braking, etc. that allows the following Train to stop safely without a collision with the lead Train. This is part of the ATP subsystem design in accordance with Part 2B, Section 11.3.9.1.2. Operations based on minimum safe separation headway will allow a given Train's velocity versus distance profile to influence the velocity versus distance profile of following Trains.

**Non-Interference Headway** - The minimum sustainable headway that does not result in any given Train's velocity versus distance profile influencing any other Train's velocity versus distance profile, regardless of the number of routes that may be in simultaneous operation (i.e., no inter-
Train performance interference). For purposes of this definition, all external interferences such as passenger-induced delays are assumed to not be present.

**Minimum Operational Headway** - The minimum operational headway involves multiple Trains, Station stops, normal disturbances, passenger interference, etc. and is for operational planning to “ensure” smooth normal operations without Train bunching and unscheduled stopping on the Guideway. The minimum operational headway shall not be less than 115 percent of the non-interference headway, and shall not be greater than 120 seconds.

**Operational Headway** - The headway determined appropriate for planned scheduled operations to meet passenger demand.

The safe separation headway and the non-interference headway shall be used for carrying out APM Operating System design but shall not be used in defining APM Operating System performance such as the operational headway, line capacity and trip time.

Non-interference headway for the APM Operating System shall be proven by the Developer by simulation and subsequent test demonstrations on the APM Operating System. The simulation methodology and results shall be documented and submitted in accordance with the Summary of Submittals list in Part 2A, Section 6.7 (see Part 2B, Section 11.3.3.1.7). The test demonstration shall be according to a procedure accepted by LAWA described in Part 2C, Section 4.3.4 and shall involve maximum length Trains launched and separated by the non-interference headway being demonstrated. The Trains shall be required to complete all route circuits at least twice and each test demonstration shall not be less than one-hour duration. Station dwells shall be the nominal dwells specified in Part 2B, Section 11.3.3.1.3.

The operational headway shall be used to calculate the APM Operating System Line Capacities (Part 2B, Section 11.3.3.1.5), fleet size (Part 2B, Section 11.3.3.1.6) and predicted APM Operating System performance (Part 2B, Section 11.3.3.1.7). The operational headway shall not be less than the minimum operational headway.

The Developer shall design the APM Operating System such that the specified line capacity can be met with an operational headway as specified in Part 2B, Section 11.3.3.1.2.1.

**11.3.3.1.2.1 APM Operating System Maximum Operational Headways**

For the APM Operating System, the operational headway required to meet the specified capacities shall not exceed the following values for the specified period:

- **Night Mode Period:** 272 seconds
- **Off-Peak 1 Period:** 155 seconds
- **Peak Period:** 134 seconds
- **Off-Peak 2 Period:** 218 seconds

**11.3.3.1.3 Station Dwell Time**

Station dwell time is the time during which the Train is stopped in the Station, beginning at the time Train doors are commanded to open and ending at the time Train doors are closed and locked. The dwell time for Trains at each Station shall be a minimum of ten (10) seconds adjustable in one second increments up to a maximum of sixty (60) seconds. Within this 50 second range, Station dwell times shall be automatically adjustable by the ATS subsystem to achieve proper Train spacing on the route, or manually adjusted by the CCO to provide dwell times that are appropriate for specific, short-term patronage or other conditions.

Station dwell times for each Station shall be calculated for all operating periods by the Developer on the basis of the following criteria, which shall all be satisfied:
A. Vehicle loaded to normal capacity, as defined in Part 2B, Section 11.3.7.3.

B. For the APM Operating System, the percent of the total number of passengers on each Vehicle loaded to normal capacity deboarding and boarding at each Station location is defined in Table 11.3.3.1.3-1 below.

**TABLE 11.3.3.1.3-1**

PERCENT OF PASSENGERS BOARDING AND DEBOARDING AT EACH STATION

<table>
<thead>
<tr>
<th>Passengers Boarding and Deboarding</th>
<th>West</th>
<th>Center</th>
<th>East</th>
<th>West ITF</th>
<th>East ITF</th>
<th>ConRAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ons</td>
<td>45%</td>
<td>30%</td>
<td>35%</td>
<td>30%</td>
<td>20%</td>
<td>35%</td>
</tr>
<tr>
<td>Offs</td>
<td>35%</td>
<td>25%</td>
<td>30%</td>
<td>35%</td>
<td>30%</td>
<td>45%</td>
</tr>
</tbody>
</table>

C. Vehicle door size shall represent actual dimensions of the specific technology employed by the Developer.

A. The passenger load/unload rate specified in Part 2B, Section 11.3.7.10.1 shall be used.

B. A time allowance that represents actual equipment performance allowance shall be included for all ATP interlock functions, plus door unlocking/opening and closing/locking times; this time allowance does not include door fully-open time. This allowance may not exceed ten seconds.

C. In any case, dwell times shall not be less than 35 seconds at the West ITF Station, 30 seconds at the East CTA Station, and 25 seconds at the Center CTA and East ITF Stations.

D. At the West CTA and ConRAC Stations, deboarding and boarding occurs from different platforms. Under normal operations, the dwell times at the West CTA and ConRAC Stations shall not be less than forty-five (45) seconds; boarding doors shall be commanded to open no sooner than ten (10) seconds after the deboarding doors have opened.

These calculated Station dwell times shall be used to determine the operational headways of Part 2B, Section 11.3.3.1.2 and the round trip time requirements of Part 2B, Section 11.3.3.1.4.

**11.3.3.1.4 Travel and Round Trip Times**

Travel time between sequential Stations on a route is the time a Train takes to travel from one Station to the next, beginning at the time Train doors are closed and locked at the originating Station and ending at the time the Train is stopped and the doors are commanded to open at the destination Station. Station dwell times are not included in travel times.

The round trip time is the time a Train takes to complete one circuit around its route. Round trip time consists of the sum of all travel times and Station dwell times on a route.

For determination of the travel times and round trip time, the Developer shall assume Station dwell times as defined in Part 2B, Section 11.3.3.1.3 and Trains loaded at the AW1 weight specified in Part 2B, Section 11.3.7.2.

**11.3.3.1.4.1 APM System Travel Times**

There are no specified inter-Station travel time requirements for the APM Operating System.
11.3.3.1.4.2 APM Operating System Round Trip Time
The round trip time for all Trains in operation shall not exceed 1,200 seconds.

11.3.3.1.5 Line Capacity
Line capacity is the number of passengers per hour per direction (pphpd) that can be carried past a given point on each independent route by Trains operating on that route. All of the line capacities specified in this Part 2B, Section 11.3.3.1.5 shall be provided by Trains that are:

A. Operating in accordance with APM Operating System operating hours specified in Part 2B, Section 11.3.3.1.1;
B. Operating at the operational headway specified in Part 2B, Section 11.3.3.1.2;
C. Operating with Station dwell times calculated as specified in Part 2B, Section 11.3.3.1.3; and
D. Are loaded at the normal capacity as specified in Part 2B, Section 11.3.7.3.

11.3.3.1.5.1 APM Operating System Line Capacity
The APM Operating System shall provide the following minimum line capacity:

- Night Mode period operations capacity: 1,622 pphpd
- Off Peak 1 period operations line capacity 4,487 pphpd
- Peak period operations capacity: 5,515 pphpd
- Off-Peak 2 period operations capacity: 3,210 pphpd

11.3.3.1.6 Fleet Size, Train Length and Spare Vehicles
The Developer shall provide a fleet of Vehicles sufficient to meet all requirements of the APM Operating System in accordance with the following requirements.

11.3.3.1.6.1 Peak Period Operating Fleet
The headway requirements of Part 2B, Section 11.3.3.1.2, the round trip time requirements of Part 2B, Section 11.3.3.1.4, and the line capacity requirements of Part 2B, Section 11.3.3.1.5 shall be used by the Developer to establish the length of Trains (number of entrained Vehicles) and the operating fleet size of the APM Operating System so that all APM Operating System requirements are met.

During Peak period operations, the operating fleet shall include one spare Train(s) in standby mode, equipped and functioning with no faults and ready for passenger-carrying service. The spare Train(s) shall be located to replace a failed Train on the line within the Departure Test area just outside the M&SF.

11.3.3.1.6.2 Spare Vehicles
In addition to the peak period operating fleet of Trains specified in Part 2B, Section 11.3.3.1.6.1, the Developer shall provide sufficient spare Vehicles for the APM Operating System to meet APM OS Availability and maintenance requirements and as follows. The number of spare Vehicles shall be such that:

A. The average annual Vehicle mileage is normalized and the Vehicle design life of Part 2B, Section 11.3.7.5 is met;
B. The number of spare Vehicles is at least ten percent of the peak period operating fleet, rounded up to a whole number, where the spare Train(s) in hot standby mode is (are) included in the peak period operating fleet; and

C. The minimum number of spare Trains, in hot stand-by mode, shall be one. Such Train length shall be no less than the maximum length Train operating during the peak period.

11.3.3.1.6.3 Fleet Size to Meet APM Operating System Line Capacity

The headway requirements of Part 2B, Section 11.3.3.1.2, the round trip time requirements of Part 2B, Section 11.3.3.1.4, the Line Capacity requirements of Part 2B, Section 11.3.3.1.5, and maximum length Train shall be used by the Developer to determine the fleet size necessary to meet the APM Operating System line capacity requirements in accordance with the same requirements as specified in Part 2B, Section 11.3.3.1.6.1 and Part 2B, Section 11.3.3.1.6.2.

11.3.3.1.6.4 Maximum Length Train

Based on the determination of the required Train lengths (number of entrained Vehicles) for the APM Operating System, the Developer shall establish the maximum length Train. All facilities and equipment provided by the Developer for the APM Operating System shall be sized to accommodate a maximum length Train. Station platforms provided by the Developer will be designed to accommodate up to a Maximum Length Train.

11.3.3.1.6.5 Train Composition

All Trains supplied by the Developer and operated in the APM System shall have the capability to operate with multiple Train lengths including concurrent operations of any combination of Trains of different lengths from smallest operating units to maximum length Trains. While preferred operational configuration is in a counter-clockwise mode, it shall be possible to operate in a clockwise mode without any impacts on the line capacities, headways or the round trip times.

11.3.3.1.7 APM Operating System Performance and Failure Management Analysis

To predict the performance of the APM Operating System and to demonstrate analytical conformance with the requirements of the Contract Documents, the Developer shall conduct the computer-based System Performance and Failure Management Analysis (SPFMA) described in this section. The SPFMA shall accurately predict the operation of the Developer's Trains operating on the APM Operating System using mathematical techniques. The SPFMA shall be completed for the APM System assuming maximum length Trains loaded at the AW1 weight specified in Part 2B, Section 11.3.7.2. With respect to failure management, the SPFMA shall provide an analytical assessment of the failure operating modes of Part 2B, Section 11.3.3.2.2 and the failure management functions and strategies of Part 2B, Section 11.3.3.3 when these are applied to recover the APM Operating System from Train and or wayside equipment failures occurring on all Guideway segments, and at each Station platform, considered singly. It shall serve as a primary input to the APM System Operating Plan and APM System Maintenance Plan (see Part 2C, Sections 3.1.1 and 3.1.2) to ensure that:

A. Clear, unambiguous criteria are established for contact and communication between the CCO and the maintenance manager and/or responsible personnel.

B. Clear, unambiguous criteria are developed for determining when and where maintenance personnel are dispatched.

C. Clear, unambiguous criteria are developed for determining whether the disruption results from a wayside fault and for initiating the necessary repair or replacement and check-out operations.
D. Clear, unambiguous criteria are developed for determining whether the disruption results from a Vehicle fault and making the choice between manual operation, coupling and pushing or pulling retrieval responses.

E. APM Operating System designs include failure recovery features that limit the delays to other Trains. The analysis shall include the determination of maximum delays due to isolated failures that block a track, such as a moveable failed Train, and shall consider utilization of APM Operating System features such as manual operation, automatic coupling, push/pull recovery and strategically located storage tracks. See Part 2B, Section 11.3.3.3.D.

F. Control procedures provide a clear path and method for disposition of disabled Vehicles, re-entry of recovery Vehicles and equipment and introduction of spare Vehicles into passenger-carrying Guideway.

G. Passenger transfer from disabled Vehicles is facilitated.

H. Clear, unambiguous criteria are established for recording/reporting the incident and assuring that necessary data are recorded for future use in computing APM OS Availability (see Part 2C, Section 3.2.1).

I. The SPFMA submittal shall include:

1) Input Parameters:
   a) Predicted Train performance characteristics, taking into account the weight, propulsion characteristics, aerodynamic drag characteristics and braking characteristics of the Trains, and the ride comfort requirements of Part 2B, Section 11.3.7.6.3.
   b) Guideway characteristics of the route, including vertical and horizontal curves, switches, Stations, and any speed restrictions.
   c) Station dwells times resulting from application of the requirements of Part 2B, Section 11.3.3.1.3.
   d) Passenger boarding/deboarding activity calculated per Part 2B, Section 11.3.3.1.3.
   e) Headway restrictions in accordance with Part 2B, Section 11.3.3.1.2.
   f) Train and wayside equipment failures on all Guideway segments and at each Station platform, considered singly.
   g) The locations for Guideway switches, storage tracks, and similar failure management facilities.

2) Output Parameters. The results of the SPFMA shall define APM Operating System operating characteristics of the normal and failure management modes for the APM System, and shall include, as a minimum:
   a) Round trip times and travel times between sequential Stations (Part 2B, Section 11.3.3.1.4).
   b) Line capacities (Part 2B, Section 11.3.3.1.5).
   c) Station dwells times (Part 2B, Section 11.3.3.1.3).
   d) Operational headway (Part 2B, Section 11.3.3.1.2).
e) Train velocity and time continuously presented as a function of route position.

f) The probability of, average duration of, and maximum delay to other Trains for each type of failure on each Guideway section and at each Station platform.

g) The recommended set of failure management facilities and strategies.

h) A description of the proposed failure management modes/operations to meet the requirements of Part 2B, Section 11.3.3.2.2 and Part 2B, Section 11.3.3.3.

i) The resulting headways and capacities provided for each failure operating mode during failure management operations.

The SPFMA for the APM System shall be submitted by the Developer in accordance with the Summary of Submittals list in Part 2A, Section 6.7. The performance of the APM System predicted by the SPFMA shall be verified by acceptance testing without passengers prior to the APM Operating System Demonstration. See Part 2C, Section 4.5.

The Developer shall establish and provide all failure management provisions, including but not limited to switches, pocket tracks, response/recovery personnel etc. as appropriate, and shall be able to operate failure management modes such that:

AA. The minimum available line capacity for any single point failure within the system is not less than 50% of the peak period operations Line Capacity defined in 11.3.3.1.5.1, considering that restricted access to certain CTA Station platforms during certain failures within the CTA (between the CTA East and CTA West Stations) segment are acceptable based on the available/selected failure operating mode.

BB. All line blockage(s) along any segment such as, but not limited to those caused by failed Trains, shall be cleared within 15 minutes of the event causing the blockage. (See Part 2B 11.3.5.D.1)

CC. Provide acceptable alternate emergency power to operate the APM Operating System including APM System UPS equipment at 50% of passenger capacity in the event of power failures upstream from the APM substations provided by the Developer. Alternate emergency power shall be derived from energy storage devices or generators or a combination of these that does not adversely affect the environmental compliance monitoring requirements of Part 2A Section 7.

DD. Appropriate communication and operational protocols between the Developer and LAWA during failure events, satisfactory to LAWA, are submitted as part of the SPFMA. The Developer shall incorporate the operational requirements identified during the SPFMA process into the APM System Operating Plan.

11.3.3.1.8 Design Requirements for Subsystems

The Developer shall design this APM Operating System using the design requirements for subsystems of the APM Operating System which may be more severe than fleet and operational requirements resulting from the SPFMA analysis of Part 2B, Section 11.3.3.1.7. Specifically, maximum length Trains (as established by the Developer’s analyses for all phases, see Part 2B, Section 11.3.3.1.6) loaded to the design capacity (not the normal capacity) specified in Part 2B, Section 11.3.7.3, operating on the Guideway horizontal and vertical alignment at the non-interference headway specified in Part 2B, Section 11.3.3.1.2, and in all environmental conditions.
specified in Part 2B, Section 11.3.4, shall be used as the basis for the design of the APM System Stations, the Automatic Train Control system, the Power Distribution System, switches and other APM Operating System equipment.

11.3.3.2 APM Operating System Operating Modes

Operating modes shall include at least: (1) normal operating modes for standard peak, peak-day, off-peak service and on-demand and (2) failure operating modes for failure management and unscheduled wayside maintenance-related operations. The APM Operating System shall operate in all of these modes as specified in this Part 2B, Section 11.3.3.2.

11.3.3.2.1 Normal Operating Modes

All normal operating modes shall be fully automatic, regulated operations. In these modes, the headway shall be regulated in accordance with Part 2B, Section 11.3.9.3.3.1. Actual Station dwell times shall normally be determined by the ATO subsystem and shall be based on the nominal dwell times of Part 2B, Section 11.3.3.1.3. Dwell times shall be adjustable by the CCO through the use of associated manual overrides as specified in Part 2B, Section 11.3.9.3.3.2. When normal movement of any Train is impeded for any reason, including manual intervention, the ATS subsystem shall automatically, without CCO intervention, re-establish regulated operation by adjusting Train speeds and/or Station dwell times. Current dwell time values shall be displayed to the CCO as specified in Part 2B, Section 11.3.9.3.2.1. During Peak periods, the Developer shall operate only in Pinched Loop Mode. The Developer shall submit other Normal Operating Modes of operation at other times to support Scheduled Maintenance activities as part of the APM System Operations and Maintenance Plan in Part 2C, Section 3.

11.3.3.2.1.1 Pinched Loop Mode

The normal operating mode shall be the pinched loop operating mode, with Trains operating between the two (2) end Stations (West CTA Station and ConRAC Station). In the pinched-loop mode, Trains shall operate in a counter-clockwise direction when viewed from above, with forward operations on the right-side lane of the dual-lane Guideway. They shall depart the West CTA Station and proceed along the south Guideway traveling east. As the Trains enter intermediate Stations, they shall stop on the south side of the Station platforms to allow passengers to deboard and board. As Trains approach the ConRAC Station, they shall normally enter the Station through the Guideway crossover and berth on the north side of the center-platform Station platform. After processing passengers at the ConRAC Station, Trains shall reverse direction, exit the Station and retrace the trip, this time on the north Guideway, traveling west. As the Trains enter intermediate Stations, they shall stop on the north side of the Station platforms to allow passengers to deboard and board. On the return trip, the Trains shall enter the West CTA Station through the crossover, berthing on the south track side of the Station platform. After processing passengers at the West CTA Station, Trains shall reverse direction and repeat the trip. Pinched loop operation shall be possible between any two (2) of the four (4) end platform berthing positions.

11.3.3.2.1.2 Synchronized Double Shuttle Mode

Synchronized double shuttle mode shall be selectable as the normal mode of APM Operating System operation. This mode shall be a fully automated and regulated operation under Automatic Train Control. In this mode, the two (2) Trains depart from opposite end Stations at approximately the same time and arrive at the destination Station at approximately the same time. Normally, dwell times at the Stations are set by the Automatic Train Control system to be equal. Synchronization shall be controlled in accordance with the requirement of Part 2B, Section 11.3.9.3.3.1. If the normal movement of either Train is impeded for any reason for longer than thirty (30) seconds, the APM Operating System shall automatically, without human intervention, revert to the unsynchronized double shuttle mode, with the two (2) Vehicles operating
independently of each other. As soon as the impeded Train again proceeds normally and under Automatic Train Control, provided that no other operating mode has been initiated by the Central Control Operator, the APM Operating System shall automatically revert to the synchronized double shuttle mode as quickly as practicable. Synchronization shall be reestablished by the Automatic Train Control system by adjusting Vehicle dwells. The time period during which the APM Operating System was operated in the nonscheduled unsynchronized mode shall be automatically counted as downtime in accordance with Part 2B, Section 11.3.6.2 and Part 2B, Section 11.3.6.5. Wherever synchronized double shuttle mode is called out, it shall refer to the above specified normal mode of operation. Synchronized double shuttle mode shall be initiated by the CCO, who shall select the two (2) end Stations to be served.

11.3.3.2.1.3 Single Shuttle Mode

In single shuttle mode, only one of the two (2) Guideway lanes linking the Stations of the APM Operating System shall be operational. Operation shall be fully automatic under Automatic Train Control, with dwells adjustable by the Central Control Operator. Single shuttle operation shall be initiated by the Central Control Operator, who shall select the two (2) end Stations to be served. Single shuttle mode service between different Stations utilizing a single tracking mode is required. It shall also be possible for the single shuttle mode to be operated utilizing single tracking between the two (2) end Stations (or any combination of Stations in-between); such single tracking may not be a single Guideway but a route that utilizes switches to run around segments of Guideway that may not be available for service.

11.3.3.2.1.4 On-Demand Mode

In On-Demand mode, operations may be pinched loop, dual shuttle mode or single shuttle mode depending on whether both Guideway lanes are operational or one lane or portion thereof is taken down for maintenance. The operational lanes and modes shall be selectable by the CCO. Operation shall be fully automated under Automatic Train Control. Each Station boarding platform shall be provided with a passenger service call button located to be readily accessible by all passengers. As soon as the service call button is depressed, a call for Train service shall be automatically initiated and a light on the call button shall be lighted. If the Train is at the Station where demand is sensed, the Station and Vehicle doors shall open for the prescribed dwell time, and a one-way trip to the opposite end Station shall be commanded. If the Train is at the Station other than the one from where the demand is registered, the Train shall be dispatched immediately and a round trip commanded.

If passenger demand is sensed after the Train doors have begun to close, or while a Train is in route, the demand shall be processed as above when the active Train arrives at its destination Station. At times when there is no passenger demand, the Train shall remain parked in one of the end Stations with the Station and Train doors closed.

The design, number and placement of the passenger service call buttons shall be included in the Station Equipment Design Audit.

11.3.3.2.2 Failure Operating Modes

The Developer shall provide at least the following failure operating modes primarily for failure management purposes and for maintenance of the wayside. Each failure operating mode shall be a fully automated and regulated operation which does not require manual intervention while operations are underway. All Trains operating automatically in these failure operating modes shall be fully protected by the ATP subsystem (irrespective of the CCO actions) in accordance with Part 2B, Section 11.3.5.1.1 and Part 2B, Section 11.3.9.1. The Developer shall use one or any combination of these failure modes to continue service when a section of the line is blocked due
to failure, or if a switch or Station is inoperative. Initiation and control of these failure modes shall be in accordance with Part 2B, Section 11.3.9.3.3.1.

11.3.3.2.2.1 Skip-Stop Mode

The skip-stop mode shall be a fully automated, regulated operation that may be used during failure mode operations as defined in Part 2B, Section 11.3.3.2.2. The specific skip-stop routes shall be programmed into the ATS/ATO software. This failure mode shall be from the West CTA Terminal Station to the ConRAC Station by-passing one or more of the other Stations. The Station or Stations to be skipped shall be selectable by the CCO.

11.3.3.2.2.2 Shuttle Modes

In this mode, the APM Operating System shall be operated as a dual lane or single lane shuttle, where a single Train remains on a particular lane and shuttles back and forth between two (2) Stations. The shuttle modes may be used individually or in combination with other failure modes to provide connecting service around a blockage or to connect two (2) short turnback operations.

Shuttle mode operation shall be initiated by the CCO, who shall select the two (2) end Stations to be served.

11.3.3.2.2.3 Single-Tracking Mode

In single-tracking mode, one or more sections of the Guideway are excluded from the routes, and Trains shall automatically be directed to by-pass such section or sections. This will result in bi-directional traffic on certain single lane Guideway sections.

Single-tracking mode shall be initiated by the CCO, who shall select the route Trains shall follow. The Automatic Train Control system design shall provide for the operation of single tracking on any single lane Guideway section that the crossovers shown on the Part 5, Contract Drawings/Engineering Data will allow.

11.3.3.2.2.4 Short Turnback Mode

In this mode, portions of the APM Operating System between two (2) crossovers shall be temporarily set up and operated as truncated routes.

Short turnback mode operation shall be initiated by the CCO, who shall select the two (2) end Stations to be served.

The Automatic Train Control system design shall provide for the operation of all possible short-turnback routes that the crossovers shown on the Part 5, Contract Drawings/Engineering Data will allow.

11.3.3.2.2.5 Other Failure Operating Modes

Pinched-loop, dual lane shuttle and single lane shuttle modes between the West CTA Station and the ITF East Station are required, in the event that the ConRAC Station is out of service and between the ConRAC and the Center CTA Stations in the event the West CTA Station is out of service. It shall also be possible to operate pinched-loop, dual lane and single lane shuttle modes between the West CTA Station and ConRAC Station with by-passing one or more of the other Stations. See Part 2B, Section 11.3.3.2.2.1.

11.3.3.2.3 Operational Overrides and Adjustments

It shall be possible to override and adjust the automatic operation of the APM Operating System in all modes by commands from Central Control in accordance with the requirements of Part 2B, Section 11.3.9.3.3.
When imposed, APM Operating System overrides or adjustments, except for single, one-time Train or Station overrides, shall remain in effect until removed by the CCO.

Operational overrides by the CCO that affect system capacity, including speed restrictions on the Vehicles, Guideway or system shall be considered a failure operation mode except as excluded by Part 2B, Section 11.3.6.2.D.

11.3.3.3 Failure Management

To respond to APM Operating System failures and rapidly restore the APM Operating System to full service, at a minimum, the following failure management strategies shall be provided. The Developer shall be responsible for defining and including any additional strategies to meet the APM OS Availability requirements of Part 2B, Section 11.3.6.

The Developer’s specific plans for failure management shall be fully described in the APM Operating System Operations Plan; see Part 2C, Section 3.1.

A. Central Control shall be able to detect and to reset minor anomalies and execute control functions as described in Part 2B, Section 11.3.9.

B. Each self-propelled Vehicle shall be capable of manual operation, as described in Part 2B, Section 11.3.7.20.2. This shall be implemented by means of a permanently installed manual control panel at each end of each Vehicle. Remote manual Train operation shall not be possible, regardless of the means of propulsion or control. In manual operation, the on board operator shall have direct control over all necessary Train functions, and the CCO shall have no override control of any Train functions. It shall be possible to operate a Train manually in either direction. Manual Train operations are specified in Part 2B, Section 11.3.7.20.2. Each self-propelled Vehicle/Train shall have the capability to be operated by on board personnel to operate a Train manually to push/pull any Train of the same length up to and including a maximum length Train at AW1 loading. A Train shall be switchable between the automatic and manual modes of operation only by a manual action performed on the Train by authorized personnel. A change of status (automatic to manual and manual to automatic) shall be annunciated by an audible alarm at the CCC, which shall require CCO acknowledgement to silence. It shall not be possible to affect a change-over between manual and automatic modes solely from Central Control.

C. At the Developer's option, a CCO-initiated, automatic coupling and push recovery capability without on board maintenance personnel may be proposed, in addition to the manual operations push/pull recovery of paragraph B, above. It shall be subject to LAWA's prior review and written acceptance. The design, implementation, and procedures of this feature shall be subject to technical review pursuant to Part 2C, Section 4. The Automatic Train Control system shall permit this automatic push recovery operation in accordance with Part 2B, Section 11.3.5.1.1 and Part 2B, Section 11.3.9. No safety hazards shall exist when this operation is invoked by the CCO, nor shall it cause any safety hazards.

D. The Developer shall propose adequate Guideway switches, crossovers, and/or storage lanes at the M&SF, to facilitate the storage of reserve Trains and failed Trains. The locations and quantity of these crossovers and storage lanes shall be sufficient so that:

1) The maximum delay to operational Trains due to a movable Train failure, either by restarting the failed Train or by pushing or pulling it by another Train, to be not greater than fifteen (15) minutes, and
2) Any combination of the failure operating modes of Part 2B, Section 11.3.3.2.2 can provide a line capacity as specified in Part 2B, Section 11.3.3.1.5. The failure mode performance for the locations of these features shall be confirmed in the SPFMA of Part 2B, Section 11.3.3.1.7.

E. In the event of a complete failure of the APM System, the Developer shall coordinate with LAWA to direct passengers to alternate transportation modes.

11.3.3.3.1 Recovery of Stalled Trains

The recovery of stalled Trains shall be accomplished by the following actions.

A. The CCO shall attempt to restart the stalled Train remotely by issuing a command from Central Control. The APM Operating System shall be designed so that, if the malfunction or condition that resulted in the stalled Train no longer exists, the Train shall respond to this command by automatically restarting and continuing in fully automatic service. This feature shall not apply to malfunctions that require a local reset or reset on board the Train to restore fully automatic service, as specified elsewhere in these Part 2B, Design & Construction Technical Requirements. If the same or another malfunction or condition exists that prohibits the Train from performing the command issued, a message shall be sent to Central Control identifying the conditions prohibiting performance of the command.

B. If the actions of A, above, are inappropriate or are not effective, operations or maintenance personnel shall be dispatched to the stalled Train and/or inoperable Guideway section. They shall thoroughly check the Train and/or Guideway equipment and attempt to restart the Train using on board or wayside reset devices.

C. If the Train cannot be restored to automatic operations, an operations or maintenance person shall manually drive it to the most convenient Station using the on board controls. Passengers shall be deboarded at that Station.

D. As an alternative, or in addition to the actions of B and C, above, operations or maintenance personnel shall be dispatched to the Train immediately in front of or behind the stalled Train, which, normally after unloading its passengers at the most convenient Station, shall be manually driven to the stalled Train, coupled mechanically with it, then driven manually to push or pull the stalled Train to the next Station, where passengers shall board. The coupling engagement speed and deceleration shall be limited to 2 mph or to 0.25g, respectively for item F) below. The stalled Train shall then be removed from the operational Guideway by pushing or pulling it with the recovery Train. All such push/pull operations shall have an authorized operations or maintenance person at the front, given the direction of travel, of both the failed and the recovery Trains for communications with each other and Central Control and for other safety reasons.

E. If the APM Operating System includes the CCO-initiated automatic coupling and push recovery option of Part 2B, Section 11.3.3.3.E, the recovery process shall not be started until after A, above, has been attempted. Automatic push recovery shall comply with the following requirements:

1) The wayside and Vehicle directional condition shall be remotely established and verified by the ATP subsystem to ensure that both the stalled and recovery Trains have the same direction of travel conditions.

2) The stalled Train shall be commanded to an ATP subsystem verified stopped condition with brakes applied ready for push recovery.
3) The automatic recovery Train shall be remotely commanded into an ATP subsystem verified and constrained push recovery mode.

4) The recovery Train in the push recovery mode shall proceed under ATO and ATP constraints. The speed of engagement shall not exceed two (2) mph, and the coupling deceleration shall not exceed 0.25 g.

5) The auto-coupling maneuver shall be irrevocable; if the auto-coupling maneuver is not successful on the first attempt, it shall be treated as a failure, and recovered through local manual intervention. In the event that auto-coupling is unsuccessful, manual coupling shall be performed by manually advancing the recovery Train until coupling occurs as specified in D, above. Successful completion of the coupling and entrainment shall be ATP-verified and automatically reported to Central Control.

6) Once the coupling maneuver has been completed, the newly made Train shall remain stopped with brakes set.

7) Restart of the combined Train shall be by local manual or by remote command from Central Control only and shall be in normal ATO and ATP operations control and constraints.

Passengers on the recovery Train shall be unloaded if there is a Station between it and the stalled Train when the CCO initiates this operation. Appropriate announcements shall be made in that Train and Station to minimize the likelihood of the presence of passengers on the recovery Train during the recovery operation. Announcements shall also be made on the failed Train to explain the procedure before coupling. Once coupled, the Trains shall automatically travel to the next Station, where all passengers on the stalled Train, and the recovery Train, if passengers are still on board, shall be unloaded. The combined Trains shall then proceed automatically to the M&SF, or another CCO-designated location for repair or storage of the stalled Train at speeds not greater than those that will assure operation of the coupled Train in accordance with all ATP system requirements. The recovery Train shall then be uncoupled and returned to service.

AA. If it is not possible to advance the Train manually to the Station and it cannot be pushed or pulled by an adjacent Train, then as a last resort passengers shall be evacuated in accordance with Part 2B, Section 11.3.5.1.6. After passengers have been evacuated safely from the Guideway, a failure mode of Part 2B, Section 11.3.3.2.2 may be used to restore service while the failure is cleared. Train retrieval shall then be accomplished by using a recovery Train, or by use of the maintenance and recovery vehicle (MRV), if provided (see Part 2B, Section 11.3.13.6.1).

BB. Certain Vehicle or APM Operating System equipment failures such as wheel lockup, broken axle, and power pick-up/rail damage, may result in lengthy APM Operating System interruptions that are not correctable through the capabilities and procedures outlined above. Such events shall require use of one or more of the failure operating modes specified in Part 2B, Section 11.3.3.2.2 until the failure is cleared.

Any failure management activity, such as any of the above stalled Train recovery actions, shall include the CCO and/or other trained operations and maintenance personnel providing frequent and clear information and instructions to riders, particularly those on the affected Train(s) and Station platform(s), using the Vehicle and Station public address subsystems.
11.3.3.4 APM Operating System Start-Up and Shutdown, Mode Transition, and Restart

11.3.3.4.1 Start-up and Shut-down

The APM Operating System shall be started automatically by action of the CCO; after which Trains shall be dispatched automatically into the passenger-carrying parts of the APM Operating System. Consistent with operational requirements, Trains shall assume positions along their assigned route(s) and be debunched prior to the required time to initiate service. As an alternative, Trains in a ready state may be staged along the Guideway prior to the initiation of service.

Prior to discontinuing APM Operating System service, announcements to that effect shall be made in all Stations and Trains. Trains shall continue to operate until all passengers then on board complete their trips. Then Train operations shall be terminated and maintenance personnel shall visually verify by physical inspection at the last Station at which each Train stops that each Car is empty of passengers. Trains may be staged along the Guideway or routed to storage lanes prior to returning them to the M&SF for cleaning and maintenance.

11.3.3.4.2 Mode Transition and Train Adjustments

Normal operating mode transitions and the insertion and removal of Trains into and from passenger service shall be accomplished automatically by Automatic Train Control commands initiated by the CCO and shall not require manual Train operations. The APM Operating System shall not be shut down to perform transitions or Train changes. Service mode transitions in normal operations shall be completed within one round trip period. Delays to any Train enroute during these actions shall not exceed one scheduled headway in duration. Before a Train is removed from service, appropriate announcements shall be made on that Train and at each Station it enters prior to its actual removal. The Train to be removed shall continue to operate until all passengers on board at the first announcement have completed their trips. Maintenance personnel shall visually verify by physical inspection at the last Station at which the Train stops that each Car is empty of passengers prior to its being taken out of service, as in Part 2B, Section 11.3.3.4.1.

Transitions between operating states and modes shall be measured for APM OS Availability as specified in Part 2B, Section 11.3.6.2.

11.3.3.4.3 APM Operating System Restart

APM Operating System restart refers to restoration of automatic APM Operating System operations after an irregular APM Operating System shutdown, partial or total. In this circumstance, Train locations on the Guideway are random as opposed to the controlled initialization status at APM Operating System startup. APM Operating System restart to automatic operations shall be initiated by CCO command subject to the following constraints:

A. Procedural verification that the Guideways are clear of all personnel, equipment, tools, and any obstacles to normal service.

B. ATP subsystem functions are verified to afford total APM Operating System movement protection per Part 2B, Section 11.3.9.1.

After verification of proper APM Operating System performance, passenger service shall be resumed.

11.3.3.5 Operations in Precipitation

The APM Operating System shall sustain normal operation in conditions of rain, as described in Part 2B, Section 11.3.4.8. Precipitation, and/or wet conditions shall not hinder nor degrade the normal precision starting and stopping of Trains anywhere in the APM System. The Guideway equipment shall prevent the accumulation of water particularly on running surfaces and shall be designed to facilitate drainage of water to Related Projects drainage systems.
The entire Power Distribution System, particularly the Vehicle power collection and distribution equipment, shall prevent the occurrence of electrical faults, interruption of power and/or loss of contact (power or grounding) under any precipitation conditions specified in Part 2B, Section 11.3.4.8.

Vehicle, Guideway, and wayside equipment shall prevent accumulation of water on, around or within equipment and equipment compartments in any manner that will inhibit the operation of or endanger the equipment. In particular, motors, mountings, and enclosures shall not fail due to the accumulation of water on, around, or within the motor windings.

11.3.3.6 Bi-Directional Operation and Train Orientation

All Vehicles and Trains shall be fully bi-directional, with equal propulsion and braking performance in either direction under both automatic and manual control. In addition, Trains shall be operable throughout the APM Operating System with either end in the forward direction, and in a counter-clockwise or clockwise direction without any impacts to the line capacity, headways or the round trip times.

11.3.4 APM Operating System Environmental Design Requirements

The APM Operating System shall be operated, stored and maintained as specified in Chapter 2 Operating Environment of ASCE 21 and the requirements of this Part 2B, Section 11.3.4 without impairment resulting from the environmental conditions of the following sections occurring either individually or in natural combinations. APM Operating System operations and maintenance shall not cause or induce environmental consequences greater than specified in the appropriate following sections. APM Operating System equipment shall survive, without damage, the environmental conditions to which it is subjected by the Developer at the Developer’s facilities and while being stored and shipped.

11.3.4.1 Temperature and Humidity

The APM Operating System shall be designed to, and be capable of operating in accordance with Section 2.1.1, Temperature and Humidity and Section 2.1.3, Precipitation of ASCE 21 and Part 2B, Section 11.3.4.8, Precipitation. The APM Operating System components shall operate normally for conditions outside of the above ranges as may be caused by the Developer’s specific design.

11.3.4.2 Electromagnetic Compatibility

11.3.4.2.1 General

The APM Operating System, and all of its subsystems and components, shall be electromagnetically compatible with their environments in existence prior to the issuance of the Certificate of PSA and shall comply with the requirements of Section 2.1.8, Electromagnetic Background, and Section 2.2.3, Electromagnetic Radiation of ASCE 21.

Prior to the issuance of the Certificate of Final Completion CFC, should the APM Operating System, when installed and operating, either create electromagnetic emissions that adversely affect other APM System or non-APM System equipment or be adversely affected by the surrounding electromagnetic environment, the Developer shall investigate the problem and successfully complete remedial measures that remove the adverse effect(s) without additional cost to LAWA.

11.3.4.2.2 Electromagnetic Compatibility Control Plan

The Developer shall develop an Electromagnetic Compatibility Control Plan prepared in accordance with APTA SS-E-010-98, Standard for the Development of an Electromagnetic Compatibility Plan. This plan shall be submitted in accordance with the Summary of Submittals.
list in Part 2A, Section 6.7. The Electromagnetic Compatibility Control Plan shall contain, at a minimum, the following elements:

A. Interference emission and susceptibility requirements and rationale for selection, including applicable support computations;
B. Design techniques to minimize interference coupling;
C. Safety grounding protection requirements for personnel and equipment;
D. Electromagnetic compatibility evaluation and analysis;
E. Problem area definition and fix recommendation if applicable;
F. Compliance verification requirements for operational components and associated test equipment;
G. Critical compatibility demonstration requirements including critical circuit definition and success criteria; and
H. Configuration control method.

Frequency management techniques shall be used to minimize emission spectra and receiver bandwidths and to control frequencies, pulse rise time, harmonics, sidebands, and duty cycles. The materials and fabrication/construction methods for subsystems and equipment shall inherently provide attenuation of electromagnetic emanations. Furthermore, these methods shall enhance the ability of the equipment to meet all EMI requirements. Electrical/electronic wiring and cables shall be separated and routed to minimize electromagnetic interference. The design shall take into account physical placement, bonding, and grounding of components to minimize conductive and inductive coupling among APM System and subsystem components. Bonding techniques shall conform to MIL-STD-464C.

11.3.4.3 Airborne Noise

The Developer shall design and install the APM System to comply with Noise limits in this section.

11.3.4.3.1 Exterior Noise

The exterior noise level generated by the APM System, with all contributing noise sources in operation, shall not exceed the levels specified in Table 11.3.4.3.1-1 measured in still air in the environment along the APM System. Should the required noise levels not be met, the Developer, at its own cost, shall design and install additional noise mitigation measures at the source, on the Guideway, or off the Guideway along the alignment such that the noise levels are not exceeded.

With the exception of the aforementioned noise levels, all other requirements of Section 2.2.1, Exterior Airborne Noise of ASCE 21, shall be met. The design of any barrier-type noise reducing devices along the Guideway shall be included in the appropriate Station Equipment or Guideway Equipment Design Audit.

Noise emanating from any maintenance and support equipment and any MRV or similar Vehicle shall meet all exterior noise requirements, and the use and functions of these Vehicles shall have appropriate noise muffling devices, particularly considering their normal use for maintenance during night periods.

All noise measurements are to be taken with a Train on which there are no more than three (3) test/observation personnel and necessary equipment. All auxiliary systems, including air conditioning, compressors, and pumps shall be operating. Exterior noise levels shall be measured using the instrumentation and settings specified in the referenced Section 2.2.1, Exterior Airborne Noise of ASCE 21 and Table 11.3.4.3.1-1.
Exterior noise measurements shall be made in each Station and on an open section of elevated Guideway. In the latter case an open section of elevated Guideway in the APM System shall be chosen that best represents a free field environment where reflections and any ambient noise will be the least within the APM System. A maximum length Train shall be operated with all auxiliaries in operation, including the air conditioning compressors and fans and any air compressors. At least three (3) runs shall be made for each case and data taken for at least the following cases: (1) Train operated at maximum cruise speed; (2) Train accelerating from zero speed at its maximum acceleration rate to the maximum cruise speed; and (3) Train decelerating to zero speed at the maximum service deceleration rate from the maximum cruise speed. Other runs may be made for slower speeds and/or Train operating conditions, as applicable for certain sections of the line. The Developer shall then perform a noise analysis over the entire APM System Guideways to determine compliance with the noise limits specified in Table 11.3.4.3.1-1. The Developer shall make site-specific noise measurements at locations where special noise mitigation is provided and where noise limits are analyzed to be exceeded.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Maximum dBA Level</th>
<th>Measurement Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Maximum length Train entering and leaving Station</td>
<td>(slow response) 76</td>
<td>In the Station, 5 feet from the platform edge and 5 feet above the Station floor.</td>
</tr>
<tr>
<td>B. Maximum length Train stopped in Station</td>
<td>(slow response) 74</td>
<td>In the Station, 5 feet from the platform edge and 5 feet above the Station floor, with Vehicle doors and platform doors fully open.</td>
</tr>
<tr>
<td>C. Maximum length Train traveling along the entire Guideway under any normal velocity, acceleration, and deceleration operating condition</td>
<td>(fast response) 76 (See Note 1)</td>
<td>At any point* on a cylindrical envelope co-axial with, and 50 feet from, the centerline of each Guideway lane (track), whichever is closer and in direct line of sight to the nearest noise sensitive receptor.</td>
</tr>
<tr>
<td>D. Maximum length Train traveling at 10 mph</td>
<td>(fast response) 74</td>
<td>At any point* on a cylindrical envelope co-axial with, and 50 feet from, the centerline of each Guideway lane (track).</td>
</tr>
</tbody>
</table>

*Acceptance test points shall be limited and proposed by the Developer within its accepted Test Procedures.

Note 1: Under Condition C, in addition to the fast response dBA level criteria for this condition, the Sound Exposure Level (SEL) at a measurement location shall not exceed 78 dBA.

11.3.4.3.2 Interior Noise

Noise levels inside each Car or Vehicle shall meet the requirements of Part 2B, Section 11.3.7.6.2.

11.3.4.4 Structural Borne Noise and Vibration

Vehicle interactions with the Guideway and the guidance and running structures and surfaces shall minimize the transmission of noise and vibration through the Guideway structure to the surrounding buildings and terrain during the passage of Trains. APM Operating System-induced vibrations shall be in accordance with Section 2.2.2, Structure-Borne Noise and Vibration of ASCE 21. These requirements shall be coordinated with Related Projects and be included as part of the Developer's APM Operating System Guideway Equipment Design Audit.
11.3.4.5  Air Pollution
The APM Operating System shall tolerate existing atmospheric pollution per the requirements of Section 2.1.5, Existing Atmospheric Pollution of ASCE 21.

11.3.4.6  Water Pollution
The Guideway shall be maintained so that pollutants dropped or deposited by Trains are prevented from entering the storm drainage system or on areas below the Guideway, as required in Part 3, APM System Operations & Maintenance Requirements.

The Developer shall be responsible for the discharge of water from activities at the M&SF. Discharge from activities in the M&SF, including the car wash, shall be into the sewer system. The Developer shall provide all equipment and systems upstream to contain any accidental spills prior to discharge and pretreat all discharge (e.g., oil skimming) to meet the requirements of the AHJ. The Developer shall provide all related design information, including at least flow rates and volumes and a list of APM Operating System effluents, to LAWA as part of the General Design/Construction Interface Document in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

11.3.4.7  Wind
All APM Operating System equipment shall be designed and protected to safely withstand, without damage, all design conditions required by the California Building Code and ASCE 7 for the Project area; during the design wind speed conditions.

The APM Operating System shall be capable of operating under varying wind conditions as described below:

A. In sustained winds up to and including forty-five (45) mph, the APM Operating System shall be capable of normal automatic operations, meeting all requirements of this specification.

B. In sustained wind conditions above forty-five (45) mph and below fifty-five (55) mph, the APM Operating System shall operate automatically and safely, but allowing up to twenty-five (25) percent degradation in overall performance (e.g., Train velocity, acceleration, and deceleration).

C. In sustained wind conditions at fifty-five (55) mph and below sixty-five (65) mph, the APM Operating System shall operate safely for the purpose of terminating APM Operating System operations. Either manual or automatic operations are acceptable under these conditions.

D. At sustained wind levels of sixty-five (65) mph and above, there is no requirement for any APM Operating System operations.

11.3.4.8  Precipitation
The APM Operating System shall be capable of operating in accordance with Section 2.1.3, Precipitation of ASCE 21, and this Part 2B, Section 11.3.4.8. Additional APM Fixed Facilities drainage requirements are provided in Section 8.

The APM Operating System shall be capable of normal operations during rain falling at all rates up to three (3) inches per hour. Operating Trains shall have adequate traction to sustain normal and failure operations, including acceleration, service and emergency braking, and precision Station stopping under these precipitation conditions. Developer aspects of the Guideway and emergency walkway design shall minimize the accumulation of water.
The Power Distribution System, including the Vehicle power distribution and collection equipment, shall prevent the occurrence of electrical faults, interruption of power, and loss of power and grounding contact under these precipitation conditions. APM Operating System equipment shall prevent the accumulation of water on, around, and within equipment and equipment compartments.

11.3.4.9 **Lightning Protection**

All Developer-provided equipment and facilities shall be protected against the incidence of lightning encountered in the Los Angeles (Los Angeles County) area. Lightning protection shall be in accordance with Section 2.1.4, Lightning of ASCE 21.

The Developer shall provide protection of the Developer-provided structures and equipment, as required by the APM System design. The Developer shall be responsible for coordinating all aspects of the lightning protection system with LAWA.

11.3.4.10 **Other Site-Specific Environmental Conditions**

The Developer shall determine the ambient environmental conditions in the Los Angeles (Los Angeles County) California area, in accordance with Section 2, Operating Environment of ASCE 21.

11.3.4.10.1 **Fungi and Corrosion**

The APM System shall be designed to operate with airborne salt levels in particulate and/or dissolved form appropriate for the Project area. The APM Operating System shall be resistant to the growth of fungi and similar organisms.

11.3.4.10.2 **Solar Heat Load**

Selection of materials exposed to solar radiation shall meet the requirements of Section 2.1.6, Solar Heat Load of ASCE 21.

11.3.4.11 **Earthquakes**

Earthquakes are an environmental factor at the site. APM Operating System responses to seismic ground motions shall be based on measurements from sensors as specified in Part 2B, Section 11.3.9.3.7.

The APM Operating System shall operate safely after seismic events up to the severity of the Operating Design Earthquake (ODE) as defined in Part 2B, Section 1. During APM System design, the Developer shall propose for acceptance the maximum seismic activity level at which the System will safely continue operations without shutdown or inspection, this maximum seismic activity level is defined as the Restorable Design Earthquake (RDE). Below this limit there shall be no sustained APM Operating System shutdown period; Trains may stop at the time of the earthquake, but normal operations shall resume within one minute. The Developer shall provide the value of the RDE in the APM Operating System design audit.

After a seismic event greater than the RDE specified in the preceding paragraph and up to and including an ODE-level earthquake, the Developer shall inspect the APM System to ensure safe operating status and restore it to normal service within 24 hours of the event.

After a seismic event greater than the ODE, the Developer shall inspect the APM System to assess and document any damage resulting from the event that must be repaired to ensure safe operations. Restoration of the APM Operating System to normal operations shall be accomplished as quickly as practicable; the duration of the time period required to complete any required repairs shall be coordinated and agreed with LAWA immediately following the post-earthquake inspection.
In general, the ODE service level requirement is for the facilities to be put back in service for
general operation immediately after a post-earthquake inspection verifying APM System safety.

11.3.5   APM Operating System Safety and Security Technical Requirements

This section addresses the safety and security technical requirements for the APM Operating
System. The Developer’s APM Operating System safety and security program requirements are
specified in Part 2A, Section 8.

11.3.5.1   APM Operating System Safety Technical Requirements

The Developer shall implement an APM Operating System safety program that is in accordance
with the requirements of Part 2A, Section 8.

Safety shall be the primary design and performance requirement for the APM Operating System.
The entire APM System shall operate in a safe manner under all operating conditions. Safety
critical components shall be designed according to the safety principles of Part 2B, Section
11.3.5.1.1 and shall incorporate high-reliability parts, selective redundancy, warning devices, and
protective elements, as required, to contribute to the achievement of the specified requirements.
In addition, safety must be assured when APM Operating System elements fail or malfunction.

The safety of the APM Operating System in the normal operating state (i.e., in automatic mode)
shall not depend on correctness of actions or procedures used by operating personnel. At all other
times, such as when carrying out maintenance or failure recovery, there shall be minimum
dependence on correctness of actions or procedures used by operating and maintenance
personnel. However, in no case shall procedures be substituted to accomplish any safety
functions that are to be provided by specific aspects, components, subsystems or equipment.
Frequency or infrequency of use shall not be a reason to justify unsafe or marginally safe design.

The Developer shall be responsible to design, supply, construct, and install the APM Operating
System in accordance with all the requirements of these Part 2B, Design & Construction Technical
Requirements. The Developer shall be responsible throughout the course of the Contract
Documents to bring to the attention of LAWA, in writing, any changes in such condition(s), whether
caused by its design or any other basis, which it believes might result in, or has resulted in, an
unsafe condition. Whenever any hazardous condition occurs, regardless of the cause, and the
condition results in a conflicting concern for human safety versus equipment safety, the conflict
shall be resolved in favor of human safety.

11.3.5.1.1   Safety Principles and Automatic Train Control System Fail-Safe Design

The APM Operating System shall be designed and implemented in accordance with the
requirements of Section 3.2, Safety Principles of ASCE 21.

All safety critical elements of the Automatic Train Control system shall be designed and
implemented in accordance with the requirements of Section 3.3, ATC System Fail-Safe Design
of ASCE 21.

The Automatic Train Control system shall be designed and implemented to meet the Mean Time
Between Hazard Events (MTBHE) requirements of Sections 3.5 and 3.6 of ASCE 21. The
Developer shall submit safety documentation that supports and substantiates the MTBHE
calculation as part of the Automatic Train Control APM Operating System Subsystem Hazard
Analysis (SSHA), in accordance with Part 2A, Section 8.2.2.

11.3.5.1.2   Verification and Validation

The design and implementation of all safety critical hardware and software elements of the APM
Operating System, as identified by the Hazard Identification, Analysis and Resolution Process of
Part 2A, Section 8.2.2, shall be subjected to verification and validation (V&V) in accordance with the requirements of Section 3.4, Verification and Validation of ASCE 21.

The Developer shall submit an APM Operating System Safety Critical Software Verification & Validation Plan, in accordance with the Summary of Submittals list in Part 2A, Section 6.7, describing the methods, processes and/or procedures to be used on this Project to verify and validate safety critical elements.

11.3.5.1.3 Fire Safety

Vehicle materials shall conform to the flammability and smoke emissions requirements specified in Part 2B, Section 11.3.7.14. Unless otherwise specified herein, all designs for the APM Operating System prepared by the Developer, and all material and equipment provided under the Contract Documents, shall meet the fire and life safety requirements of NFPA 130 and the applicable standards and specifications of Part 4. Vehicles shall have fire extinguishers as required by Part 2B, Section 11.3.7.15.

All fire/smoke alarms shall be annunciated at the CCC in accordance with Section 10.5.1, Fire Detection of ASCE 21. For the Hazard Identification, Analysis and Resolution Process specified in ASCE 21, refer to Part 2A, Section 8.2.2. This includes all fire/smoke alarms within the APM System.

The Developer shall provide LAWA an interface location of all APM System fire/smoke alarm signals as part of the Design Audit.

11.3.5.1.3.1 Fire on Board a Train

In the event of a fire on board a Train, it shall be moved, to the nearest designated evacuation point to evacuate passengers. If the Train is in a Station, passengers shall be evacuated and the Train shall be moved to the nearest designated point for firefighting. When it is not possible to move a Train to a designated evacuation point, passenger emergency evacuation shall be by means of the emergency walkways. Designated points for evacuation and for firefighting shall be determined in coordination with the AHJ.

It shall be possible to turn off the Guideway power by sections and for the total APM Operating System remotely from Central Control (see Part 2B, Section 11.3.9.3.3.2.J), and from blue light stations to ensure safety of passengers, APM Operating System staff, and emergency services personnel. See also Part 2B, Section 11.3.8.1.3.2.

11.3.5.1.3.2 Fire on the Guideway

In the event of a report of a fire on the Guideway, any Trains approaching the area shall be stopped immediately and, they shall be rerouted by command from Central Control to a safe location where they can be held. All other Trains shall be stopped and held in Stations. The public address system shall be used to advise the public that APM Operating System operations are being temporarily suspended.

11.3.5.1.3.3 Fire in a Station

If a fire occurs in a Station, the public address system shall be used to advise the public to evacuate. See NFPA 72, National Fire Alarm Code, and Part 2B, Section 11.3.10.1.1. Any Trains in the Station shall be dispatched, and entry of other Trains into that Station shall be prohibited. Both actions shall occur automatically as the result of an Automatic Train Control system command initiated by the CCO.
11.3.5.1.3.4 Facility Fire Detection and Suppression Subsystem

The Developer shall provide a fire protection system for the APM System that performs similar functions and is fully integrated with the existing LAWA System. Equipment will include all devices, controls, conduits, and panels necessary for the detection and reporting of fires and protection. The Developer shall provide and install any fire suppression systems as required by APM System in all APM Fixed Facilities as required by the Developer.

These systems shall be fully compatible and interface with LAWA’s existing fire protection system.

The fire detection subsystem shall be electronically supervised, closed circuit, selectively coded, and continuously self-monitoring. The subsystem will include provisions for the automatic activation of local and remote alarm devices, shutdown or re-directing of air conditioning and ventilation systems in buildings, closing of fire doors, and performing other functions in the area of an alarm. The Developer shall interface with the existing LAWA-provided fire detection and suppression systems including any Developer provided HVAC system ductwork (i.e. M&SF and APM equipment rooms).

The communications transmission subsystem shall be used to transmit alarms to the CCF and the CUP. An alarm indication shall be transmitted for each zone in a Station or other facility.

All fire/smoke alarms shall be annunciated per Section 10.5.1, Fire Detection of ASCE 21. For the hazard analysis specified in ASCE 21, refer to Part 2A, Section 8.2.2. The Developer shall be responsible for interfacing with the Station fire detection and suppression systems.

All fire detection and suppression equipment shall conform to the requirements of NFPA 72, NFPA 2001 and NFPA 130 and shall not cause damage to the APM System equipment and facilities.

11.3.5.1.3.5 Fire Management Panels

Fire management panels (FMP) at the Station facilities, at each stand-alone power substations and the M&SF shall be provided by the Developer in accordance with the requirements of the AHJ. Any additional fire management/protection required to support Developer's supplemental fire detection and suppression system shall be provided by the Developer. Such equipment shall be compatible with the FMP’s. Each FMP shall be placed in an area that is readily accessible at a location designated by the AHJ. The FMP shall provide a graphic display of the facility, audible annunciation of fire alarms, and access to the communication devices in the facility.

The display shall be a graphic representation of all areas in the facility. It shall depict all circulation elements and the means by which fire fighters can reach the area indicating a fire condition. It shall show security provisions for each area and how these can be entered. Each zone and area provided with fire detection shall be indicated on the FMP graphic display. The display shall show the area(s) in which the fire or smoke alarm has been triggered.

The FMP shall contain a service telephone with an auto-dial pushbutton for connection to the CCF. The service telephone, or a similar device, shall be capable of accessing all of the public address speakers in the facility.

The FMP shall include a master key of the level needed to open all locked doors and gates in that facility. The FMP shall be locked with a LA Fire Department master key located in a key storage box installed near the panel. The key storage box shall be openable by a standard key used by LA Fire Department. This shall be documented in accordance with the Access Control Plan referenced in Part 2B, Section 11.3.5.2.1.2. The door of the FMP shall have an intrusion alarm that shall send a signal to the CCF when the door is opened.
11.3.5.1.3.6  Fire in the Vehicle Storage Area

The Vehicle storage area of the M&SF shall provide adequate space and firefighting facilities to combat a fire event, subject to the review and acceptance by the AHJ.

11.3.5.1.4  Electrical Safety

Requirements for electrical safety are provided in the following Sections:

A. Guideway power shut offs and lockouts: Part 2B, Sections 11.3.5.1.5, 11.3.5.1.6.E and 11.3.8.1.3;
B. Vehicle emergency power: Part 2B, Section 11.3.7.8.2.2;
C. Vehicle electrical subsystem: Part 2B, Section 11.3.7.8;
D. Switchgear: Part 2B, Section 11.3.8.1.3;
E. Grounding: Part 2B, Sections 11.3.7.8.7, 11.3.8.1.5 and 11.3.14;
F. Back-up power supplies: Part 2B, Section 11.3.8.2;
G. Electrical equipment in the M&SF: Part 2B, Section 11.3.13.3; and
H. Electrical materials and workmanship: Part 2B, Section 11.3.16.

All electrical and electronic subsystems shall be enclosed in locked compartments accessible only to authorized personnel. Wiring shall be installed so it is not accessible to anyone other than authorized personnel.

11.3.5.1.5  Blue Light Stations

Blue light stations shall be provided in compliance with Part 2B, Section 11.3.8.1.3.2 and NFPA 130.

11.3.5.1.6  Emergency Evacuation

The following criteria shall be satisfied:

A. Evacuation with assistance: The APM System shall enable the supervised and orderly evacuation in a safe and timely manner of all passengers, including passengers unable to self-evacuate including any Individual with a Disability from Vehicles located anywhere along the Guideway, including Vehicles aligned or misaligned at Stations berths. Vehicle emergency exit requirements are given in Part 2B, Section 11.3.7.10.5. Evacuation of misaligned Trains requirements are given in ASCE 21 Section 10.3.

B. Evacuation without assistance: In addition to the requirements of Part 2B, Section 11.3.5.1.6.A, above, the APM System shall facilitate the safe and timely evacuation of passengers and personnel from Vehicles located anywhere along the Guideway or in the Stations without assistance but with instructions from the CCO given remotely via the Vehicle public address (PA) system. Equipment and instructions shall be provided by the Developer to ensure safe self-evacuation in conditions where supervised evacuation cannot take place.

C. The emergency walkway shall provide an unobstructed surface on which passengers can safely walk in accordance with the requirements of Part 2B, Section 11.3.11.8 and NFPA 130. Emergency egress points from such walkways and the Guideway shall be at least: (1) at each Station, (2) at any barrier on or gap in the emergency walkway, (3) as required by NFPA 130, and (4) as required by the AHJ.
D. At a minimum, the APM System shall safeguard passengers and APM System personnel anywhere on an evacuation route from hazards created by moving Vehicles, power distribution equipment, and switches.

E. The CCO shall have devices to turn off Guideway power to the entire APM Operating System and to each power distribution segment. There shall also be emergency power shut-off devices in the Stations, in the M&SF, and along the Guideways. See Part 2B, Section 11.3.5.1.5 and Part 2B, Section 11.3.5.1.7. These devices shall be protected against accidental or unintentional activation. The CCO shall not be able to override such local power shut-off devices but shall be informed of their status in accordance with Part 2B, Section 11.3.9.3.2.2.B.

F. Part 2B, Section 11.3.7.10.5 specifies requirements for Vehicle emergency exits and Part 2B, Section 11.3.9.1.7 provides control and alarm requirements for unscheduled door opening protection during an emergency evacuation.

G. The Developer shall develop emergency evacuation procedures and submit them and related design information in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

The Developer shall coordinate evacuation walkways, egress points, doors, and security during evacuation with LAWA and AHJ as part of the Guideway Equipment Design Audit.

11.3.5.1.7 APM Operating System Operations and Maintenance Personnel Safety

The APM Operating System shall be designed to ensure the safety of operations and maintenance personnel working on the Vehicles, on or near the Guideway, in APM System equipment rooms, in Stations, at Central Control, in PDS substations, in the M&SF and in the administration area. Activities necessary for the operation and maintenance of the APM Operating System shall be convenient, safe, and simple, to reduce possible hazards. Protective covers or screens for equipment and personal safety equipment shall be provided to protect maintenance personnel.

Support equipment, handbooks, manuals, and procedures shall be analyzed or evaluated to ensure that they incorporate provisions to inhibit hazards to personnel and equipment or property that could result by the use of the handbook, manual, or procedure in conjunction with related support equipment.

This shall apply during APM Operating Systems installation and test, operations and maintenance, and training of APM Operating System operations and maintenance personnel.

The APM Operating System shall be designed to allow shutdown of portions of the APM Operating System for ordinary or emergency maintenance. Devices, such as disconnect switches and lockouts, shall be provided along the Guideway and within the M&SF to prevent the accidental activation of those portions of the APM Operating System that are shut down for maintenance. These devices shall be designed and installed so that only maintenance personnel have access to them. There shall be similar provisions for Station maintenance activities that require interface with the Guideway.

The design of the M&SF and its furnishings and equipment shall consider the nature of activities required to service and store Vehicles, assemble and separate Trains, conduct pre-service testing, and make energized Vehicle adjustments or repairs required for APM Operating System operations. NFPA, NESC, U.S. OSHA standards shall be followed. The Operating & Support Hazards Analysis (O&SHA), as required by Part 2A Section 8.2.2, shall address concerns for occupational safety. The M&SF and the CCF shall be provided with sufficient first aid equipment and means to summon rapidly the local emergency services.
The Developer’s procedures for emergencies and emergency equipment shall be submitted in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

11.3.5.1.8 Non-User Safety

The APM System and all of its elements shall not jeopardize the safety of non-users who are near the APM System. Non-users shall be reasonably protected from:

A. APM System-generated debris, fluid leaks, objects dropped from the Vehicle, or knocked from the Guideway, or other by-products of normal operations, maintenance and APM System failures; and

B. The acts of passengers, such as dropping objects from a Vehicle.

The APM System shall prevent unauthorized access to the Guideway and other hazardous areas by unauthorized personnel. The APM System shall alleviate ground level hazards. Signs and other devices shall provide warnings of potentially hazardous conditions to non-users who are near the APM System.

Adequate means shall be provided to alert emergency services personnel so that people in structures and areas adjacent to the APM System can be warned and protected from fire or other hazardous conditions on the APM System. These means shall also be provided to permit emergency responses to situations arising in or near the APM System access points.

11.3.5.1.9 Departure Test

The APM Operating System shall include the necessary facilities to perform departure tests on all Vehicles/Trains. Such a departure test shall be performed periodically and prior to a Vehicle being returned to passenger service following any maintenance activity that could affect safety, including the interruption of power to any Automatic Train Control equipment. Vehicles temporarily removed from the APM Operating System shall be given the departure test before they re-enter the APM Operating System if they have been de-activated in the interim. Vehicles kept in a ready condition through the continuous application of power to their control system need not be departure tested. Each Vehicle/Train shall be routinely given a departure test at the frequencies specified in the Developer's Maintenance Plan (see Part 2C, Section 3.3). This test shall assure that essential operational functions and all safety related functions of the Vehicle are operating properly for travel in both directions before it is allowed to enter passenger service.

Multiple-Vehicle Trains and multiple-car Vehicles shall be tested in a manner that assures that the Train/Vehicle and all Vehicles/Cars comprising it receive a complete departure test. Functions in each Vehicle/Car under the control of the controlling Vehicle/Car, which has ATP and ATO control over the other Vehicles in the Train, shall be tested collectively by performing a departure test on the controlling Vehicle/Car. An abbreviated test covering those functions not under control of the controlling Vehicle/Car shall be performed on all Vehicles/Cars as part of the departure test. For the controlling Vehicle/Car, this abbreviated test may be performed as part of a series of tests that also includes a sequence to test all controlling Vehicle/Car functions involved in Train control.

Single Vehicle Trains shall be given a complete departure test. If the Automatic Train Control system has the ability to transfer the ATP and ATO control from one Vehicle to another in the Train, then this feature shall be tested and verified.

The exact procedures and equipment required for the departure test shall be developed by the Developer to suit its particular technology. These shall be detailed and listed in a Departure Test Document that shall be submitted in accordance with the Summary of Submittals list in Part 2A, Section 6.7. A list of departure test deficiencies that are acceptable for passenger service shall be included in the Departure Test Document.
The departure test shall, at a minimum, satisfy the following requirements:

A. **Equipment** - The departure test equipment shall include all equipment necessary to perform the tests, evaluate the tests, and display/report test results, together with associated interfacing devices and data-transmission channels. Any failure of the test equipment to execute a full testing sequence shall void all results of the test.

B. **Capabilities** - The departure test equipment and procedures shall be designed and installed to be substantially automated and with personnel on board the Vehicle/Train and assistance from Central Control. Although starting and stopping of the test sequence, and stopping between individual tests, may be done manually, performance of the tests themselves shall be substantially automatic. For each test, the APM Operating System shall be capable of automatically generating inputs according to a programmed sequence, sensing the results, evaluating and summarizing these results, generating GO and NO-GO signals, and displaying the summary results on a test panel. Design of the departure test system shall ensure that the test technician is an active part of the test sequence and is involved in the decision making process to determine whether the Vehicle/Train is acceptable or not acceptable.

C. **Location** - The equipment for interfacing with the Vehicle, and any other equipment necessary to perform the departure tests shall be located in the M&SF near the point where Trains enter the active part of the APM Operating System. The Developer shall provide protection for this equipment and persons performing the test against normal Train movement and the environment. Departure test equipment shall be located to allow for its convenient and rapid use and repair with minimum disruptive effect on Train movements.

D. **Malfunctions Alarms Test** - The Developer shall determine the test points on the Vehicle and the techniques to be used in testing the appropriate Vehicle diagnostic and alarm circuits. These malfunction tests shall be indicated on the CCC and/or on a separate departure-test control console. The Developer shall provide a reset control for activated malfunction alarms in the departure test equipment.

E. **Braking Equipment** - The departure test shall verify that the Automatic Train Control equipment will control the service and emergency brakes properly. Verification of bi-directional brake performance shall be by force load measurement or by measuring actual stopping distance.

F. **Doors** - The departure test shall cycle each Vehicle door open-closed-locked at least twice and verify correct operation. Each door’s sensitive edge/door recycle function shall also be verified. Each emergency exit shall be opened and closed and associated alarm reporting to Central Control shall be verified. On board maintenance personnel may be utilized to conduct the sensitive edge and emergency exit tests and to visually verify that all doors operate correctly.

G. **Vehicle-mounted Control Equipment** - The departure test shall verify that Vehicle-mounted equipment essential to automatic operations is operating properly for both directions of Vehicle operation. This shall include verification of the following functions, as specified in Part 2B, Sections 11.3.9.1 and 11.3.9.2:

1) Presence detection;
2) Unscheduled door opening protection;
3) Programmed Station stop;
4) Door operation; and
5) Train movement control.

H. **Passenger Static Signage** - The departure test shall verify that the proper orientation of the Vehicle route map is properly coordinated with the Vehicle orientation while operating on the APM System mainline track.

I. **Other Equipment** - The departure test shall verify that the Vehicle HVAC subsystem, fire and smoke detector and alarm circuit functionality, lights, and audio communications are working correctly. These functions may be verified by on board maintenance personnel, who shall also verify that all equipment is intact and that the Vehicle meets cleanliness standards.

J. **Test Results** - The results of the departure test shall: (1) indicate the operating condition of the Vehicle subsystems tested, and (2) positively establish the operating condition of the Vehicle. A Vehicle shall be rejected if it fails any element of the departure test. A failed Vehicle shall not be placed in service until corrective action is taken and a new departure test is passed.

K. **Permanent Record** - The Developer shall develop a convenient manual or computer generated form for use in recording the results of the departure tests. This form shall be included in the Departure Test Document. The test record shall include the date and time of performance of the test as well as the identification of the Vehicle(s) and the test operator. A test record shall be completed and retained in a permanent file for every departure test performed.

11.3.5.1.10 Fire Extinguishers and Personal Safety Equipment

The Developer shall provide and install fire extinguishers, personal safety equipment and associated equipment/materials, as required, in all Developer provided or Developer finished-out APM Fixed Facilities, in accordance with NFPA 10 and 130 and other applicable standards.

11.3.5.2 APM Operating System Security Technical Requirements

The Developer shall implement a system security program that is in accordance with the requirements of Part 2A, Section 8.

The APM System shall be designed, constructed, operated, and maintained to prevent the occurrence of personal injury, property damage and loss, and service disruptions resulting from acts of crime, vandalism, or sabotage. The APM System shall include the following security-related features at a minimum:

A. **Prevention** – APM System features to forestall breaches of security:

1) Remote visual and auditory surveillance of Station facilities.
2) Barriers to unauthorized intrusion into non-public areas of the APM System.
3) Protective covers to prevent damage or loss.
4) Vandal-resistant materials.
5) Access control subsystem in accordance with Part 2B, Section 11.3.5.2.1.2.
B. Detection – APM System features to permit timely detection of criminal acts:
   1) Intrusion detection alarms at equipment rooms, power substations, Guideway access/egress points, the M&SF, the CCF, and administration offices, and other restricted access areas.
   2) Passenger activated alarms.
   3) Emergency communications devices in each Car and Station.

C. Restoration – APM System features to enable rapid response to security problems and restoration of normal service:
   1) Ease of access for non-APM System emergency personnel and Vehicles.
   2) Emergency procedures training programs.
   3) Maintenance procedures that minimize repair-in-place time.
   4) Security training programs.

Security equipment shall provide audio and visual information that shall be located conspicuously and include instructions for use. Security communications equipment shall be easy for all passengers to use. All security installations shall be tamper-resistant, with both wiring and equipment protected and monitored. Procedures and equipment shall be provided for periodic testing of security subsystems.

The intrusion protection system shall be subject to the Hazard Identification, Analysis and Resolution Process specified in Part 2A, Section 8.2.2.

11.3.5.2.1 Facilities Security

Entrances to selected enclosures and rooms shall be: (1) provided with intrusion detectors and alarms as described in Part 2B, Section 11.3.5.2.1.1; and (2) posted with suitable warning signs.

The Developer shall coordinate the facility security requirements with LAWA.

11.3.5.2.1.1 Intrusion Alarm Subsystem

Intrusion alarms shall be provided to monitor security, including when the APM System is not operating. All points that provide access to restricted areas of the APM System and safety critical equipment associated with the APM Operating System shall be provided with intrusion detectors and alarms. Restricted areas are any areas where unauthorized personnel are not permitted, such as those facilities listed in Part 2B, Section 11.3.5.2.1.2. Specific access control provisions shall be coordinated with LAWA as defined in Part 2B, Section 11.3.5.2.1.2. Sensors to detect a person on the Guideway are not required.

Redundant and separately routed transmission cables shall be provided to interconnect the intrusion alarm equipment at the CCF and the Stations, M&SF, Guideway points, and other locations. The paths to CCF shall be configured such that, upon failure or loss of one path or link, the transmission equipment will automatically transfer to an alternate path or link. Failure or loss of one path shall generate an alarm at CCF.

The transmission links shall provide high speed, high quality, and interference-free data transmission in the temperature and humidity conditions of Part 2B, Section 11.3.4.1. Data transmit and receive characteristics shall have a minimum bandwidth that is sufficient to accommodate the intended frequency response and signal to noise ratio.

Intrusion alarm lines and cables shall be installed in dedicated communication wiring troughs, wireways, and/or conduit fixtures provided and installed by the Developer on the Guideway,
Intrusion alarms shall be routed to the CCF where they shall result in an audible alarm that requires CCO acknowledgment to silence the alarm, a visual alarm, and a printer recording containing an index number, location of the intrusion, time of the report of the alarm and time of the acknowledgment. Selected alarms, such as fire and security, shall also have provisions to be transmitted to other sites for use by the LAWA-designated emergency services personnel. Interface cabinets to facilitate LAWA access to such signals shall be located at the CCF. See Part 2B, Sections 11.3.9.3.4 and 11.3.12.1.1.5.

The intrusion alarm subsystem shall meet the communications delay and redundancy requirements specified in Part 2B, Section 11.3.10.3 and Part 2B, Section 11.3.10.4. Failure or loss of one path or link shall be alarmed at the CCF.

11.3.5.2.1.2 Access Control Subsystem

The Developer shall provide an access control subsystem to control personnel access to APM Fixed Facilities, particularly restricted areas. These areas shall include, at a minimum: Station equipment rooms, wayside equipment rooms, PDS substations, Guideway access/egress points, the M&SF including any gates that control access to the parking areas, and gated areas adjacent to the TPSSs, and TPSS access doors, the CCF FMP’s and the administrative offices. The access control subsystem shall include all equipment required to regulate access to these areas. The Developer shall identify, in the Design/Construction Interface Document specified in Part 2B, Section 11.3.2, all of the rooms which are to be secured by the access control subsystem. Specific requirements for the ACAMS system are included in Part 2B, Section 11.3.7. The access control subsystem shall have a hierarchical structure so that different areas and specific access points can limit access to authorize personnel and to permit authorized personnel access to different areas. Access control equipment shall be of a high security type that is not readily duplicated. The Access Control Subsystem shall be an extension of the LAWA ACAMS System, using compatible hardware, and activated by LAWA identification badges obtained through the LAWA Badging Office.

The Developer shall submit an Access Control Plan in accordance with the Summary of Submittals list in Part 2A, Section 6.7. This plan shall include the design of the access control equipment, the access zone hierarchy, the areas that will have locks, and the program to control access control equipment distribution and loss.

11.3.5.2.1.3 Video Surveillance

The Developer shall provide a Video Surveillance System (VSS) in accordance with Part 2B, Section 11.3.10.2.

11.3.5.2.2 Vehicle Security

Vehicle characteristics and features related to Vehicle security are included in Part 2B, Section 11.3.7.10 and Part 2B, Section 11.3.7.13.

11.3.5.2.3 Wayside Enclosures

Wayside enclosures shall be of stainless steel NEMA 4X construction and protected by tamper-resistant covers. All electrical connections shall be vandal-resistant and shall be in vandal-resistant enclosures. Enclosures with safety critical equipment shall have intrusion alarms as required by Part 2B, Section 11.3.5.2.1.1.
11.3.5.2.4 Security Wiring

Power supply, telephone communications, VSS, and electronic security lines entering Central Control, at each of the Stations, APM System equipment rooms, M&SF and PDS substations, and along the Guideway shall be located unobtrusively and protected. All cables shall be in rigid conduit or suitably secured in cable trays. Security measures acceptable to LAWA, for protection of hardware and software shall be provided by the Developer.

11.3.5.2.5 Guideway

Access between the Guideway and the ground or adjacent structures shall be prohibited. Guideway access shall be permitted only at Stations and at maintenance access and emergency egress points. All Guideway access and egress points shall be provided with an intrusion alarm in accordance with Part 2B, Section 11.3.5.2.1.

11.3.5.2.6 Communications

Communications devices shall be provided to ensure rapid and effective coordination between Central Control and local emergency services personnel, as accepted by the AHJ. Related audio and video communications requirements are given in Part 2B, Section 11.3.10, and related CCO functions are given in Part 2B, Section 11.3.9.3.3.2.

11.3.6 APM OS Availability

11.3.6.1 General

This section provides the requirements for APM OS Availability. APM OS Availability is a measure of the total quantity and quality of transportation service actually provided compared with that scheduled to be provided over a given time period.

APM OS Availability (A) is defined as the product of service mode availability (Am), fleet availability (Af), and Station platform availability (As), each of which is determined for the same specific service mode and time period.

The normal operating modes defined in Part 2B, Section 11.3.3.2.1 shall be provided and shall receive full credit when provided according to the schedule in Part 2B, Section 11.3.3.2.1. The failure operating modes of Part 2B, Section 11.3.3.2.2 used for failure management purposes may receive partial APM OS Availability credit as described below. Override commands by the CCO that affect system capacity or performance (including but not limited to reduced speed modes) shall be considered a failure operating mode and may be eligible for partial system availability credit.

The units of hours used to calculate service availabilities shall be taken from actual measurements made in hours, minutes and seconds. Accuracy of all intermediate calculations and results shall be rounded to the thousandths of an hour.

11.3.6.2 Service Mode Availability

Service mode availability for each time period during which a specific operating mode is provided is defined as:

\[ A_m = \frac{AMH}{SMOH} \times RC \]

Where:

A. **AMH - Actual Mode Hours** - The total time, in hours, that the APM Operating System is scheduled to provide passenger service in the specific operating mode
minus the total time, in hours, of all mode downtime events occurring while the APM Operating System is scheduled to provide service in the specific operating mode, including Trains stopping at all platforms on their assigned route and providing the required capacity. AMH is calculated by subtracting mode downtime hours from scheduled mode operating hours. AMH = (SMOH-MDH).

B. **MDH - Mode Downtime Hours** - The total time, in hours, of all mode downtime events occurring while the APM Operating System is scheduled to provide service in the specific operating mode.

C. **Mode Downtime Event** - An event in which one or more APM Operating System-related problems cause an interruption of the normal service provided by the desired operating mode. For the purposes of calculating service mode availability, examples of interruption to normal service are Trains not stopping at assigned Station platforms or not providing the required capacity. When such an interruption occurs, downtime for the event shall include all the time from the beginning of the interruption until all Trains stopped on the Guideway are restarted and normal operation in the scheduled mode is restored (i.e. continuously and normally equal Train spacing). A Train stopping on the Guideway or failing to depart from a Station shall be considered a mode downtime event. Downtime events of a duration that are less than one operational headway shall not be counted in the calculation of service mode availability, but shall be counted for Part 2B, Section 11.3.6.6.2 downtime limits purposes. Stoppages resulting from causes listed below as exclusions shall not be counted as mode downtime events.

D. **Exclusions** - The following events are not attributable to the APM Operating System itself and are not Mode Downtime Events. Delays due to these exclusions are not to be used in determining service mode availability, and shall result in the entire period affected by them being deleted from consideration in calculating service mode availability (i.e. SMOH is reduced), but not from data collection and storage. All data collection means shall include all periods of time; exclusions shall be determined subsequently upon review by the Developer and LAWA.

1) The time period to transition from one scheduled operating mode to another scheduled operating mode or adjusting scheduled fleet size or both, provided that 1) the APM Operating System shall not be shut down to perform transitions or Train changes. 2) Service mode transitions in normal operations shall be completed within one round trip period. 3) Delays to any Train enroute during these actions shall not exceed one scheduled headway in duration. Valid transition periods shall not be counted in calculating \( A_m \). The time to change into and out of a lesser, nonscheduled, operating mode due to a failure of the scheduled, or higher capacity mode, operating mode shall not be excluded, but shall be counted as the lower of the operating modes. Mode Downtime Events that are the result of inserting or removing Trains that occur during a non-valid transition time(s) shall not be excluded when calculating \( A_m \).

2) Passenger-induced interruptions or delays.

3) Interruptions caused by loss of utility service, electrical power provided outside the nominal range will be excludable above the 50% passenger capacity limit required by Part 2B Section 11.3.3.1.7.CC, Vehicle diversion resulting from intended security or passenger emergency event responses, and acts or omissions of LAWA or its agents or contractors.
4) Periods of scheduled operating times when the specified environmental limits of Part 2B, Section 11.3.4 are exceeded.
5) During occurrence of a Station Downtime Event for availability reductions due to that station being unavailable.
6) Operational delays induced by the Automatic Train Control system to regulate Train operations, maintain schedules and for anti-bunching; where such delays do not exceed the operational headway for the route.

E. **RC - Reduced Capacity Factor** - Used to calculate partial APM Operating System mode availability during failure mode operations. RC factor cannot exceed 1.0 values and are to be calculated by the Developer. When the APM Operating System is not in any failure mode, RC factor shall be equal to one. Operating Modes that provide minimal benefit to LAWA and are not accepted as valid Operating Modes in the SPFMA shall not have a RC factor greater than 0.10.

F. **SMOH - Schedule Mode Operating Hours** - The amount of time recorded in hours for which a specific operational mode of service is scheduled to be provided.

11.3.6.3 **Fleet Availability**
The fleet availability for each time period during which a specific operating mode is provided accounts for fleet reliability and the ability to provide the scheduled capacity at the scheduled operational headway and is defined as:

\[ A_f = \frac{ACH}{SCH} \]

Where

A. **ACH - Actual Car Hours** - The cumulative Car hours of scheduled Cars that are Fully Functional and have actually operated in the APM Operating System for the specific operating mode period. Cars are considered to be in the APM Operating System for the specific operating mode between the time they have performed a normal dwell at an assigned Station and the time they complete a normal dwell at their last assigned Station. ACH is the product of the scheduled number of Cars in the specific operating mode and the number of hours during which the mode and Cars are scheduled to operate, minus Car Downtime Hours. The actual number of Car hours shall not exceed the scheduled number of Car hours in the aggregate. When the actual number of Cars in a Vehicle/Train exceeds the scheduled number of Cars in the Vehicle/Train, no more than the scheduled number of Cars shall be counted towards Actual Car Hours for that Vehicle/Train.

B. **Car Downtime Hours** - The total time, in hours, of all Car downtime events occurring while the APM Operating System is scheduled to provide service in the specific operating mode period.

C. **Car Downtime Event** - An event in which the service of a scheduled Car is interrupted or the scheduled Car is not fully functional, for a duration equal to or greater than twice the scheduled minimum operational headway. A Car Downtime Event is quantified by total hours of the total scheduled Cars affected and begins at the time a scheduled Car fails to provide service or loses its status, and ends at the time the Car begins to provide service, becomes, is replaced in the operating fleet by a Car, and/or is no longer required as a scheduled Car. A Car occupied by passengers cannot be removed from service and replaced with a Fully-
Functional Car until all passengers have safely reached and deboarded at a Station. Events caused by conditions (2), (3), (4), (5), (and 6) of Part 2B, Section 11.3.6.2.D shall be excluded.

D. **Fully Functional Cars** - A Car shall be Fully Functional if it does not have a Priority I or II malfunction, as defined in Part 2B, Section 11.3.7.21.1 and Part 2B, Section 11.3.9.3.4.1 and shall be defect free, i.e. no broken or scratched windshields, broken seats, damaged or missing panels (interior or exterior), and/or damaged flooring, etc. A Car in manual mode shall not be considered to be Fully Functional. A Car with a CCO override command shall not be considered to be Fully Functional.

E. **SCH - Scheduled Car Hours** - The product of the total number of Cars scheduled for operation for the specific operating mode and the time, in hours, scheduled for that mode.

Where individual Cars are not provided, this Part 2B, Section 11.3.6.3 shall apply to Vehicles. See Part 2B, Section 11.3.7 for definitions and discussion of Car, Vehicle and Train.

11.3.6.4 **Station Platform Door Availability**

The Station platform door availability for each time period during which a specific operating mode is provided is defined as:

\[ A_s = \frac{APDH}{SPDH} \]

Where:

A. **APDH - Actual Platform Door Hours** - APDH is the product of the scheduled number of Station platform doors operated on the APM Operating System and the time, in hours, of the specific operating mode, minus the total time of all Door Downtime Events.

B. **SPDH - Scheduled Platform Door Hours** - SPDH is the product of the scheduled number of Station platform doors required to be operable and the time, in hours, for the specific operating mode. In no case shall the actual number of doors exceed that scheduled, either in the aggregate or at any Station platform. If a Station platform is not served because the Guideway to it is blocked, it shall not be included in \( A_s \) but the event shall be counted as a downtime for the calculation of service mode availability.

C. **Door Downtime Event** - Any failure of Station, wayside, or other APM Operating System equipment or of software that renders a platform door not operable when commanded to operate shall be counted as a door downtime event. For purposes of determining a door downtime event, Station platform doors consisting of two, bi-parting panels shall be considered as one door. A failure of one or both of the bi-parting panels at the same time shall be counted as one door downtime event. A door downtime event begins at the time a scheduled door fails to operate normally and ends once the door operates normally through its first subsequent dwell cycle. Separate door downtime events occurring at the same time shall be counted individually and considered as different events.

D. **Exclusions** - The duration of time a Station platform is closed due to conditions (2), (3), (4), and (5) of Part 2B, Section 11.3.6.2.D, or the closing of a Station or platform for other than APM Operating System problems shall also be excluded.
At an end Station with two (2) platforms, if only one is required for service, the failure of one platform shall be excluded if the switchover occurs within one minute and no Train is affected by the failed platform.

11.3.6.5 APM OS Availability Determination

For a specific time period \((i)\), \(A_m\), \(A_f\), and \(A_s\) shall be calculated in accordance with Part 2B, Sections 11.3.6.2, 11.3.6.3, and 11.3.6.4, respectively, for the mode, fleet, and Station platform doors required for the specific operations scheduled for that mode. APM OS Availability shall be calculated as the product of \(A_m\), \(A_f\), and \(A_s\). APM OS Availability for that period of time shall then be calculated as:

\[ A_i = A_{m(i)} \times A_{f(i)} \times A_{s(i)} \]

If a downtime event occurs and service is not restored within the time specified in Part 2B, Section 11.3.6.2.C to that scheduled for the APM Operating System, but rather a lesser service mode is operated for failure management as defined in Part 2B, Section 11.3.3.2.2, then the entire time period for operating in any failure mode shall be counted as partial mode downtime. To determine \(A_m\), for the time period the APM Operating System operates in failure mode, the appropriate RC factor as defined by the Developer. Fleet and Station availability, \(A_f\) and \(A_s\) respectively, shall be determined in accordance with the requirements of Part 2B, Section 11.3.6.3 and Part 2B, Section 11.3.6.4 for that lesser mode of service over that period.

Downtime for an event shall be counted either with regard to the APM Operating System, or the fleet, or the Station platform consistent with that portion of the APM Operating System that is disrupted and shall not result in either double- or triple-counting of downtime. Where it may be possible to count a downtime event in more than one area (i.e., mode, or fleet, or platform), it shall be counted in that area that best measures the quantity of service that is not available.

Depending on the type of service provided, an extended period of downtime may be redefined to be two (2) or more downtime events, each measuring best the quantity of service that is not available.

Cumulative APM OS Availability \(A_c\) is calculated as follows (reference Table 11.3.6.5-1):

A. Each service period (Column 1) is defined by the actual operating mode scheduled to be provided or actually provided.

B. For each service period, the data shown in Table 11.3.6.5-1, Columns 2, 3, 8, 9, 11 and 12 shall be provided.

C. The calculated service mode availability (Column 6), recorded service mode availability (Column 7), fleet availability (Column 10) and Station availability (Column 13) shall be determined following the instructions of Table 11.3.6.5-1.

D. The time-factored APM OS Availability (Column 14) shall be determined following the instructions of Part 2B, Table 11.3.6.5-1.

E. The cumulative APM OS Availability \(A_c\) for any calendar time period is the sum of the time-factored APM OS Availabilities (Column 14) during the calendar period divided by the sum of all scheduled service times (Column 2) for the same calendar period. (See instructions in Table 11.3.6.5-1).

The Developer shall provide an automated process to gather and analyze the data required for calculating APM OS Availability and for accountability of Mode Downtime Events against the specified limits of Part 2B, Section 11.3.6.6.2. This process, including the details of definitions, RC factors, calculations, and reporting, shall be included in the APM Operating System Assurance.
Monitoring Plan in Part 2A, Section 6.7. This automated process may also include the collection of other data related to service quality.

The Developer shall provide graphs or charts of Train location versus time, ‘string charts’, for each calendar day. The time resolution shall not be less than one minute.

The Developer shall provide a specific list of failure modes and the Developer shall calculate RC factors for each failure mode as part of the SPFMA. The RC factors shall be determined, based on the APM Operating System Performance and Failure Management Analysis (see Part 2B, Section 11.3.3.1.7), as a ratio of the quantity of service delivered by the lesser service mode to that of the scheduled normal service mode. For example, for a dual-track shuttle operating mode, failure of one track would render fifty (50) percent of the APM Operating System inoperable and would reduce the service delivered by fifty (50) percent. An additional reduction in RC shall be applied to account for the loss of access to a platform or passengers transferring at a Station resulting from any Failure Operating Mode.
Table 11.3.6.5-1: APM OS AVAILABILITY DATA TABLE

<table>
<thead>
<tr>
<th>Service Period (n)</th>
<th>Service Time In Hours (T_i)</th>
<th>Scheduled Service Mode</th>
<th>Actual Service Mode</th>
<th>Applicable &quot;RC&quot; Factor</th>
<th>Calculated Service Mode Availability (A_m)</th>
<th>Recorded Service Mode Availability (A_m)_i</th>
<th>Scheduled Car Hours</th>
<th>Actual Car Hours</th>
<th>Fleet Availability (A_f)</th>
<th>Scheduled Platform Door Hours</th>
<th>Actual Platform Door Hours</th>
<th>Station Platform Door Availability (A_s)</th>
<th>Time Factored APM OS Availability (T_i x A_f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
<td>(7)</td>
<td>(8)</td>
<td>(9)</td>
<td>(10)</td>
<td>(11)</td>
<td>(12)</td>
<td>(13)</td>
<td>(14)</td>
</tr>
<tr>
<td>One Line for Each Date &amp; Time Period</td>
<td>(Hours)</td>
<td>(Mode)</td>
<td>(Mode)</td>
<td>(1 or RC)*</td>
<td>(See Part 2B, Section 11.3.6.2.2)</td>
<td>(5)X(6)</td>
<td>(See Part 2B, Section 11.3.6.3)</td>
<td>(See Part 2B, Section 11.3.6.4)</td>
<td>(9)/(8)</td>
<td>(See Part 2B, Section 11.3.6.4)</td>
<td>(12)/(11)</td>
<td>(2)X(7)X(10)X(13)</td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>Sum all Hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cumulative APM OS Availability

\[ A_c = \frac{\sum_{i=1}^{n} (T_i \times A_i)}{\sum_{i=1}^{n} T_i} \]

RC Factors shall be submitted by the Developer, subject to review and acceptance by LAWA, for alternate mode or failure modes planned by the Developer for deployment when the scheduled mode cannot be achieved.
11.3.6.6 APM OS Availability Requirements

This section sets the availability requirements for APM Operating System acceptance. These availability measures and levels shall continue to be required after the issuance of the Certificate of Final Completion (CFC) for the operating and maintenance period, as defined in the O&M Period Operations and Maintenance Requirements.

11.3.6.6.1 APM OS Availability Levels

APM OS Availability requirements for passenger service availability and final completion are set forth on Exhibits I5R and 15F respectively of the Agreement.

11.3.6.6.2 Mode Downtime Limits

In addition to the APM OS Availability requirements of Part 2B, Section 11.3.6.6.1, during the qualifying thirty (30)-day APM Operating System Demonstration and during each month of operation and maintenance of the APM Operating System prior to the issuance of the CFC, the total APM Operating System shall not exceed the following mode downtime limits:

<table>
<thead>
<tr>
<th>Length of Mode Downtime Event</th>
<th>No. per Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater than 0 seconds and less than or equal to 1 minute</td>
<td>250</td>
</tr>
<tr>
<td>Greater than 1 minute and less than or equal to ten (10) minutes</td>
<td>30</td>
</tr>
<tr>
<td>Greater than ten (10) minutes and less than or equal to twenty (20) minutes</td>
<td>2</td>
</tr>
<tr>
<td>Greater than twenty (20) minutes</td>
<td>0</td>
</tr>
</tbody>
</table>

Additionally, no more than ten (10) Mode Downtime Events of any duration shall occur during any day of operation. Every event that occurs beyond the tenth event in a single day shall be considered as an event greater than 1 minute, or the actual duration of the event, whichever is larger.

11.3.7 Vehicle

Vehicles shall be automatically controlled and operate normally without a driver. Multiple or single-Vehicle Trains shall be used as necessary to meet APM Operating System requirements. All Vehicles provided for the APM Operating System fleet shall be essentially identical and shall operate interchangeably in any Train and on any part of the APM Operating System.

All Trains shall be 1) configured with the same types of Vehicles, 2) be of equal length but it shall be permitted and possible to concurrently operate any combination of Trains of different lengths at the same time in any operating mode, and 3) the maximum length Train shall not exceed the Station platform length available after all circulation and other requirements (overrun distance, etc.) are met.

11.3.7.1 Dynamic Envelope and Clearances

11.3.7.1.1 Vehicle Dynamic Envelope

The Vehicle dynamic envelope shall be defined in accordance with Section 7.2, Vehicle Dynamic Envelope of ASCE 21.

The worst-case Vehicle dynamic envelope at any location along the Guideway shall be used to calculate the clearance requirements of Part 2B, Section 11.3.7.1.2.

11.3.7.1.2 Clearance Requirements

The APM Operating System shall be designed and installed so that the Vehicle dynamic envelope is separated from all stationary equipment and structures by at least four inches.
Appropriate clearance shall be provided between the Vehicle and other APM System equipment and structures, including power rails and undercar equipment, to ensure proper and safe operation.

The minimum horizontal clearance between worst-case combinations of Vehicle dynamic envelopes on adjacent Guideways shall be 12 inches, reflecting all effects of super elevation and Guideway curvature.

Specifically excluded from these clearance requirements are the platform gap and the horizontal distance between the Station platform doors and Vehicle doors, which shall be as specified in Part 2B, Section 11.3.7.10.4. Contact between the Vehicle side and the platform edge may be permitted in extreme failure conditions as long as the protective features of Part 2B, Sections 11.3.7.9.4 and 11.3.12.1.1.2 are provided.

11.3.7.2 Vehicle Space and Weight Allocations

The following are Vehicle passenger area and weight allocations for the purposes of these Part 2B, Design & Construction Technical Requirements.

Total passenger area shall be all of the area available to and intended for seated and standing passengers. Standee floor area is defined as the area available to standing passengers and is equal to the total passenger area less 4.5 ft² for each fixed seat position. For calculating the number of seat positions on benches, 18 inches of bench width and no more than 24 inches of bench depth shall be allocated for each seat position.

Vehicle allocated loadings are defined as follows:

A. AW0 - The weight of an empty Vehicle, ready to be operated.

B. AW1 - The Vehicle design weight, calculated by adding AW0 with the product of 160 pounds per passenger multiplied by the design capacity (See Part 2B, Section 11.3.7.3).

C. AW2 - The maximum Vehicle weight or “crush load”. This weight shall be calculated by adding AW0, 107 lbs/ft² of standee floor area, 160 pounds for each fixed seat position, and 36 lbs/ft² of interior plan area not included in the total passenger area. This definition shall apply for references to AW2 in the ASCE APM Standards.

D. AW3 - This weight, as defined in Section 7.1, Vehicle Capacity and Load of ASCE 21, shall be AW2 as defined above. All references to AW3 in the ASCE APM Standards shall be interpreted to be AW2 as defined above.

11.3.7.3 Vehicle Capacity

The Vehicle passenger capacity shall be determined based on the Vehicle passenger area definitions of Part 2B, Section 11.3.7.2 and the provisions of this Part 2B, Section 11.3.7.3. Each Vehicle shall comply with the accessibility provisions specified in Part 2B, Section 11.3.7.6.4. Flip up and stowable seats shall be prohibited.

For the purposes of these Part 2B, Design & Construction Technical Requirements, the following definitions of Vehicle capacity shall be used:

A. Seating Capacity - Seating capacity is the number of seat positions provided for passengers (not including wheelchair passengers). Each Vehicle shall have a seating capacity of at least ten (10) percent and not more than fifteen (15) percent of the normal capacity, unless the seats are integrated into the body of the Vehicle and cannot be removed.
B. Design Capacity - Design capacity shall be calculated by assuming all seat positions are occupied by passengers, no wheelchair passengers, and one standing passenger for each 2.7 ft² of standee floor area.

C. Normal Capacity - Normal capacity shall be calculated by assuming all seat positions are occupied with passengers, no wheelchair passengers, and one standing passenger for each 6 ft² of standee floor area.

In calculating design and normal capacities, the number of standing passengers shall be rounded downward to the nearest integer.

11.3.7.4 Vehicle Structure

This section defines the structural requirements for the APM Operating System Vehicles. Prior to beginning fabrication, the Developer shall develop a set of criteria to be used for the design of the Vehicle structure. Upon LAWA's acceptance of these criteria, the Developer shall perform a complete structural analysis of the Vehicle, in accordance with Part 2B, Section 11.3.7.4.2, to demonstrate that the design will withstand the loads defined in Part 2B, Section 11.3.7.2 over the range of environmental conditions defined in Part 2B, Section 11.3.4 without permanent deformation or failure during the entire design life and duty cycle of the Vehicle as defined in Part 2B, Section 11.3.7.5. The Developer shall also analyze the tipping stability (see Part 2B, Section 11.3.7.4.3) and crashworthiness (see Part 2B, Section 11.3.7.4.5) of the Vehicle on the Guideway.

The Vehicle structure shall be designed and manufactured for the Vehicle design life specified in Part 2B, Section 11.3.7.5.

11.3.7.4.1 Structural Design Criteria

The Developer shall develop the detailed structural design criteria for the Vehicle. The following subsections specify minimum requirements for both Cars and Vehicles for specific structural design criteria.

11.3.7.4.1.1 Design Loads

Design loads shall be defined in accordance with Section 7.4.4.1, Design Loads of ASCE 21, and the following:

A. Application of the required 485 pound (2157 N) loading on each seat pan, seat structure and attachments to the structure per Section 7.4.4.1.2, Worst-Case Loads of ASCE 21, shall be as follows:
   1) A downward vertical load applied uniformly to seat pan.
   2) A downward vertical load applied uniformly along the front edge of the seat pan.
   3) A rearward horizontal load applied at the top of the seat back.

B. Seat-back handholds shall withstand 25,000 suddenly applied loads in each longitudinal and lateral direction of a horizontal force of 125 pounds (556 N) with less than one-quarter inch permanent deformation and without visible deterioration.

C. The requirement for the perpendicular static loading force of 220 pounds (979 N) on a 4 inch by 4 inch area (10 cm by 10 cm), as specified in Section 7.4.4.1.2, Worst-Case Loads of ASCE 21, shall also apply to glass door panels. If that location is a glass surface, glass shall not become loose or damaged.

D. Jacking and lifting loads shall be considered in the design of the Vehicle structure as provided in Part 2B, Section 11.3.7.4.4.
11.3.7.4.1.2 Material Properties

Material properties shall be in accordance with Section 7.4.4.3, Material Properties of ASCE 21. Regardless of the ASCE requirements, any structural material in which the yield strength exceeds 80 percent of the tensile strength shall not be used, unless it can be substantiated to have a proven record of successful use in a similar transit application.

11.3.7.4.1.3 Paints, Coating, and Protection of Metals

Paints, coating and protection of metals shall be in accordance with Section 7.4.4.4, Paints, Coatings, and Protection of Metals of ASCE 21, except that the referenced structural design life shall be as specified in Part 2B, Section 11.3.7.5.

11.3.7.4.1.4 Allowable Stress

Allowable stress shall be determined in accordance with Section 7.4.4.5, Allowable Stress of ASCE 21, except that the hazard analysis of component failure shall be in accordance with Part 2A, Section 8.2.2.

11.3.7.4.1.5 Deformation

Elastic deformation shall be in accordance with Section 7.4.4.6, Deformation of ASCE 21, with the additional requirement that the deflection anywhere on the floor shall not exceed 1.0 inch over a span of 800 inches (or equivalent ratio) from the normal plane with the Vehicle loaded to AW2 and rigidly supported at the bogie/truck mounting points or equivalent suspension mounting points.

11.3.7.4.1.6 Vehicle Connections

Structural joints and connections shall be in accordance with Section 7.4.4.7, Structural Joints and Connections of ASCE 21. Additionally, couplers, drawbars, and articulation connections shall withstand tensile and compressive forces not exceeding the Vehicle or Car buff strength but greater than the maximum loads that the Vehicle or Car may experience in service and normal yard operations and as required to meet the crashworthy design requirements of Part 2B, Section 11.3.7.4.5 without damage or permanent deformation. All exposed parts of the coupler on which a person can stand shall withstand a downward vertical load of 350 pounds without damage or permanent deformation. These connections shall be designed so that no combination of Vehicle deflections, including suspension failures and flat tires, and Guideway geometry shall cause the connection to bind or result in stresses that will damage the connection or the Vehicle.

11.3.7.4.1.7 Equipment

The design loads for all underfloor equipment and roof-mounted equipment, equipment boxes, equipment hangers, safety hangers, standby supports, and any parts of the Car/Vehicle to which these items are attached shall not be less than forces resulting from an acceleration of 3.0 g in the longitudinal direction, nor less than forces resulting from an acceleration of 2.0 g in either the vertical or lateral directions. These loads, applied separately, shall not result in stresses that exceed the guaranteed minimum yield strength of the material. The strength of a fastener or the local area of the fastened structure shall not be the limit of the load-carrying capacity of that structure.

11.3.7.4.1.8 Vibration

All structural body and panel natural frequencies shall be designed in accordance with Section 7.7.5, Vibration of ASCE 21, and shall be sufficiently removed from primary excitation frequencies to preclude any damaging resonant vibrations at all speeds and power conditions up to 110 percent of maximum cruise speed. Carbody frequencies shall not couple with suspension
frequencies and the combination of carbody and suspension shall not couple with Guideway frequencies. The Developer shall provide calculations to confirm compliance with this requirement. If a vibration as specified above remains, the Developer shall locate and eliminate the vibration.

11.3.7.4.2 Structural Analysis

This section defines the requirements for structural analysis by the Developer based on the criteria established in accordance with Part 2B, Section 11.3.7.4.1 and compliance with requirements of Part 2B, Section 11.3.7.4.3 through Part 2B, Section 11.3.7.4.6.

The Developer shall perform a complete structural analysis of the Car/Vehicle body structure, suspension and guidance elements, underframe, and equipment supports in accordance with Section 7.4.1, Structural Analysis of ASCE 21. The Vehicle Structural Analysis shall be submitted for review by LAWA in accordance with the Summary of Submittals list in Part 2A, Section 6.7. At a minimum, the analysis shall consist of a combination of manual and/or computerized calculations and finite element analysis. Finite element analysis shall be used, at a minimum, for any complex structural element whose failure affects safety or availability. The analysis shall include at least the following:

A. Structural arrangements and layouts of the Car/Vehicle and suspension/guidance elements. Materials and sizes of structural elements and the method of fastening shall be defined.
B. Diagrams showing externally applied loads and boundary conditions. Where finite element analysis is used, diagrams showing the element and node numbers, and their relation to each other and the Car/Vehicle and bogie structures.
C. Documentation showing the properties of the materials used in the Vehicle structure. This shall include at least the guaranteed minimum yield and ultimate strengths, elongation, Young's modulus, and allowable fatigue stress data for each material.
D. Detailed stress calculations, including calculation of the safety margin, for each structural element.

A previous structural analysis may be used, provided that it meets the requirements of Section 7.4.2, Previous Structural Analysis of ASCE 21, and this Part 2B, Section 11.3.7.4.2.

11.3.7.4.3 Tipping Stability

Vehicle stability shall be in accordance with Section 7.4.4.8, Tipping Stability of ASCE 21. Further, the Developer shall analyze the tipping stability for a single Vehicle and all possible Train lengths up to and including maximum length Trains loaded to both AW0 and AW2 using the appropriate center of gravity location for each. Worst-case forces generated by linear induction motors and other equipment that affects stability shall be included in the analysis.

The Tipping Stability Analysis shall be submitted for review by LAWA in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

11.3.7.4.4 Jacking Pads and Hoists

The Vehicle design shall comply with the requirements of Section 7.4.4.2, Jacking and Lifting of ASCE 21. Further, adequate attachment points for hoisting the Vehicle with a crane, including any special slings or fixtures, shall be provided by the Developer. Jacking pads shall be provided to facilitate jacking the chassis at all suspension tie-down points and the trucks/bogies, if necessary. Jacking pads shall have an alignment hole or at a minimum, an anti-slip feature. If the cabin is not integral with the chassis, jacking pads or hoisting points shall be provided to permit
its removal. It shall be possible to jack or hoist the Vehicle where required to recover a disabled Vehicle or Train at all locations along the Guideways.

11.3.7.4.5 Crashworthy Design

Vehicle crashworthiness shall be shown by analysis (per Part 2B, Section 11.3.7.4.2) to comply with Section 7.4.4.9, Crashworthiness of ASCE 21, except as specified below. Additionally, the structure design shall allow end sill yield prior to failure of the anticlimbing mechanisms or attachments.

The Crashworthiness Analysis shall be submitted for review by LAWA in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

11.3.7.4.5.1 Vehicle/Vehicle Collision

The collision of either end of a Vehicle/Train, for any Train condition between the shortest-length at AW0 and a maximum length at AW2, and another AW2 loaded Train of any length parked on a level Guideway with its brakes not applied; (1) at any speed up to 5 mph shall not cause any damage to the Vehicles of either Train; and, (2) at any speed greater than 5 mph up to the maximum speed at which the Vehicle/Train may be operated manually, but not subject to ATP, shall not cause any damage to the integrity of the Vehicle passenger compartments of either Train, any hazardous high voltage damage, or damage to the Guideway structure. During such collisions, the Vehicles/Trains shall not be derailed, i.e., demate from running and guidance surfaces, except for the power collector.

Exception to the above requirements for collisions at speeds up to 5 mph may be granted when Trains are located on curves or in crossovers if the Developer can show that operational procedures and control system speed restrictions are in place such that Vehicle to Vehicle impacts cannot occur at a speed greater than 5 mph. Damage shall be limited to cosmetic damage to the Vehicles only.

11.3.7.4.5.2 Vehicle/Buffer Collision

11.3.7.4.5.2.1 Collisions with Buffers within the Passenger Carrying APM System

The buffers (overtravel protection device) located at ends of tracks within the passenger-carrying APM System shall stop a Train at any condition between a shortest-length Train at AW0 and a maximum length Train at AW2 from any speed: (1) up to 5 mph without any damage to the Train, the buffer and the Guideway, except for cosmetic damage; and, (2) from 5 mph up to the maximum speed at which the Vehicle may be operated manually, but not subject to ATP, without any damage to the Vehicle passenger compartment integrity, any hazardous high voltage damage, or damage to the buffer and Guideway structure. During such collisions the deceleration shall not exceed 1.2 g and the Train shall not leave the Guideway.

If the retrieval of a disabled Vehicle/Train is performed by pushing or pulling it with another Vehicle/Train, the above requirement shall be expanded to include both Vehicle/Trains at any loading condition up to and including AW1. The Developer shall ensure proper design of the buffers and supporting devices for loads imposed as above and shall ensure that these loads do not overstress the Guideway structure.

11.3.7.4.5.2.2 Collisions with Buffers within the Non-Passenger Carrying APM System

At ends of tracks within the non-passerger carrying portions of the APM System, such as in the M&SF, the requirements of Part 2B, Section 11.3.7.4.5.2.1 shall apply except that the weight of the maximum length Train shall be AW1 and the weight of a push/pull retrieval Train shall be AW0.
11.3.7.4.6 Bolts, Nuts, Fasteners, Welding and Bonding Standards

All bolts shall be at least equal in strength to SAE grade 5. All welding shall be in accordance with American Welding Society Structural Welding Code for dynamically loaded structures: ANSI/AWS D1.1 for steel and ANSI/AWS D1.2 for aluminum. Bonding, including chemical and thermal adhesion shall be performed in accordance with proven, documented manufacturer’s or industry procedures or standards.

Unless otherwise specified, all structural connections shall be designed and implemented so that the ultimate strength of a fastener or the local area of the fastened structure shall not be the limit of the load-carrying capacity of that structure.

Each removable bolt, screw, nut, pin, or other fastener shall incorporate a locking device, if it is:

A. Part of a major structural load path, including all suspension members and propulsion and braking force paths; or
B. Part of a sensor, detector, or antenna mounting essential to control APM Operating System operation; or
C. Part of an actuator or control linkage essential to Vehicle control; or
D. Performing any other safety-related function.

Self-locking nuts may be used to satisfy this requirement only if the Developer provides data specifically demonstrating that such fasteners are suitable for the above applications.


At least one and a half (1-½) screw threads shall project beyond all nuts. Except for terminal board studs, the maximum projection beyond the nut shall be provided by the shortest standard-length screw or bolt that provides one and a half (1-½) screw threads beyond the nut.

All fasteners that are not stainless steel or aluminum shall be plated with cadmium or zinc. Cadmium plating shall conform to the latest revision of Federal Specification QQ-P-416, Class 2 or 3, Type II. Zinc plating shall conform to the latest revision of ASTM-B-633, Type II SC3 or SC4.

All nuts, bolts and fasteners shall be clean and free of rust.

All fasteners shall be properly torqued in accordance with the applicable standards or manufacturer’s requirements. All safety related fasteners, including suspension, guidance and brake equipment bolts, shall be “torque-striped” after torquing by paint or other accepted means.

11.3.7.5 Vehicle Design Life

The Developer shall design and manufacture Vehicles to operate for the duration specified in Part 2A, Section 5.13 in passenger service at the average number of Vehicle miles per year to meet the operating performance specified in Part 2B, Section 11.3.3.1 and in an operating duty cycle as specified in these Part 2B, Design & Construction Technical Requirements and when maintained in accordance with the Maintenance Plan and Maintenance Manuals. The Vehicle shall provide safe and reliable service during its entire design life. Normal deterioration due to causes such as corrosion and fatigue shall not degrade safety or performance of the body, chassis, and running gear.

Consumables, such as motor brushes, tires, and brake linings, are excluded from this requirement. All Car borne wiring, conduit, and piping shall not require replacement during the design life of the Vehicle.
11.3.7.6 Passenger Comfort

This section defines the requirements for passenger comfort on the Vehicle, including requirements for HVAC, interior noise, ride quality and accessibility.

11.3.7.6.1 Heating, Ventilation, and Air Conditioning

Each Vehicle shall be provided with a heating, ventilation and air conditioning (HVAC) system that shall meet the requirements of this section. The type of refrigerant selected by the Developer shall be in accordance with Item N of this Part 2B, Section 11.3.7.6.1.

The Developer shall perform a qualification test to prove the capacity and initial functionality of the control of the air conditioning portion of the HVAC system. Acceptable capacity qualification testing shall be in accordance with the air/enthalpy method as defined in ASHRAE Standard 37. The Developer shall submit a complete design of the air handling/diffusing system along with flows and velocity calculations for the design. The Developer shall perform a qualification test of air balancing of the HVAC system. The complete air supply/diffusing system shall be measured and balanced and the flows/velocities confirmed. Measurements shall be conducted in accordance with ASHRAE requirements or equivalent.

Vehicle heating, ventilation, and air conditioning (HVAC) shall meet the following requirements. HVAC load calculations shall include the conditions of the following subsections and Section 7.7.1, Heating and Air Conditioning of ASCE 21. These assumptions and the calculations shall be submitted to LAWA for review in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

A. Air Conditioning - Each Car or separately enclosed passenger compartment shall have at least two (2) equal and independent air conditioning systems where the Car or compartment design capacity, as specified in Part 2B, Section 11.3.7.3, is greater than 16 passengers, and at least one air-conditioning system where the Car or compartment capacity is 16 or fewer passengers, having an aggregate cooling capacity equal to the maximum calculated cooling requirement for the Car or passenger compartment. The systems shall maintain Vehicle interior conditions not greater than 75°F Design Dry Bulb and sixty (60) percent relative humidity under the outside temperature and relative humidity conditions specified in Section 7.7.1, Heating and Air Conditioning of ASCE 21. These conditions, together with the concurrent heat loads from: local summer solar radiation falling on the roof and on all opaque and glazed surfaces of all sides of the Vehicle; Vehicle loaded to design capacity; all interior lighting, electric, and electronic equipment within each passenger compartment; required forced fresh air ventilation; duct gains; losses due to Car body conduction; and miscellaneous interior loads shall be included to determine cooling capacity. For this calculation, each occupant shall be evaluated at 270 Btu/hr. sensible and 240 Btu/hr. latent heat.

In addition to the maximum cooling cycle for the above design conditions, the Vehicle air-conditioners shall automatically (without manual intervention) go into an “economy cycle” or “ventilation cycle” for energy savings when conditions permit.

B. Ventilation and Air Circulation - Positive ventilation of outside air during all operating conditions shall be at least 9 cfm per passenger at the design capacity specified in Part 2B, Section 11.3.7.3. All of the ventilated air shall be introduced through the air conditioning equipment and shall not include air introduced when the doors are open. There shall be no windows that are capable of being opened by passengers for ventilation.
C. The total air circulation rate shall be that required to absorb the Vehicle’s cooling requirement at a supply air temperature no lower than 18°F below the Vehicle interior temperature or 23 cfm per design capacity occupant, whichever is greater.

D. **Heating** - Provide, in at least one of the air conditioning systems per Car or passenger compartment, direct resistance electric heaters in the air stream, arranged to provide heating for the Vehicle interior when the control system so dictates. Reverse cycle air conditioning (heat pump) may be provided but not in lieu of the resistance electric heaters. The total heating system shall have the capacity to maintain Vehicle interior temperature of at least 60°F under the outdoor temperature conditions specified in Section 7.7.1, Heating and Air Conditioning of ASCE 21. Heating capacity calculations shall include only the transmission and ventilation losses. For heating, blowers shall operate at lower speed and ventilation shall be provided at the rate of at least 9 cfm per passenger or 25 percent of the total reduced air flow, whichever is greater.

E. **Condensation and Humidity** - The HVAC system shall prevent condensation on interior surfaces, including windows. The cooling system shall not induce condensation on metallic or other surfaces. Active control of humidity is not required. Reheat is permitted if required to limit the interior humidity.

F. **Controls/Temperature Uniformity** - Interior temperature shall be fully automatically controlled in cooling, ventilation and heating modes without manual intervention. All HVAC system controls shall be inaccessible to passengers. The control set point, measured at the controlling thermostat, shall be 75°F for air conditioning and 60°F for heating, adjustable in a range of ±10°F. The inside temperature in the occupied portion of the Vehicle shall not vary more than ±4°F from the design temperature one foot from any inside surface. An exception may be made when the Vehicle doors are open at an open air Station (i.e. a Station platform that is open to the elements and not air conditioned), but the above standard shall be met within thirty (30) seconds after the doors close.

G. **Temperature Variations** - If the ambient temperatures encountered exceed or fall below the defined design values related to A above, the interior temperature will be permitted to rise or fall degree for degree with the temperature in excess of or below the design values at the design capacity.

H. **Air Flow, Diffusion and Discharge Temperature** - The air distribution system shall provide sufficient diffusion at the outlet or diffuser so that air mixing will prevent direct impingement of coil discharge temperature air onto occupants. Air velocities one foot from the diffuser or outlet face shall not exceed 400 fpm and velocities throughout the occupied portion of the Vehicle shall not exceed 150 fpm. HVAC outlet location and performance shall be subject to review and acceptance by LAWA if they are within one foot of any passenger seating positions. Moisture carryover from cooling coils shall not be permitted.

I. **Failure Operations** - If all of the cooling systems of a Car or Vehicle fail, indicated by an inability to maintain interior temperatures, the cooling systems shall continue the highest speed blower operation from both units and with the maximum outside air being introduced not less than 9 cfm per design capacity passenger or 25 percent of the total air flow, whichever is larger.

J. If Vehicle primary electrical power is lost, ventilation of at least 9 cfm of outside air per passenger at the design capacity shall be provided for a time period...
as determined in accordance with the Hazard Identification, Analysis and Resolution Process requirements of Part 2A, Section 8.2.2, which shall not be less than one hour, using power from the Vehicle batteries. See Part 2B, Section 11.3.7.8.2.2.

K. **Smoke Detectors** - A smoke detector shall be located in the return air duct of each air conditioner in accordance with Part 2B, Section 11.3.7.15.

L. **Air Intakes** - All fresh air intakes shall be located to minimize the intake of heat from Vehicle HVAC or other equipment, fumes, and dust.

M. **Filters** - The Vehicle HVAC subsystem shall have appropriate air filters for the evaporator supply and fresh air ducts or interfaces that shall remove dust and other undesirable particles, be easily removed for cleaning and replacement.

N. **Emergency Controls** - Where operations are required indoors, the on board Automatic Train Control system shall be able to turn off all fresh air intake fans and close all air intakes on a Vehicle when an indication of a fire other than on board the Vehicle has been received.

O. **Condensation Control** - Condensate from the Vehicle HVAC shall be either evaporated or drained into the Guideway drainage system and shall not run down the sides of the Guideway structures or drip to areas below the Guideway.

P. **Refrigerant Types** - The air-conditioning system shall be designed and capacity shall be based upon the thermodynamic properties and for the use of R-134a refrigerants.

11.3.7.6.2 **Interior Noise**

Interior noise levels shall be in accordance with Section 7.7.4, Interior Noise Levels of ASCE 21, with the addition that the stated noise level requirements shall apply across the full normal range of accelerating, cruising and braking, as well as stopped, and interior noise limits shall be measured along the entire alignment during a normal operation round trip.

11.3.7.6.3 **Ride Comfort**

Vehicle ride characteristics for maximum sustained acceleration and deceleration, maximum rate of change of acceleration, and ride quality shall be in accordance with ASCE 21, Section 7.7.3, Ride Quality, except that (1) vertical acceleration shall be limited to plus or minus 0.05 g with respect to 1.0 g datum, and (2) the normal longitudinal acceleration, excluding grade effects, shall be limited to plus or minus 0.1 g. Furthermore, ride quality testing shall be required. Additional definitions and exceptions to the ASCE requirements for ride quality are as follows:

A. The limit on emergency deceleration may be exceeded under conditions of brake equipment failure. However, the Developer shall carry out an analysis to determine and propose an upper limit on deceleration under such failure conditions that shall be subject to review and acceptance by LAWA.

B. Sustained refers to the nominal values used for design of curves, crests, sags, and speed profiles and excluding random vibration effects. Sustained shall include durations equal to or greater than 1.0 seconds.

C. Longitudinal is fore and aft motion, the x direction in ISO 2631; vertical is up and down motion, the z direction in ISO 2631; and lateral is side to side motion, the y direction in ISO 2631.
D. Lateral and vertical acceleration and deceleration include grade effects and are the values obtained with a standard piezoelectric accelerometer with a frequency range of at least 0.1 - 80 Hz.

E. Longitudinal acceleration and deceleration ignoring grade are the rates of change of Train speed as determined from the maximum slope of tachometer generated data. Longitudinal acceleration and deceleration including grade are the values obtained with a standard piezoelectric accelerometer with a frequency range of at least 0.1 - 80 Hz, noting that this device reads acceleration along the longitudinal (fore/aft) axis of the Vehicle.

F. “Jerk” is the rate of change of sustained acceleration/deceleration with lateral and vertical acceleration/deceleration and with longitudinal acceleration/deceleration ignoring the effect of grade. Jerk limiting is required for normal longitudinal acceleration and braking. Longitudinal jerk during removal of emergency brakes need not be controlled.

These ride quality criteria and measurements are with respect to the Vehicle while it is operating anywhere on the APM System Guideway. The Developer shall coordinate the Vehicle ride quality responses and the Guideway tolerances of Part 2B, Section 11.3.11.1.1 to achieve these requirements.

Ride quality shall be verified by human response testing in accordance with the requirements of Section 7.7.3.2 of ASCE 21.

11.3.7.6.4 Accessibility Considerations

Vehicle interior design shall incorporate the principles of universal design as required by Part 2B, Section 11.3.1.4. Vehicle passenger compartments shall comply with ASCE 21, Section 7.7.6.1, Priority Seating Signs, and Section 7.7.6.2, Interior Circulation, Handrails, and Stanchions.

All Cars and passenger compartments shall have automatic on board announcements in accordance with Part 2B, Section 11.3.7.13.9 and shall have clear, legible graphics to identify Stations, routes, emergency evacuation instruction placards, and other information needed for passengers to have simple and intuitive use of the APM System.

All Cars and passenger compartments including messaging shall comply with the requirements of the Code of Federal Regulations, Title 49 Parts 27, 37 and 38.

11.3.7.7 Propulsion and Braking Systems

The propulsion and braking systems (PBS) shall be rated to provide traction and all Train movement along the Guideway, under the specified loads and environmental conditions specified in Part 2B, Section 11.3.4, and to ensure motion control up to the maximum specified speed, so that the acceleration, deceleration and jerk rates are within acceptable passenger comfort limits per Part 2B, Section 11.3.7.6.3.

All Vehicles, and all Trains up to and including the maximum length Train, shall be capable of continuous operation at a sustained cruise speed as required for this application and for the maximum speeds proposed for the APM Operating System for Vehicles loaded at AW1 and operating on level, tangent APM System Guideway.

All Vehicle and Train configurations at loading of AW1 shall be able to:

A. Cruise at least at maximum normal cruise speed under all conditions along the Guideway where grade, geometry, and Station constraints permit.
B. Maintain normal cruise speeds on the steepest grade in the APM System Guideway.

C. When stopped on the steepest uphill grade, start and accelerate to 25 mph within 750 feet without violating the ride quality requirements of Part 2B, Section 11.3.7.6.3.

The smallest sized self-propelled Train shall be propelled by more than one electric motor, such that the Train, when operated with one motor inoperative, shall have its power reduced by not more than 50 percent and the Train can be operated in service indefinitely at a level of service not less than 75 percent of normal service.

All Vehicles and Trains shall be capable of bi-direction operation, and shall be operable throughout the APM System with either end of the Vehicle in the forward orientation, in accordance with the requirements Part 2B, Section 11.3.3.6.

11.3.7.7.1 Propulsion/Braking Control

The propulsion and braking control system shall respond to signals from the Automatic Train Control system and adjust tractive effort, blend friction with electrical braking, and produce the tractive effort and braking necessary for smooth Vehicle acceleration, deceleration, and cruising. The propulsion and braking control system, including the combinations of dynamic/regenerative braking with mechanical friction braking when used simultaneously shall accelerate and decelerate the Vehicles and any length Train to and including the maximum length for the APM System from rest to a maximum cruise speed at rates not to exceed the maximum longitudinal acceleration/deceleration and jerk rates specified in Part 2B, Section 11.3.7.6.3.

The propulsion and braking control system shall be stable over time. Periodic adjustments required to account for drift or other problems shall be capable of being incorporated efficiently into the Vehicle checkout routine. The Developer shall make necessary adjustments to maintain performance within specifications.

The PBS shall provide the functions of service braking, emergency braking and the parking brake. The inherent internal friction of the PBS can serve as one or all of the braking methods if the minimum internal friction, under all conditions including unacceptable or undesirable hazards as defined in Table 3-1, Risk Assessment of ASCE 21, is sufficient to meet the braking requirements of this Part 2B, Section 11.3.7.7.

11.3.7.7.2 Duty Cycle

The PBS shall be thermally rated at AW2 load for the highest temperature per Part 2B, Section 11.3.4.1, without degradation to equipment. The APM Operating System shall also be rated for the intermittent operating conditions including pushing or pulling another Train as specified below, motor failures and other specified conditions. Limits of stopping distance per Part 2B, Section 11.3.7.7.4 and Part 2B, Section 11.3.7.7.5 shall be met.

Multiple brakes or combinations of dynamic/regenerative braking with mechanical friction braking when used simultaneously, shall be applied in such a fashion as to not exceed the limits for deceleration and jerk specified in Part 2B, Section 11.3.7.6.3.

Overheating of the PBS elements shall be addressed in the hazard resolution process per Part 2A, Section 8.2.2.

The thermal capacity of the propulsion and brake systems shall be based on the greater of the following two (2) requirements:

A. Continuous operation of a maximum length Train over the APM System Guideway. Dwell time as established in Part 2B, Section 11.3.3.1.3. Headways shall be set
for the maximum line capacity required in Part 2B, Section 11.3.3.1.5. All Vehicles in the Train shall be loaded to AW2. The maximum ambient temperature of Part 2B, Section 11.3.4.1 shall be assumed and does not include local temperature changes due to Vehicle or wayside equipment. Air conditioning and other accessories shall be operating.

B. One maximum length AW1-loaded Train shall be able to push or pull another maximum length AW1-loaded inoperative Train into the most convenient Station, regardless of where it is located, and then push or pull the same Train with both Trains empty (AW0) to the M&SF. The environmental and operating conditions of Paragraph A above shall apply except that degradation in speed, acceleration, and deceleration will be permitted. Assuming only one Train is operable; the service brakes on one Train shall be able to stop both Trains. Emergency braking shall be available from both Trains; that is, an emergency brake condition shall cause emergency brake application on both Trains, except under special conditions when the emergency brakes of the failed Train must be disabled for it to be moved.

Where traction is required for either propulsion or braking, measures shall be taken to provide proper Guideway running surface traction.

11.3.7.7.3 Service Brakes

Service braking shall be provided in accordance with Section 8.3.1, Service Braking of ASCE 21 except that the service braking system shall be provided to accomplish the Train movement control requirements of Part 2B, Section 11.3.9.2.3. Additional service braking requirements are specified below.

The service braking system shall stop the Vehicle within its normal deceleration profile and deceleration and jerk constraints for all Vehicle speeds, loadings, grades, turn radii, and environmental conditions within the System’s operating range, and without overheating under continuous operation at the duty cycle specified in Part 2B, Section 11.3.7.7.2. Service brake system failure that may result in the Vehicle’s inability to meet its designed normal deceleration profile shall result in the application of emergency brakes in accordance with Part 2B, Section 11.3.7.7.4 and 9.7.5. All failures of the service brake system or any portion of it shall be alarmed at the CCC in accordance with Part 2B, Section 11.3.9.3.4.1.

Service brakes shall use either: (1) combined electric motor braking and friction braking, or (2) only friction braking. If both are used, a smooth transition from one braking mode to the other shall be provided to meet the acceleration and jerk requirements of Part 2B, Section 11.3.7.6.3.

Friction service braking effort for self-propelled Vehicles shall be provided by redundant devices such that upon the failure of one such device, specified service braking may be provided.

If regenerative braking is used, the electrical power generated shall be accepted solely by the APM System and not fed back to LADWP. Any regenerative braking subsystem shall provide guaranteed receptivity of regenerated power by other energy users and/or by wayside resistors to consume the regenerated energy. If the regenerative braking subsystem does not meet all service braking requirements, including reliability and receptivity, the Developer shall correct all design and implementation problems at no additional cost to LAWA. Any regenerative braking approach shall be subject to review and acceptance by LAWA.

Friction braking wear material shall have a minimum service life to maintain performance requirements defined in the Contract Documents.
### 11.3.7.7.4 Emergency Brakes

Emergency braking shall be provided in accordance with Section 8.3.2, Emergency Braking of ASCE 21, and this Part 2B, Section 11.3.7.7.4. Where applicable, the Hazard Identification, Analysis, and Resolution Process of Part 2A, Section 8.2.2 shall be used instead of the process identified in the ASCE reference.

The emergency brakes shall stop the Train whenever a potentially dangerous condition occurs. Such conditions include failure to maintain proper safe speed, failure of the normal braking system, or other ATP conditions as required in Part 2B, Section 11.3.9.1. Emergency braking rates shall meet the requirements of Part 2B, Section 11.3.7.6.3.

The emergency brakes shall be irrevocable, that is, once the command is issued for them to be applied, they shall remain applied continuously until the Train comes to a complete stop, even if the initiating command is removed. After the Train has stopped, the emergency brakes shall be reset for normal operation by a manual reset on the Train by authorized personnel; additionally, the emergency brakes shall be reset by a control signal to that Train from the CCO, unless otherwise prohibited for specific situations by these Part 2B, Design & Construction Technical Requirements. If conditions are not safe for the Train to move, the emergency brakes shall remain applied regardless of any reset signals or actions. If, when safe conditions exist and the Train is allowed to move, a subsequent malfunction occurs, the emergency brake shall be applied as before.

The emergency brake controls shall be interlocked with the propulsion controls and designed in accordance with the safety principles and Automatic Train Control system fail-safe design requirements of Part 2B, Section 11.3.5.1.1, to include removal of propulsion power during emergency braking such that braking commands dominate and shall have priority over any other method of braking.

The emergency brake may use components of the service braking system, but must operate properly without any Guideway or propulsion system power and in accordance with the requirements for design stopping conditions as specified in Part 2B, Section 11.3.7.7.5.

If the emergency braking system has any elements in common with the service braking system, then the emergency braking system shall comply with the above stopping requirements after meeting all requirements for the service brake duty cycle in Part 2B, Section 11.3.7.7.2. In addition, the emergency brake shall incorporate sufficient redundancy and capacity such that the safe Train separation assurance requirements of Part 2B, Section 11.3.9.1.2 can be met under design stopping conditions as specified in Part 2B, Section 11.3.7.7.5.

The energy source for emergency brakes using electrical, hydraulic or pneumatic power for actuation shall be redundant; and the failure of any one active source shall be detected in accordance with the safety principles and Automatic Train Control system fail-safe design requirements of Part 2B, Section 11.3.5.1.1. Failure of any one active energy source shall not result in a braking capability less than as from a single, worst case failure of the braking system; and in the event that a failure has been detected, the emergency brakes shall be applied and the Train shall not be permitted to be operated under automatic control until all braking power sources have been restored.

For self-propelled Vehicles that depend upon traction between wheels and running surfaces for emergency braking, the devices that provide braking effort shall be located on either the axles or wheels, and shall not be located on the motor shaft or other drive links separated from the drive axle by gears and/or other forms of drive coupling devices except where the coupling device can be shown to meet Frequency “D-Remote” of Table 3-1 Risk Assessment of ASCE 21.
11.3.7.7.4.1 Heat Fade

The emergency braking system shall function without degradation for a minimum of three (3) successive applications from the maximum speed with an AW2 load and without overheating at the maximum ambient temperature of Part 2B, Section 11.3.4.1, or, alternatively the ATP system shall prohibit more than one remote reset of the emergency brake from the CCC within a cooling period of not less than five minutes. If the emergency braking system has any components in common with the service braking system, then the emergency braking system shall function without degradation after meeting all requirements for the service brake duty cycle as specified in Part 2B, Section 11.3.7.7.2.

11.3.7.7.4.2 Wet Fade

Wet conditions, as defined by thorough spraying of all mechanical portions of the braking system with water for ten minutes or the immersion technique of Paragraph 5.19 of SAE J843d, shall not cause any departure of the braking capability from the deceleration and stopping distance requirements necessary for the safe Train separation assurance requirements of Part 2B, Section 11.3.9.1.2 and the overspeed protection requirements of Part 2B, Section 11.3.9.1.4.

11.3.7.7.4.3 Contaminants

Contamination of the emergency braking system by any fluids or foreign substances in proximity to braking components that might reasonably enter through a leak or other system malfunction shall not adversely affect the deceleration levels required for the safe Train separation assurance requirements of Part 2B, Section 11.3.9.1.2 and the overspeed protection requirements of Part 2B, Section 11.3.9.1.4.

11.3.7.7.5 Design Stopping Conditions

Design stopping distances for the APM Operating System shall be developed analytically and the results provided to LAWA in accordance with the Summary of Submittals list in Part 2A, Section 6.7. Such computations shall include all worst-case time delays, Train and motor overspeeds, and acceleration conditions. The effects of any grade shall be properly accounted for. The maximum length, AW2 loaded Train shall be used. Guideway, tire, and other relevant conditions shall be the cumulative worst-case conditions as specified in Part 2B, Sections 11.3.7.7.4, 11.3.7.7.5.1, 11.3.7.7.5.2, 11.3.7.7.5.3 and 11.3.7.7.5.4 and temperature conditions specified in Part 2B, Section 11.3.4.1. The deceleration rate shall be appropriately reduced to reflect the emergency brake performance and holding capability resulting from a single worst-case element failure or loss within the brake system. This consideration is to be applied irrespective of emergency brake fail-safe design criteria.

The design stopping distances, as computed above, shall be greater than the actual worst-case stopping distance exhibited by the completed APM Operating System. When tested under the conditions specified in this section, the worst-case stopping distance shall be determined as the sum of the three-sigma upper limit from statistically significant samples that include all Vehicles tested on several different days and a distance analytically calculated that accounts for worst-case conditions not present in the tests. Both manual on-Train and Central Control remote reset of emergency brakes shall be provided. The Developer shall conduct these stopping distance tests off-site as the qualification test required by Part 2C, Section 4.3.1 as part of the initial verification of design. Subsequently, stopping distance tests shall also be included over the APM System Guideway in the APM Operating System acceptance tests.
11.3.7.7.5.1 Guideway Conditions

Design stopping distances shall be calculated assuming a wet Guideway. For rubber-tired technologies that depend upon traction for braking, a wet Guideway is defined as one that is watered at a rate sufficient to produce a 0.02-inch film depth.

11.3.7.7.5.2 Tire Conditions

For rubber-tired technologies that depend upon traction for braking, the design stopping distance shall be calculated assuming the standard Vehicle tires are operated at maximum specified pressure. Tread shall be assumed worn to the depth at which tires of the APM Operating System would normally be replaced. These requirements are intended to assure that assumed traction is the minimum anticipated in service.

For Vehicles on which emergency braking is accomplished through other than rubber tires, this requirement shall be interpreted appropriately to assure that the minimum traction condition is assumed for such Vehicles.

11.3.7.7.5.3 Out-of-Tolerance Conditions

The effect of out-of-tolerance conditions caused by brake lining wear, low air pressure, etc., shall be investigated by means appropriate for the particular brake subsystem to assure that proper parameters are used in the stopping analysis. Tolerances to be investigated shall include at least: (1) variations in brake lining coefficients as manufactured and after operation; (2) effects of wear on mechanical tolerances, clearances, and seals; and (3) other characteristics that, while not representing a brake subsystem failure, could reasonably be expected to cause degraded APM Operating System performance. Stopping distances shall be calculated for the worst-case of all plausible combinations of out-of-tolerance conditions that are individually inadequate to constitute APM Operating System failure.

11.3.7.7.5.4 Wind Loads

Design stopping distance calculations shall include the effects of tail-wind loading that occurs at the maximum allowable operating wind specified in Part 2B, Section 11.3.4.7.

11.3.7.7.6 Parking Brake

A parking brake system shall be provided in accordance with Section 8.3.3, Parking Braking of ASCE 21. Specific additional requirements are as follows.

The parking brake function shall be provided by a mechanical friction brake. It shall be activated wherever the Vehicle is stopped, including normal service stops in Stations and when the Vehicle is parked and not in operation. Parking brake failure that results in inability to function as specified shall result in application of emergency brakes in accordance with Part 2B, Section 11.3.7.7.4 and Part 2B, Section 11.3.7.7.5. All failures of the parking brake system shall be alarmed at the CCF in accordance with Part 2B, Section 11.3.9.3.4.1.

The parking brake shall be capable of holding an AW2-loaded, maximum length Train on the maximum grade, considering all environmental conditions specified in Part 2B, Section 11.3.4, without application of Guideway or Vehicle-borne power for the maximum period of time required to evacuate passengers during a total APM Operating System power failure; thereafter, it shall be capable of holding an AW0-loaded Train on the maximum grade for an indefinite period. Alternatively, it shall hold for at least 24 hours and for an indefinite period thereafter with manual interventions, such as chocking the wheels. The parking brake function may be provided by elements of the service and/or emergency brake equipment, provided that the requirements of Part 2B, Section 11.3.7.7.3 and Part 2B, Section 11.3.7.7.4 that are applicable to that equipment would be satisfied.
are met. If a separate parking brake is provided, it does not have to be applied during normal service stops as long as the friction service or emergency brake is applied.

11.3.7.7.7 Propulsion and Braking System Component Design

The components of the propulsion and braking system (PBS) shall be designed for the service/application as defined in the following subsections.

11.3.7.7.7.1 Design Requirements

PBS components shall be designed in accordance with Section 8.4.1, Design Requirements of ASCE 21, except for the following:

A. In lieu of the referenced ASCE APM Standards Sections 7 and 3, the requirements of Part 2B, Section 11.3.7 and Part 2B, Section 11.3.5, respectively, shall be used.

B. In performing the Hazard Identification, Analysis and Resolution Process specified in Part 2A, Section 8.2.2, the Developer shall include the items referenced in Section 8.4.1 of ASCE 21.

11.3.7.7.7.2 Service Requirements

Service requirements shall be in accordance with Section 8.4.2, Service Requirements of ASCE 21, with the following exceptions and additions:

A. Duty cycle shall be in accordance with Part 2B, Section 11.3.7.7.2.

B. Hazards analysis performed on the propulsion and braking systems shall be conducted in accordance with Part 2A, Section 8.2.2.

11.3.7.7.8 Installation and Protection

Installation and protection shall be provided in accordance with Section 8.5, Installation and Protection of ASCE 21, except that propulsion and braking machinery placed along the Guideway or in Stations shall be determined to be acceptable by analysis according to the hazard analysis specified in Part 2A, Section 8.2.2.

11.3.7.7.9 Controls and Interlocks

Propulsion and braking interlocking shall be provided in accordance with Section 8.6, Controls and Interlocks of ASCE 21 and Part 2B, Section 11.3.7.7.4.

11.3.7.7.10 Brake Testing

Periodic testing of emergency braking and any other braking system shall be performed in accordance with Section 8.7, Brake Testing of ASCE 21, except that required brake testing shall be performed at a frequency sufficient to verify compliance with the hazard analysis specified in Part 2A, Section 8.2.2.

11.3.7.8 Electrical Subsystem

The Vehicle electrical subsystem shall comply with the following requirements. If any of the subsystems addressed in this section are implemented by wayside equipment instead of car-carried equipment, the wayside function shall meet the same performance criteria as specified herein.

11.3.7.8.1 Vehicle Primary Power Subsystem

Power for the Vehicle shall be obtained from power rails on the Guideway and conditioned, as necessary, on the Vehicle to the appropriate voltage for propulsion, auxiliary, and housekeeping functions.
11.3.7.8.2 Auxiliary Subsystem

The auxiliary subsystem provides for the distribution and conversion as required of collected power for purposes other than propelling the Vehicle.

11.3.7.8.2.1 Low Voltage Power

A low voltage direct current source shall be provided for powering all on board control circuits. It shall operate in conjunction with and may serve as the charger for the storage batteries specified in Part 2B, Section 11.3.7.8.2.2.

11.3.7.8.2.2 Emergency Power Subsystem

In the event of loss of primary Vehicle power, an on board battery emergency power subsystem shall assure uninterrupted continuation of the following functions for a period of at least one hour or longer as may be determined in accordance with the Hazard Identification, Analysis and Resolution Process requirements specified in Part 2A, Section 8.2.2, or as otherwise specified:

A. Public address and continuous two-way communications with Central Control;
B. Ventilation as required Part 2B, Section 11.3.7.6.1.H;
C. Vehicle emergency lights of Part 2B, Section 11.3.7.8.8.1;
D. Any Vehicle function required for disabled Vehicle recovery;
E. Automatic Train Control system;
F. Alarm and malfunction reporting;
G. Vehicle service and emergency braking system; and
H. On board Video Surveillance.

Each Vehicle shall have a means for keeping the emergency battery(ies) in a constant state of readiness and with an indicator showing the level of charge in the battery (ies). All batteries on the Vehicle shall be transit type, shall be properly encased and ventilated, and shall be mounted in a corrosion-resistant steel box, isolated from the passenger compartment and meet the requirements of Section 8.6.9 of NFPA 130. A low battery charge condition shall be alarmed at the CCC. Battery charger failure (or load on batteries) shall also be alarmed at the CCC as a necessary precaution to preventing total discharge of the battery.

11.3.7.8.3 Power Collection

Vehicle power shall be obtained from power collectors as specified in Section 7.12.4, Power Collectors, ASCE 21, with the following exceptions and/or additional requirements:

A. Pantographs and trolley poles shall not be used.
B. The power collector shall function under all permissible Vehicle dynamic operating conditions as specified in Part 2B, Section 11.3.7.1 and the Vehicle environmental operating conditions specified in Part 2B, Section 11.3.4.
C. The brushes used in the power collectors shall have a service life sufficient to meet system service availability requirements.
D. The connector(s) of the power collectors and the Vehicle electrical subsystem shall ensure that power to the collectors is disconnected whenever maintenance shop power is provided to the Vehicle. This connector and the location(s) for application of shop power shall be protected from the environment. They shall include a locking device to ensure that connections are not broken while the Vehicle is in service. They shall not expose maintenance personnel to hazardous conditions.
11.3.7.8.4 Circuit Breakers and Interrupters

Circuit breakers shall be provided in accordance with Section 7.12.2.2, Protection Devices of ASCE 21, and shall meet the following additional requirements:

A. All faults shall be isolated to the smallest isolatable segment of circuit; and
B. Each breaker shall have a name plate clearly and permanently marked with the name of the circuit it protects.

11.3.7.8.5 Wiring

Vehicle wiring shall meet the following requirements, including the requirements of Part 2B, Section 11.3.16.7.

11.3.7.8.5.1 General

All Vehicle and control circuit wiring shall be unalloyed copper and at least equal to that specified in the latest revision of NFPA 70 Table 310-16 and NFPA 130 Section 8.6.7; except that larger wire sizes shall be provided if specified herein. Wiring shall be clearly marked in accordance with the Vehicle electrical schematic for ease of identification in maintenance and troubleshooting.

Wiring insulation shall meet the flammability and smoke emission requirements of Part 2B, Section 11.3.7.14.1. When measured individually with a 500-volt megohmmeter, a resistance bridge instrument, or the voltmeter-ammeter method, insulation resistance to ground of all wiring shall be:

A. 1 megohm minimum for nominal low voltage DC control wire and for wire normally operating at voltages between nominal low voltage DC and primary line voltage; and
B. 5 megohms minimum for wire normally operating above nominal primary voltage.

All wiring connected to a given piece of electrical apparatus shall be insulated for the highest voltage so connected.

The wiring layout shall be designed in advance of its installation and in cooperation with those furnishing the related equipment. All wiring shall be fabricated on the bench into convenient units and installed in prefabricated groupings and standardized locations. Wiring shall be functionally separated into categories of control wiring, AC auxiliary power, DC auxiliary power, and traction power and not be cabled together. Control wiring shall be physically isolated from power wiring to prevent conducted EMI from interfering with APM Operating System performance.

Wires connected to transient-generating devices shall not create interference in other circuits.

Wiring for communications and Automatic Train Control equipment shall conform with the requirements established by the manufacturer of such equipment.

All circuits and branches must be separable to isolate them when searching for grounds or other problems. Soldered connections are not acceptable.

All circuits subject to periodic high potential test shall be arranged to be conveniently set up for that test.

11.3.7.8.5.2 High Temperature Wire and Cable

At locations subject to high temperature, all wire and cable shall be insulated and jacketed. This type of wire shall not be bundled together or run with any other type of cable. Conductor material shall be tinned copper wire. Class K stranding shall be used for sizes AWG 20 to AWG 10; Class H shall be used for larger sizes. High temperature wire and cable shall be constructed and tested.
in accordance with NEMA HP 100. It shall be rated for a maximum conductor temperature of 110°C.

11.3.7.8.5.3 Conduit and Raceways

All Vehicle wiring shall be housed in metal or plastic raceways. All plastic materials shall meet the flammability and smoke emission requirements of Part 2B, Section 11.3.7.14. Open metal raceways and their elbows, couplings, nipples, bushings, locknuts, universal joints, expansion joints, and other conduit fittings shall permit the sections to be mechanically and electrically coupled while protecting the wires from abrasion. All conduits shall be of a material capable of withstanding the duty and environment into which it is applied.

Wire in conduit, ducts, and raceways shall be free of kinks, insulation abrasions, and insulation skinning. No conduit, duct, or raceway shall contain more wires than will result in more than a 40 percent fill.

Wire shall not be bundled if in a conduit, duct, or raceway. Each wire shall be removable for replacement without disturbing other wiring in the enclosure. Where wire is in open areas, bundling shall be permitted if this wire removal criterion is met. Any exposed wire shall be cleated, tied, or secured by other suitable means.

Pulling compound, if used, shall be non-conductive, non-hygroscopic, non-odorous, and shall not attract vermin.

Flexible conduit shall be aluminum or steel alloy tubing with watertight compression fittings. Both inside and outside surfaces shall be protected against corrosion. All flexible metal conduits shall conform to the requirements of UL-1.

Electrical metallic tubing (EMT) shall be fabricated from high strength aluminum or steel and shall conform to the requirements of ANSI C80.3. Their interior surfaces shall be smooth and free from injurious defects. Fittings for EMT shall be corrosion-protected metal and shall meet the requirements of UL-797.

Firestops shall be provided in raceways to control spread of fire. Wires connected to different sources of energy shall not be cabled together or be run in the same conduit, raceway, tubing, junction box, or cable unless all such wires are insulated for the highest rated voltage in such locations. Wires connected to electronic control apparatus shall not touch wires connected to a higher voltage source of energy than control voltage.

Conduits, electrical metallic tubing, nonmetallic ducts or tubing, and all wires with their outer casings shall be extended into devices and cases. They shall be rigidly secured in place by means of cleats, straps, or bushings to prevent vibration or movement and to provide environmental protection. They shall be run continuously into junction boxes or enclosing cases and be securely fastened to same. Splices outside of junction boxes shall not be permitted. Connections and terminations shall be made in a manner to assure their tightness and integrity.

Conductors and enclosures of any kind shall be protected from the environment and from mechanical damage including damage from other larger conductors.

11.3.7.8.5.4 Junction Boxes

Pull boxes, outlet boxes, and junction boxes shall be provided specifically for application with the conduit and cable systems with which they are to be used. Exposed exterior boxes shall protect enclosed equipment against splashing water, water seepage, and falling or hose-directed water normally encountered in Vehicle operations and cleaning. Boxes shall be of sufficient size to provide free space for conductors in accordance with NFPA 70.
11.3.7.8.5.5 Undercar Wiring

All undercar wiring of AWG 8 or smaller shall be run in an accepted manner in properly coated metal raceways and wire ducts with removable metal covers of adequate size and design. These covers shall be adequately fastened for wire protection and against vibration, but shall be easily removable when necessary for maintenance or repair. The enclosures shall be securely anchored to prevent damage, vibration, rattling, or drumming. Where wiring leaves such enclosures, it shall be routed to prevent wear or damage from abrasion. Additional protection in the form of extra insulation shall be used in exposed areas.

AWG 6 or larger wires may be supported in place by using molded rubber cable support blocks at frequent intervals and without an enclosure. Openings where the wires enter or leave the enclosure shall be contoured to the shape of the wire and shall have strain relief bushings. Insulated throat box connectors shall be used and shall have non-metallic, strain relief end bushings.

Lead wires to electrical components shall be carried in a wire duct or conduit to a point as close to the compartment as possible. There shall be a sufficient length of lead between the end of the duct or conduit and the compartment.

All penetrations into the passenger compartment shall be in accordance with Part 2B, Section 11.3.7.13.3.

Wires or cables, even if in conduit or ducts, shall not pass over or through any battery compartment over any propulsion or braking resistors.

Wires or cables carrying primary line voltage shall not be tied to or directly supported by conductive members at ground potential. Such wires and cables shall be securely anchored in an accepted manner and shall be covered at any points of contact with an accepted insulating material.

All wires and cables shall have sufficient slack to prevent breaking or pulling out of bushings or terminals and a serviceability loop of sufficient length to permit at least three (3) cable end reworks. Drip loops shall be provided. All wiring shall be installed and secured to prevent chafing with each other, interior surfaces of enclosures, adjacent components in compartments, or any metallic parts.

Electrical connections between any two (2) Cars or articulated sections of a Vehicle shall be carried in body-mounted devices using multi-conductor cables. Connections on either side shall be on terminal blocks, except that connectors shall be used for low voltage DC wiring. Such devices shall be MIL-DTL-5015 environmentally protected connectors. Sufficient conductors, plus eight spare circuits of which four shall be shielded, shall be provided to make these electrical connections.

11.3.7.8.5.6 Wire and Terminal Marking

All electrical conductors shall be assigned circuit designations for the entire Vehicle. The system of designating circuits shall be the prerogative of the Developer.

The individual conductors within any cable shall be appropriately color coded and/or numbered, with markings at all ends and terminal points. Complete reference to these markings shall be included in all documents relating to the cables. The Developer shall ensure that its own personnel and its suppliers adhere to the same method of marking and coding, and that all designations are consistent across all equipment interconnections, regardless of their source of supply. Decals shall be provided indicating the terminal and wire identification at terminal boards.
11.3.7.8.6 Connections, Connectors, and Splices

Connections shall be through environmentally protected locking-type plugs, as accepted by LAWA, or bolt-on terminal strips. Wires between terminals shall not be spliced or soldered. If unavoidable and accepted in advance by LAWA, solderless connectors installed under a controlled process may be used.

All cable connectors shall conform to MIL-DTL-5015. They shall employ removable crimp contacts of the correct size for the wire being terminated.

Connectors shall be keyed so as to not be accidentally interchanged between adjacent connectors. Spare contact allocation shall be a minimum of ten percent, but no less than four, per connector. Disconnected plugs shall be supported so as to not drop to the ground, floor, or other position in which they might be readily damaged. Connectors shall be mounted to provide convenient hand access so as to be easily mated and unmated.

Wires shall be terminated by mechanical means, using solderless terminals of the ring type or "Weidmuller" type, with crimp-on ferrule. Soldered terminals shall not be used. Conductors shall be attached to the terminals in accordance with the specification prescribed by the terminal manufacturer.

Terminals used on AWG 10 or smaller conductors shall be of the insulating type and shall grip and hold the insulation on the conductor securely. Conductors subject to motion relative to the terminal shall be protected to eliminate fracture of the conductor at or near the terminal.

Bolted terminal connections with overall insulating sleeves may be used to connect Vehicle wiring to the propulsion motor leads and the maintenance power connection.

11.3.7.8.7 Grounding

Each Vehicle shall be grounded in accordance with Section 7.12.5, Grounding of ASCE 21. The following requirements shall also apply.

Vehicle grounding shall be made through a non-fused grounding circuit.

A minimum of two (2) grounding brushes, each with sufficient current-carrying capacity to handle fault currents of the entire Vehicle electrical subsystem, shall be in contact with the ground rail at all times. With the Vehicle operating at any location on the Guideway of the APM System, including the yard of the M&SF, and with only one ground brush contacting the ground rail, the touch-potential requirements specified in Part 2B, Section 11.3.8.1.5.2 shall be met. In addition, a means to detect the loss of any ground brush connection to the ground rail shall be incorporated in the Vehicle that will provide an alarm at the Central Control Console per Part 2B, Section 11.3.9.3.4.1.

All metal parts inside and outside the Vehicle, including equipment boxes and cabinets, panels, and test receptacles, that could be contacted by passengers or operating and maintenance personnel shall not exceed the above specified touch-potential. The Vehicle-Station-Guideway grounding shall satisfy the requirements of Part 2B, Section 11.3.8.1.5.

The Vehicle body, frame, and structure shall not be used to carry current for any Vehicle electrical circuit. A differential current sensing means shall be used to remove power from the Vehicle in the event of a primary power (i.e., traction power) ground fault on board the Vehicle.

A grounding strap shall bond each bogie, truck or other primary suspension element frame to the Vehicle body. Grounding straps shall also bond all sections of the body that might become electrically isolated. Components mounted on these primary suspension system elements shall be bonded to the frames of those elements. The propulsion motor frame shall be bound directly to ground brush.
All electrical and electronic metal enclosures and all equipment that uses electrical power shall provide a low-impedance path from the enclosure/equipment to the Vehicle structure. The bonding method shall produce a DC resistance of not more than 0.0025 ohms from the enclosure to the structure, and an AC impedance of less than 0.025 ohms at 60 Hz or of a comparable level at higher frequencies. Bonding shall be direct metal-to-metal contact between the enclosure/equipment and Vehicle structure; otherwise, conductors of sufficient cross-section to carry lightning discharge current and fault current of the equipment shall be used and shall limit the voltage drop across the bond to 25 V.

Wire shielding shall be provided to protect against and/or suppress electrical noise induced by any electromagnetic or electrostatic coupling. The wire shields shall be carried through all applicable junction boxes. Circuits shall be categorized. Shields contained in one category shall not be interconnected with shields in another category. Shields on low-level signal leads shall not be interconnected with shields on high-level signal leads in the same category. Each group of shields shall be carried through a connector pin or pins, or on terminal strips, that shall be in the immediate proximity of the categorized group of circuits. There shall be no loops due to interconnection of shields.

11.3.7.8.8 Lighting
The Developer shall provide all Vehicle lighting.

11.3.7.8.8.1 Interior
Vehicle interiors shall be provided with lighting fixtures that are secure, rattle free, and vandal resistant. Lighting elements and powered fixtures shall be inaccessible to passengers.

Diffusers shall be provided of a material that is shatterproof. Illumination levels, as follows, shall be consistent and shall be measured with all light diffusing panels in place.

A. Normal Lighting
   1) At least five (5) foot-candles at all floor level locations, including doorways; and
   2) At least twenty (20) foot-candles at all points in a horizontal plane thirty (30) inches above the Vehicle floor at all times.

B. Emergency Lighting
   1) At least five (5) foot-candles at all locations when power is provided by the Vehicle emergency battery; and
   2) Emergency exit lighting shall illuminate the path from each Vehicle emergency exit to the emergency walkway. Such lighting shall be at least 5 foot-candles and shall be powered from the Vehicle battery. There shall be no degradation in the above specified lighting levels for the Part 2B, Section 11.3.7.5 design life of the Vehicle, assuming lamp replacement for burn-out only and that the specified maintenance has been performed.

It shall be possible for authorized personnel to turn off interior lights selectively from inside the Vehicle to improve visibility for manual operations at night, especially to eliminate any reflections and glare on the windows.

11.3.7.8.8.2 Exterior
The front and rear of a Vehicle or Train shall be readily identifiable as such, and visible at all times.
Reflectors with a total surface area of at least fifty (50) square inches shall be mounted on each end of each Train in the APM Operating System. The reflectors shall be located in the center of the Car at the highest level below end windows.

Headlamps and tail lights or equivalent light sources meeting the requirements of Federal Motor Vehicle Safety Standard (FMVSS) 108 shall be provided on each end of each Vehicle (see Agreement, or Vehicle definition). These lights shall be interlocked so that the headlamps are illuminated only on the forward end, in the direction of travel, and tail lights illuminated only on the rear, opposite to the direction of travel of the Train. Headlight aiming shall be adjustable and aimed in accordance with SAE J599 for lower beams.

11.3.7.8.9 120-Vac Power Supply

An on board power supply shall provide 120 Vac, 60 Hz, sine wave power through at least two (2) standard, three (3)-prong grounded outlets per passenger compartment. The distance between such outlets shall not exceed ten feet.

Each outlet shall be protected against unauthorized use or vandalism by a tamper-resistant cover. A 20-ampere minimum capacity is required. A larger capacity shall be provided if required by soldering irons, electronic test and diagnostic equipment, and other Vehicle maintenance equipment provided by the Developer for on board use.

11.3.7.8.10 Maintenance Power Connection

The Vehicle shall include a device to accommodate the connection of electrical power to the Vehicle from a source other than the power collectors described in Part 2B, Section 11.3.7.8.3. This device shall have automatically-engaged weatherproofing when not in use. Such a connection shall be for the purposes of conducting Vehicle maintenance and shall be through an umbilical cable and connector assembly. It shall be possible to operate all Vehicle electrical loads, including propulsion at AW0 loading, through this connection. Connection of this umbilical connector to the Vehicle electrical subsystem shall be as required in Part 2B, Section 11.3.7.8.3 to ensure that it is not possible for the Vehicle collectors to be powered while the Vehicle is connected to the maintenance power source. While connected to the maintenance power source, the Vehicle shall be grounded through a non-fused grounding circuit.

11.3.7.9 Suspension and Guidance Subsystems

The Vehicle suspension and guidance subsystems shall provide positive mechanical methods for retaining the Vehicle in the lateral direction. The Vehicle shall be stable against tipping for all operating and environment conditions. See Part 2B, Section 11.3.7.4.3.

11.3.7.9.1 Clearance of Obstacles

Each Vehicle shall be provided with deflectors to remove debris at least from the paths of wheels, or their equivalent if wheels are not used. Deflectors shall be provided to protect any linear electric/induction motors and magnets. The suspension subsystem shall enable Vehicles to traverse any debris that is not removed by the deflectors safely and without damaging or shorting power collectors, suspension subsystem, communications antennas, motors, or other equipment.

11.3.7.9.2 Flat Tires/Loss of Levitation

Where pneumatic tires are used, failure of a tire to maintain proper pressure shall not result in a condition that allows damage to the Vehicles, electrical system, or Guideway, or presents a hazard to passengers, as verified by hazards analysis per Part 2A, Section 8.2.2. Tire pressure shall be monitored and an alarm shall be sent to Central Control if the pressure drops below a value to be determined during the design audit process, subject to acceptance by LAWA.
Similar loss of levitation elements shall also not result in such conditions. Suitable backup for pneumatic tires shall be provided by using dual tires, metal discs, or other methods of protection. Foam filled tires or tires using other means of puncture proofing shall be subject to the acceptance of LAWA not later than the preliminary Vehicle Design Audit. For dual or safety tires, the backup tire shall be capable of providing 24 hours of uninterrupted, normal service without failure, unless suitable means are provided for earlier positive identification of the tire failure.

11.3.7.9.3 Tire Life

All tires shall be provided new and shall meet the following requirements.

11.3.7.9.3.1 Non-Steel Tires

Tires shall have a service life adequate to meet the performance requirements of the Operating System.

11.3.7.9.4 Loss of Load Leveling

If load leveling is used to provide vertical alignment, unsafe Vehicle tilting in the event of a failure shall be prohibited. In addition, the sides of the Vehicles that might contact the platform edge rub strip of Part 2B, Section 11.3.12.1.1.2 shall be sufficiently strong to withstand such contact without being damaged or causing an unsafe condition for passengers.

11.3.7.9.5 Mileage Recording Equipment

Each wheeled Vehicle shall be equipped with mileage recording equipment as specified in this section. Non-wheeled Vehicles shall incorporate similar equipment to satisfy the performance requirements of this section. Wayside equipment, as described below, shall also be provided to automatically record the mileage of each Vehicle and transmit the information for maintenance and scheduling purposes. The mileage recording equipment shall automatically collect, record, compile and transmit data as specified in this Part 2B, Section 11.3.7.9.5.

11.3.7.9.5.1 Electronic Hub-Mounted Trip Recorders

Each Vehicle shall be equipped with at least one electronic, hub-mounted trip recorder that shall record Vehicle mileage regardless of the direction of travel of the Vehicle. The electronic hub-mounted trip recorders shall be sealed and mounted in a case designed for installation on a Vehicle hub. Each recorder shall be programmable by LAWA with the Vehicle number, initial life-to-date mileage, and tire size factor (revolutions per mile of tire travel). The trip recorders shall automatically respond to a beacon signal sent from a portable handheld receiver unit (see Part 2B, Section 11.3.7.9.5.2) or a wayside receiver unit (see Part 2B, Section 11.3.7.9.5.3) and, upon receipt of such beacon signal, shall transmit via radio frequency the Vehicle number, miles to date and tire factor programmed in the recorder. In addition, the trip recorder shall transmit a voltage reading showing the status of the battery in the recorder.

11.3.7.9.5.2 Portable Handheld Receivers

A sufficient number of handheld receivers (but no less than 2), capable of interrogating, reading, storing and transferring data from the hub-mounted trip recorders shall be supplied. The portable units shall be battery-powered with a standard nine-volt battery, and shall have an LCD display and an interface for transmitting data to the maintenance management information system (MMIS) (see Part 2B, Section 11.3.13.7) directly or through a modem. The unit shall be capable of interrogating the trip recorders from a distance of three (3) feet or less. When a hub-mounted trip recorder is interrogated, the Vehicle number, life-to-date mileage, and tire factor shall be read, stored and displayed on the unit's LCD. The data so read and stored shall be time and date-stamped and this time and date shall also be stored with the record of information. The portable units shall be capable of storing at least 1300 data records. A special message shall also be
displayed to indicate any low-battery condition of a reporting trip recorder, or the handheld unit itself.

11.3.7.9.5.3 Wayside Receiver Unit

The APM Operating System shall be designed with wayside receiver units to automatically interrogate the Vehicle-mounted hub trip recorders. This interrogation shall occur: (1) when the Vehicle or Train is positioned in at least one of the APM System Stations; (2) at the Train receiving track; and (3) at the Train ready track. When a Train is stopped in the interrogation location, the wayside receiver unit(s) shall be commanded to interrogate the hub trip recorder(s) on the Train. The receiver units shall receive such transmitted data, add the time and date stamp (see Part 2B, Section 11.3.7.9.5.2), perform data verification checks and transmit the information to the MMIS described in Part 2B, Section 11.3.13.7. The wayside receiver units shall be designed for exterior installation, and shall not interfere in any way with APM Operating System operation.

11.3.7.9.5.4 Programming Kits

A total of 2 programming kits shall be supplied to allow programming and re-programming of the electronic hub-mounted trip recorders with the Vehicle number, initial life-to-date mileage and tire factor (revolutions per mile of tire travel). Programming kits shall consist of a special transceiver unit, software for a portable computer and a cable with connectors to plug into a portable computer. The programming kits shall be capable of use on an office computer to program the hub-mounted trip recorders prior to installation on the Vehicles, and shall also be capable of being run on a laptop computer for programming the recorders after they have been installed on a Vehicle.

11.3.7.9.6 Alignment of Axles

11.3.7.9.6.1 Rubber-Tired Vehicles

To ensure satisfactory operation of rubber-tired Vehicles, the axles of such Vehicles shall be maintained perpendicular to the direction of motion under all conditions.

11.3.7.9.7 Vehicle Weight Overload

The Developer shall include a sensor to detect the weight of the Vehicle if the design is limited by the suspension system, propulsion system, or is safety-critical and can be overloaded. If such a weight sensor is provided, it shall detect the Developer’s specific Vehicle overload condition (which shall not be less than AW1) when the Vehicle is parked at a Station. When such an overload condition is detected, the overloaded Vehicle/Train shall transmit a Priority II alarm as described in Part 2B, Section 11.3.9.3.4.1; further, the Vehicle shall be inhibited from departing the Station until the condition is corrected.

11.3.7.10 Doors

Automatic, power-operated, bi-parting, horizontally sliding doors shall be provided on both sides of the Vehicle for passenger entrance and exit. The number and width of doors shall meet the requirements of Part 2B, Section 11.3.7.10.1 given the Vehicle capacity calculated as per Part 2B, Section 11.3.7.3.

If doorways connecting adjoining Cars in a multi-car Train are provided, then such doorways shall have thirty (30)-inch minimum clear opening widths.

11.3.7.10.1 Features and Dimensions

It shall be possible to completely unload a Vehicle filled to the normal capacity, as defined in Part 2B, Section 11.3.7.3, in 25 seconds or less through the doors on one side only, under the assumption that one passenger per 2.2 seconds can be unloaded through each thirty (30)-inch
unit of clear width at each doorway. For this calculation, the clear width of each doorway shall take into account any reduction in width due to stopping misalignment within the tolerances specified in Part 2B, Section 11.3.9.2.1 for a normal programmed Station stop. Doorway exit width shall be measured on a doorway basis; combining "extra" width from different doorways is not permitted. In calculating loading and unloading times, the effective clear width, in inches, of each doorway shall be divided by thirty (30) inches and rounded downward to the nearest 0.1 units.

The minimum doorway height shall be 76 inches. The doorway width shall provide a minimum clear opening per Part 2B, Section 11.3.9.2.1.

11.3.7.10.2 Door Operation

Automatic operation of the Vehicle doors, and Station platform doors, shall occur only if the conditions specified in Part 2B, Section 11.3.9.1.8, are satisfied. Automatic operation of the Vehicle doors, and Station platform doors, shall be controlled by the ATO subsystem, subject to the ATP subsystem safety checks.

Door closing shall be annunciated by audio and visual warning signals, as specified in Part 2B, Section 11.3.7.13.9 and Part 2B, Section 11.3.12.1.2.3.

11.3.7.10.3 Door Safety

Door or door control subsystem failures shall not result in a Vehicle door unlocking or opening when not commanded to do so and shall meet all requirements of Part 2B, Section 11.3.9.1.7.

It shall not be possible to entrap fingers, hands or clothing between door panels and adjacent fixed sections while doors are opening or closing. Door panels, operating mechanisms, and linkages that could pinch or injure passengers shall not be accessible.

All Vehicle door panels shall have sensitive edges and a door reopening feature that, when activated by the leading sensitive edge of a door panel contacting an obstruction of one-inch or greater diameter located at any point along the closing edge and at any point of door travel, shall cause both panels to recycle: that is, stop, reverse direction, return to the fully opened position, and then begin the closing cycle again. Any object of one inch or greater diameter detected between the closing door panels shall cause them to recycle. Any proposed alternative to the use of sensitive edges shall provide equivalent safety and be subject to acceptance by LAWA. The door open period in this cycle shall be adjustable from one to five seconds and in not greater than one-second increments. Door panels at unaffected doorways on the Train shall not be recycled. Activation of the door reopening feature causing the doors to recycle three (3) times, or causing the doors to be held open for more than ten seconds, shall result in an alarm at Central Control. Door interlock requirements are discussed in Part 2B, Section 11.3.9.1.8 and Part 2B, Section 11.3.9.1.9.

Doors shall be mechanically locked. With Vehicle power applied to the door operating mechanism, the door panels shall automatically unlock and open or close and lock, as appropriate. The doors shall not be locked until the space between door edges is 0.25 inch or less. In the event of loss of power to any Vehicle door mechanism or failure of either the door controls or devices that power the lock, it shall be possible to open the failed door manually, with a force not exceeding 35 pounds, after manual unlocking. All Vehicle doors shall have a mechanism on the exterior of the Vehicle to unlock and open the door panels manually without the aid of Vehicle power and without the use of a key or similar device.

No door panel shall exert a closing force in excess of thirty (30) pounds for the full range of door motion, even when the reopening feature has been deactivated or has failed. The kinetic energy of each Vehicle door panel, including all parts rigidly connected to the door and computed for the
average closing speed, shall not exceed 7 foot-pounds. The average door closing speed shall be calculated by measuring the time required for the leading edge of the door to travel from a point 1 inch away from the open jamb to a point 1 inch away from the point of closure of the doors. Demonstration of compliance by test in lieu of calculation may be provided. When the door-reopening feature is no longer active, just before door closure, the kinetic energy, as computed above, shall not exceed 2.5 foot-pounds.

When the doors are fully closed and locked there shall be no air gap and the total opening shall not be greater than two (2) inches when an attempt is made to push the doors open. The door panels shall not separate due to forces from acceleration or deceleration in combination with Guideway grades.

Each door panel shall be of sufficient strength to meet the requirements of Section 7.4.4.1.2, Worst-Case Loads of ASCE 21. Door performance shall not be adversely affected after such loads are removed.

Station platform doors shall operate the same as the Vehicle doors and shall meet all of these Vehicle door safety requirements. Corresponding Train and Station platform doors shall be operated as a set for all normal and recycling operations.

**11.3.7.10.4 Door Alignment**

Allowable vertical and horizontal gaps between the Vehicle door threshold and the Station platform shall be as specified in Section 7.3, Clearance in Stations of ASCE 21.

To prevent entrapment of persons between the Vehicle and Stations doors, the requirements of Section 10.2.1, Intrusion Prevention System, Item (6) of ASCE 21, shall be satisfied.

**11.3.7.10.5 Emergency Exits**

Each Car or passenger compartment shall be equipped with two (2) or more emergency exit(s). At least one of these shall be a door that leads directly to a safe emergency egress route at any point in the APM System, regardless of Train length. The second may be a door that leads indirectly through other Vehicles to a safe emergency egress route or a window that leads directly to such a route. If emergency exits separate from the regular passenger doors are required to meet evacuation requirements, they shall meet the retention and release requirements of Federal Motor Vehicle Safety Standard 217. Emergency doors shall not impede passenger exiting. There shall always be at least one unblocked emergency exit from each passenger compartment at all locations along the Guideway.

A safe emergency egress route is either onto the emergency walkway or onto the Station platform. Refer to Part 2B, Section 11.3.5.1.6 for emergency evacuation requirements.

Opening of any emergency door and/or any regular passenger door used as an emergency door shall be possible from inside and outside the Vehicle by means of a mechanical latch that operates independently of any on board power and with a force not exceeding 35 pounds. The emergency door-operating mechanisms on the inside of the Vehicle shall be conspicuously marked, including simple operating instructions that discourage unintentional operation. Actuation of the emergency door operating mechanism while a Train/Vehicle is in motion shall cause the Train to stop and remain stopped in accordance with Part 2B, Section 11.3.9.1.7. Only after the Vehicle reaches a zero speed in accordance with Part 2B, Section 11.3.9.1.13 shall the door be able to be opened for passenger egress. For conditions where operation of an emergency exit could present a hazard, such hazard shall be resolved in accordance with Part 2A, Section 8.2.2.

These mechanisms and instructions shall be clearly visible under normal and emergency lighting conditions. The emergency door and any such operable passenger door shall open onto the safe
emergency egress route, in accordance with Part 2B, Section 11.3.5.1.6. Except for failures that are determined to be “Improbable” in accordance with the criteria of Table 3-1, Risk Assessment of ASCE 21, the emergency door unsafe side door blocking mechanism shall fail in a manner that permits the emergency doors to open when operated. Such failure shall result in an alarm message to Central Control. Opening any emergency exit shall meet the requirements of Part 2B, Section 11.3.9.1.7.

11.3.7.10.6 Door Reliability

Vehicle doors shall be qualification tested in operation for at least one million cycles without failures exceeding predicted reliability values with normal scheduled maintenance. Tests shall be made with one set of Vehicle doors of the same design and operation as the production doors.

After one million cycles, doors shall continue to meet all performance requirements of this specification. Predicted reliability values shall be submitted as part of the Vehicle Design Audit. See Part 2C, Section 4.3.1 for the specific requirements regarding qualification testing and conditions for any waivers.

11.3.7.11 Exterior Design

The Vehicle shall have a clean, smooth, simple design. The exterior and body features shall allow complete and easy cleaning, including in an automatic Car wash. Body and windows shall be sealed to prevent leaking of air, dust, or water under normal operating conditions and during cleaning by personnel or the automatic Car wash.

The exterior and interior of the Vehicle shall be coordinated in design, materials, and colors. The color scheme and design of the Vehicle shall include a maximum of three (3) colors. The Developer may assume that the roof color will be white or a similar reflective color for Vehicle HVAC design purposes. Logos and numbers shall be applied to the exterior, and shall meet all durability and related requirements.

The Developer shall submit color renderings and six (6) one to thirty-two (1/32) scale model of a complete maximum length Train, with the proposed Vehicle exterior design, including color scheme, in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

11.3.7.11.1 Passenger Module

The passenger module shall be fabricated of stainless steel, or aluminum, or high-strength low-alloy (HSLA) steel or gel-coated fiberglass reinforced plastic or high strength composite material, or a combination of these materials. Aluminum shall be “A” in resistance to corrosion as defined in the Aluminum Association Structural Handbook. All exterior materials shall be designed for corrosion-resistance sufficient to withstand a salt spray test in accordance with ASTM Procedure B117, Method of Salt Spray (Fog) Testing. Weathering steel, such as ASTM A588, shall not be used. All dissimilar metal components including fasteners shall be electrically insulated from each other to prevent galvanic corrosion.

11.3.7.11.2 Finishing

The Vehicle exterior shall be painted, completely or partially, to conform to the accepted color scheme and design, including at least logos, numbers, and signage. Fiberglass need not be painted if the desired finish colors are an integral part of the gel-coat. Finish coating systems shall maintain a glossy appearance under normal maintenance and operation, without fading, discoloration, or peeling and shall protect the Vehicle from rust for its structural design life. Steel shall be completely primed and painted. Stainless steel shall be painted only as needed to meet aesthetic and thematic design requirements. Aluminum shall be anodized or completely coated with epoxy-resin primer, or substitute primer having equivalent or better properties, and painted.
11.3.7.11.3 **Joints between Cars**
Articulated Vehicles shall have a continuous covering around the top and sides of each articulation joint, which shall not be of the bellows type.

11.3.7.11.4 **Vehicle Styling**
The exterior style of the Vehicle shall be subject to LAWA’s acceptance and shall at a minimum reflect the following guidelines. Horizontal lines and banding of the vehicle design shall be emphasized through appropriate placement of glazing and color that ties in with sloped car body end caps. Flat end caps are not acceptable. Vehicle styling shall be streamlined in overall appearance, incorporate natural light, provide expansive glazing that maximizes transparency, and shall be monolithic in appearance and horizontal in expression.

LAWA retains the right to participate with the Developer in the styling of the Vehicle exterior. LAWA may require changes to the exterior style of the Vehicle which do not cause changes to the Vehicle structural design and the sizes and locations of the doors and windows. Such styling may include the following:

A. Shapes of carbody end caps;
B. Size and mounting of glazing to cover windows in carbody and doors;
C. Window tinting;
D. Color and color scheme;
E. Use and placement of logos;
F. Style of exterior lights; and
G. Exterior wraps.

11.3.7.12 **Watertight Construction**
Each Car/Vehicle, at AW0 and AW2 loading with doors and window seals installed, shall be watertight when exposed to water spray from a 40 psi, 5 gpm nozzle located five feet from the exterior surface and directing the water perpendicular to the surface during factory tests required by Part 2C, Section 4.3.2.1. The entire Vehicle, sides, ends, and roof shall be tested after a minimum soak time of ten minutes. At least one watertightness test at both AW0 and AW2, as the qualification test required by Part 2C, Section 4.3.1, shall be performed on one Car/Vehicle before the installation of insulation and/or sound deadening material, and another shall be performed after all materials and equipment have been installed. Insulation that is integral with walls of a sandwich construction shall be permitted in both tests as long as tests include detection of any leaks and seepage at any holes in, and at the edges of, such wall material. A small amount of seepage will be permitted at the door seals; however, no water shall spray into the Vehicles at the door seals. During the watertightness testing, water shall not enter, or in any way impair the operation of, any subsystem or equipment.

The Vehicle shall incorporate a drip molding above the door openings. Removable covers and access panels that require sealing shall use reusable seals and shall not require caulking or sealant. These covers and panels shall meet the watertightness test above with no leaking.

The above requirements shall also be met with a completed Car/Vehicle at AW0 and AW2 during the automatic Car wash demonstration, during acceptance testing at the Project site.

11.3.7.13 **Interior Design**
Vehicle interior dimensions shall accommodate the range of the 5th percentile of female population to the 95th percentile of male population in accordance with ISO 3411. Corridors and
aisles shall have a height of at least 80 inches. The main aisle width shall be at least 42 inches to permit access by a wheelchair. See Part 2B, Section 11.3.7.6.4. All standing passengers shall have access to vertical stanchions or handholds. See Part 2B, Section 11.3.7.13.8. Window area shall be maximized to emphasize a feeling of openness.

The interior shall have no sharp depressions or inaccessible areas and shall be easy to clean and maintain. Handholds, lights, air vents, armrests, and other interior fittings shall appear to be integral with the Vehicle interior. There shall be no sharp, abrasive edges, corners, or surfaces and no hazardous protuberances.

Interior panels and partitions shall be permanently mounted by tamper-resistant and vandal-resistant fasteners or welded in place. Interior panels shall be attached so that there are no exposed edges or rough surfaces. Panels and fasteners shall not be removable by passengers. Use of moldings and small pieces of trim shall be minimized. Individual trim panels and parts shall be interchangeable to the maximum extent practicable. Panels and other interior Vehicle components shall not resonate and/or generate noise. Panels and trim shall be secured, and all joints and fastenings treated, to avoid resonant vibration and/or noise generation. Equipment mounts shall minimize the transmission of vibration.

As part of the preliminary Vehicle Design Audit and in conjunction with the similar requirement of Part 2B, Section 11.3.7.11, the Developer shall submit to LAWA in accordance with the Summary of Submittals list in Part 2A, Section 6.7 a color rendering and other drawings showing general layout and the proposed interior design and color scheme.

11.3.7.13.1 Interior Materials

Materials shall be selected on the basis of ease of maintenance, durability, appearance, safety, and tactile qualities. Materials shall comply with the requirements of Part 2B, Section 11.3.5.1.3 and Part 2B, Section 11.3.7.14. Trim and attachment details shall be simple and unobtrusive. Interior panels and trim shall be secured, and all joints and fastenings treated to avoid resonant vibration and/or noise generation.

Interior panel material shall permit easy removal of paint, greasy fingerprints, and ink from felt tip pens and dirt. Materials shall be strong enough to resist everyday abuse and vandalism and shall be resistant to scratches and markings. Interior mullion trim, moldings, and trim strips shall match the adjacent panels/walls, except where they are specifically incorporated in the interior color scheme.

Flooring shall meet the requirements of Part 2B, Section 11.3.7.13.4. Seat materials shall meet the requirements of Part 2B, Section 11.3.7.13.5.

Samples of the floor covering, seat, trim, panel, and stanchion/handhold materials shall be submitted to LAWA in accordance with the Summary of Submittals list in Part 2A, Section 6.7 as part of the preliminary Vehicle Design Audit.

11.3.7.13.2 Access Panels

Access for maintenance and replacement of equipment shall be provided by panels and doors that appear to be an integral part of the interior. All equipment compartments shall be sealed to prevent unauthorized entry. Opening of all interior access panels shall require a special tool or key. Panel fasteners shall be standardized so that only one tool is required for special fasteners within the Vehicle. Access doors for the door actuator compartments shall prevent entry of mechanism lubricants into the Vehicle interior. All fasteners that retain access panels shall be captive in the cover. Removal of fixtures or equipment unrelated to the repair task to gain access shall be minimized. Access doors shall be hinged with props to hold the doors out of the
technician's way. Overhead access panels shall have safety catches to prevent the panel from dropping.

11.3.7.13.3 Fire Barriers

The passenger compartment shall be separated from the compartments containing the propulsion unit(s), propulsion control unit(s), and any propulsion-level-voltage powered auxiliary equipment. The partition between them shall be a fire barrier by incorporation of fire-resistant materials in its construction. These fire barriers shall retard propagation of any propulsion or propulsion control unit compartment fire into the passenger compartment and shall meet the criteria of Table 8.4.1 of NFPA 130, for structural flooring.

All panels that provide separation between the Vehicle interior and any electrical or mechanical equipment other than communication panels, light switches, destination switches, etc., shall meet the performance criteria shown in Table 8.4.1 of NFPA 130, for panels.

Any penetration through the fire barrier for conduits, ducts, or any other reason shall meet the requirements of ASTM E119.

11.3.7.13.4 Floor and Floor Covering

11.3.7.13.4.1 Floor Structure

The floor deck may be integral with the basic structure or mounted on the structure securely to prevent chafing or horizontal movement. Floor fasteners shall be secured and protected from corrosion for the service life of the Vehicle.

The floor of the passenger cabin shall be a continuous flat plane. Door threshold plates shall be flush with the floor surface. The entire floor shall be covered with material that remains skid resistant in all weather conditions. The floor, as assembled, including the sealer, attachments, and covering, shall be waterproof, non-hygroscopic, resistant to wet-and dry-rot, resistant to mold growth, and impervious to insects. Any access openings in the floor shall prevent entry of fumes, flames, and water into the Vehicle interior.

11.3.7.13.4.2 Floor Covering

The entire floor of the Vehicle shall be covered with synthetic or natural rubber flooring material designed for transit Vehicle use. The interior floor covering shall be a smooth rubber sheet at least 1/8 inch (3 mm) thick. Carpeting shall not be provided. Floor coverings shall withstand a static load of at least 160 pounds applied through the flat end of a ½-inch-diameter rod without permanent visible deformation.

Floor covering material shall be installed to prevent edges from coming loose. Floor covering material shall be installed in continuous lengths oriented longitudinally. Every effort shall be made to produce a seamless floor surface. Seams shall be watertight to prevent moisture and cleaning agents from penetrating through the floor covering material. The floor covering material and transitions of it to thresholds shall be smooth and present no tripping hazards.

Where the flooring meets the walls of the Vehicle, the surface edges shall be blended to prevent debris accumulation.

The composition of the floor covering material shall be homogenous and shall resist acids, alkalines, solvents, and shall not become slippery when wet. The floor covering material shall conform to the following standards:

A. The floor covering material shall neither crack nor craze when tested in accordance with Method 3111 of FED-Std. 501.
B. The floor covering material shall not change in linear dimension by either shrinking or bunching. Stability shall be determined in accordance with ASTM D 1204.

C. The tensile strength and ultimate elongation of the floor covering material shall be in accordance with ASTM D 412.

D. The coefficient of friction of the floor covering material shall be at least 0.75, when tested in accordance with ASTM D 2047.

E. The floor covering material shall be compliant with ADA requirements and meet the applicable requirements of Part 2B, Section 11.3.7.14.

F. Floor coverings shall meet the performance criteria of Table 8.4.1 of NFPA 130, for floor coverings.

Samples of the floor covering material and attachment system shall be submitted in accordance with the Summary of Submittals list in Part 2A, Section 6.7 as part of the Vehicle Design Audit.

### 11.3.7.13.5 Seats

See Part 2B, Section 11.3.7.3 for the required Vehicle seating capacity.

Fixed seats shall be provided. The seat frames shall be of molded or machined form and of material that is easily maintained and resistant to vandalism. Coloring shall be consistent throughout the seat material, with no visually exposed portion painted. Seats shall be a color compatible with the Vehicle interior.

The seat and seat-back surfaces shall be contoured for lateral support and maximum comfort, and shall fit the framework to minimize exposed edges. The seats shall not contain cushion and upholstery materials.

Seats and seating materials shall satisfy the structural requirements of Part 2B, Section 11.3.7.4.1 and the flammability and smoke emission requirements of Part 2B, Section 11.3.7.14.

Seat design, materials, and colors shall be submitted in accordance with the Summary of Submittals list in Part 2A, Section 6.7 as part of the Vehicle Design Audit.

### 11.3.7.13.6 Windows

The window in front of the manual control panel (see Part 2B, Section 11.3.7.20) at both ends of Vehicles equipped with on board manual controllers shall provide a field of view to permit safe manual operation on the Guideway. The window shall provide a field of view that allows the driver to manually operate the Vehicle to: (1) remove failed Vehicles from the Guideway to the sidings or maintenance service area, (2) couple and uncouple Vehicles, (3) maneuver Vehicles in the maintenance and service area and elsewhere, and (4) perform similar tasks. These end windows shall have devices to remove condensation on both sides and frost on the outside, including external electric windshield wipers.

All windows shall be fixed in position and unopenable. All windows shall be easily replaceable without disturbing adjacent windows. Flexing or vibration during operation shall not be apparent.

All windows shall minimize external glare as well as reflections from inside the Vehicle. End windows shall have a means to eliminate interior reflections and glare when the Vehicle is operated manually at night. The window glazing shall be single pane and free of visual distortions. Windows shall be tinted a neutral color, complementary to the exterior design and colors. The visible light transmittance of all windows shall be 22 to 28 percent unless operation requires windows with higher light transmissibility at the manual operator’s position. Mirrored windows shall not be permitted.
All Vehicle glazing shall meet the requirements of 7.9, Windows of ASCE 21, except that front and rear windows shall meet ANSI Z26.1, Item 1 tests. All windows shall be of laminated glass with a minimum thickness of 0.25 inches. Windows shall meet the performance criteria of Table 8.4.1 of NFPA 130, for windows. However, other products may be permissible for use in the front and rear windows so long as they will meet Item 1 tests and the design/installation is accepted by LAWA.

### 11.3.7.13.7 Insulation

Any insulation material used between the inner and outer panels shall be fire-resistant as required by Part 2B, Section 11.3.7.14 and sealed to minimize entry of moisture and to prevent moisture retention in sufficient quantities to impair insulation properties. Insulation properties shall be unimpaired by vibration compacting or settling during the service life of the Vehicle. The insulation material shall be non-hygroscopic, resistant to fungus and breeding of insects, and shall not absorb or retain oils.

The combination of inner and outer panels on the sides, roof, and ends of the Vehicle and any material used between these panels shall provide a thermal insulation sufficient to meet the interior temperature requirements of Part 2B, Section 11.3.7.6.1. The Vehicle body shall be thoroughly sealed so that drafts cannot be felt by the passengers during normal operations with the passenger doors closed. Insulation shall meet the performance criteria of Table 8.4.1 of NFPA 130, for insulation.

### 11.3.7.13.8 Stanchions, Handrails and Ceiling Grips

Any standing passenger at any location in the Vehicle shall be able to reach easily a vertical stanchion, a horizontal handhold between vertical stanchions, or a handhold attached to a seat back or to a wall, or a ceiling grip as defined below. Handrails, stanchions and ceiling grips shall be convenient in location and shape for both the 95th percentile male and the 5th percentile female standee in accordance with ISO 3411. Stanchion placement restrictions and diameter/width of handrails and stanchions shall be in accordance with Section 7.7.6.2, Interior Circulation, Handrails, and Stanchions of ASCE 21; except that, knuckle clearance shall be 1.5 inches minimum. Ceiling mounted handgrips may be provided where it is not possible to provide a vertical stanchion or other handholds; however, flexible strap type handholds shall not be permitted. Such handgrips shall be rigid, metal devices conforming to the above requirements and some rotational movement, in one axis only, will be allowed depending on the specific design.

Stanchions shall be placed such that the Vehicle can accommodate passenger use of baggage carts. It shall be possible for passengers to enter a door at one end of the Car with a baggage cart and to leave by the doors at the opposite side and opposite end of the Car.

Stanchions, handholds and ceiling grips shall be of stainless steel tubing with satin finish. They shall be able to support the forces of the maximum number of passengers expected with AW2 loading under maximum emergency deceleration conditions. Any joints in the handrails, stanchions or ceiling grips shall prevent vibration or passengers from moving or twisting them.

### 11.3.7.13.9 Passenger Information

#### 11.3.7.13.9.1 Audio Announcements

All passenger compartments for all Vehicles shall have automatic on board announcements, synchronized with the location of the Train on its route, as required by Part 2B, Section 11.3.1.4 that accomplish the following:

A. Announce the imminent departure of a Train from a Station;
B. Announce the imminent arrival and impending stop of a Train at a Station, together with the identity of that Station;

C. Announce the imminent commencement of door closing with audio and visual signals;

D. Announce the identity of the Station the Train is destined for after it departs the current Station;

E. Announce the route the Train is following; and

F. Provide other appropriate messages related to passenger information and safety, as described in Part 2B, Section 11.3.10.1.4

11.3.7.13.9.2 Graphics

Static graphics shall be provided in each Car for operational and emergency information. These signs shall be easily interchangeable to accommodate proper orientation of Vehicle travel direction throughout the APM System, also see Part 2B, Section 11.3.5.1.9.H. Each passenger compartment shall have at least two APM Operating System route maps identifying all Stations. Graphics shall indicate the normal exit doors, priority seating for persons with disabilities (indicating that other passengers should make such seats available to disabled persons, and wheelchair position(s) and restraint use. Emergency instructions to passengers concerning use of fire extinguisher, the two-way communication system, emergency braking, emergency egress (including instructions regarding exiting on the safe egress side of the Train), and manual door opening controls shall be prominently displayed.

Graphical information shall be, primarily comprised of self-evident pictorial representations that require minimal written instructions. Any written instructions shall be in English and other languages as required by Part 2B, Section 11.3.1.4. Where words are necessary, graphics shall meet the requirements of ANSI Z535.1 through Z535.5. Characters on all signs shall be in accordance with character requirements specified in Section 7.7.6.1, Priority Seating Signs of ASCE 21. Other information, including prominent “no-smoking” and similar prohibition signs shall be provided. All interior graphics shall be submitted as part of the Graphics Plan in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

Dynamic graphic devices shall be provided in each passenger compartment to provide operational, advertisement, and emergency information to passengers. These devices shall conform to the following requirements:

A. Be observable and readable from all standing locations within the Car.

B. Display the same messages in each Car of a Vehicle, and all Vehicles in a Train.

C. Display messages in characters at least 2.3 inches in height.

D. Display messages in a text font accepted as part of Vehicle Design Audit.

E. Display messages in either a sequenced or scrolling format.

F. Routinely display the next Station at which the Vehicle will stop on its route.

G. Routinely display the route the Train is following.

H. Automatically display emergency or informational messages as may be selected by the Central Control Operator; these messages shall be synchronized with, and substantially the same as, the audio messages described in Part 2B, Section 11.3.7.13.9.1 and the Station dynamic graphics messages described in Part 2B, Section 11.3.12.1.2.1.
I. Display unique messages that may be formulated by the Central Control Operator and relayed to one or more Vehicles.

J. The Vehicle Dynamic graphics shall be Liquid-Crystal (LCD) type. They shall have adequate bandwidth for data transfer for future use of these displays for other non-APM type information. The exact nature shall be coordinated during preliminary Vehicle Design Audit. Each passenger compartment shall have a minimum of two (2) advertising LCD type displays. These shall be located where feasible along the tops of the side and end walls (or equal). These displays shall be capable of displaying video content provided by the dynamic sign system described in Section 11.3.12.1.2.1.

Each passenger compartment shall have standard provisions for advertising graphics between dynamic signs along the tops of the side and end walls.

All interior graphics shall be submitted as part of the Graphics Plan.

11.3.7.13.10 Resistance to Vandalism

Materials used for the Vehicle shall be vandal resistant. Fasteners exposed to passenger access shall be tamper resistant. Blind fasteners shall be provided for fastening seatbacks, trim, and panels. Where blind fasteners cannot be used, tamper-proof fasteners shall be used. Walls and ceilings shall meet, at a minimum, the graffiti-resistance rating of two (2) as specified in the APTA Transit Security Guidelines Manual.

11.3.7.14 Flammability and Smoke Emission

Incidence of fire shall be considered a category I (catastrophic) hazard as defined in Table 3-1 of ASCE 21. Vehicle fire design shall meet all requirements of Chapter 8 of NFPA 130.

The materials used for Vehicle construction shall provide fire propagation resistance in accordance with Section 8.4.1 of NFPA 130. No polyvinyl chloride, polyurethane foam, polystyrene foam, or foam rubber shall be used. Oils and hydraulic fluids shall be flame retardant except as required for normal lubrication.

A fire hazard assessment for each Vehicle or Car type shall be submitted by the Developer. The assessment shall be made using the methodology described in the appropriate Annex of NFPA 130.

11.3.7.14.1 Electrical Wire Insulation

Electrical wire insulation shall be resistant to the spread of fire and shall meet all requirements of Section 8.6.7.1 of NFPA 130. Wiring within procured commercial electronic equipment, shall be exempt from this requirement so long as the wiring is enclosed within the assembly or component, but shall be brought to the attention of LAWA for its review and acceptance.

11.3.7.15 Fire Protection

Smoke detectors shall be provided in accordance with Section 7.10.4 of ASCE 21. Smoke detector activations shall be annunciated per Part 2B, Section 11.3.9.3.3.2.U and Part 2B, Section 11.3.9.3.4.1. The detectors shall be appropriate for transit Car application. At least one smoke detector shall be mounted on the ceiling at the center of the passenger compartment and not directly in the air flow from the HVAC system. Smoke detectors shall also be located in the return air ducts of each air conditioner. See Part 2B, Section 11.3.7.6.1.I. In addition, at least one heat and/or rate of temperature rise detector shall be provided in the Vehicle interior.

Fire extinguishers shall be provided in accordance with Section 7.10.3 of ASCE 21 and Section 8.9.3 of NFPA 130. Removal of an extinguisher from its mounting location shall activate an
audible alarm on the Vehicle and send an alarm to Central Control. See Part 2B, Section 11.3.9.3.4.1. No special tools or equipment shall be required to access the fire extinguisher. Where glass is used to secure the extinguisher from tampering, the glass shall be readily breakable using personal items such as purses, briefcases and/or shoes.

Thermal protection for electric motors shall be provided. This protection shall be in accordance with NEC 430-32(a) (1), which states that each motor shall be protected by a separate overload device that is responsive to motor current.

11.3.7.16 Vehicle Coupling

Coupling shall be designed in accordance with Sections 7.5 of ASCE 21, and this Part 2B, Section 11.3.7.16.

The following coupling requirements shall apply regardless of the type of coupling provided:

A. Vehicle to Vehicle connections that are used to form multiple Vehicle Trains shall meet the requirements of this section for mechanical, electrical, and pneumatic coupling.

B. Any non-automatic coupling and uncoupling operations shall require local manual supervision. The coupling/uncoupling process shall not endanger personnel safety and in no case shall the coupling process require placement of an individual between Vehicles while either Vehicle is in motion.

C. All mechanical coupling shall be slack-free and shall have bearing and/or wear surfaces that have a means to compensate for wear. All couplings, regardless of type, shall meet the requirements of Part 2B, Section 11.3.7.4.5. The mechanical parts of couplings shall not be used as an electrical ground nor shall they conduct current between Vehicles.

D. Failure of the critical mechanical, electrical, or pneumatic connections in any coupler in a Train or Vehicle shall result in the application of Vehicle brakes in accordance with Part 2B, Section 11.3.9.1.5. Reset of this brake application shall be accomplished only on each Vehicle and only by authorized personnel.

E. It shall be possible to couple Vehicles and Trains easily anywhere on the Guideway, except in crossovers, to push or pull a failed Train with an active Train, or with the MRV. This shall be accomplished by using mechanical couplers as specified in Part 2B, Section 11.3.7.16.1.

11.3.7.16.1 Mechanical Couplers

All Vehicles provided for the APM Operating System shall be equipped to be coupled into Trains for operation by use of mechanical latching type couplers as specified herein. Drawbars may, at the Developer's option, be used only between individual Cars of a Vehicle. Where mechanical couplers are provided between individual Cars of a Vehicle, the requirements of this Part 2B, Section 11.3.7.16.1 shall apply. Where drawbars are provided, the requirements of Part 2B, Section 11.3.7.16.2 shall apply.

Mechanical couplers shall be provided at each end of all Vehicles and shall allow coupling and uncoupling of any two (2) Vehicle ends anywhere on the APM System Guideway, including within the maintenance and storage areas, without the need for manual alignment of the couplers or special tools. The following requirements shall apply:

A. A positive lock shall assure that the coupler, once engaged, cannot release without prior, on board release of this lock.
B. All required electrical and pneumatic coupling connections (trainlines) shall be accomplished automatically during a mechanical coupling and shall be disconnected automatically during a mechanical uncoupling. Upon uncoupling, all required electrical and pneumatic coupling connections shall be protected by automatically deployed weather- and moisture-resistant covers. (See Part 2B, Section 11.3.7.16.3 for requirements for trainline connections incorporated into mechanical couplers).

C. Mechanical coupling and uncoupling shall normally be accomplished only by moving Vehicles or Trains under on board manual control. Under such conditions, the coupling or uncoupling operations shall require local manual supervision and shall not require special tools. There shall be means to couple and/or uncouple from both inside and outside the Vehicles. A person shall not be required to stand between Vehicles during the coupling or uncoupling process. No more than one person in each Vehicle shall be required to perform coupling or uncoupling, including operation of the Vehicles.

D. Mechanical coupling and uncoupling may also be accomplished by moving Vehicles or Trains together to form a single Train, or separating them to form two (2) Trains, under automatic control. When such automated mechanical coupling or uncoupling is employed, it shall be initiated and directed by the Central Control Operator as appropriate and meet all applicable requirements of Part 2B, Sections 11.3.5.1.1 and 11.3.9.1.

11.3.7.16.2 Drawbars

Drawbars (including tow bars) shall provide a slack-free connection between the Cars. All drawbar and tow bar components that must be removed to uncouple Cars shall be positively retained. No part of the drawbar or tow bar, or its components, shall be able to come in contact with power rails.

11.3.7.16.3 Trainlines

The requirements of this Part 2B, Section 11.3.7.16.3 shall apply to all trainlines, regardless of whether they are (1) incorporated into mechanical couplers, or (2) independent hose/wire connectors.

Trainlines shall be used to provide pneumatic and/or electrical connection between Vehicles. There shall be no hydraulic trainlines. It shall not be possible to move a mechanically coupled Train automatically unless all trainlines necessary for safe operation are complete.

All required electrical and/or pneumatic coupling connections shall be made automatically during a mechanical coupling event. Similarly, all required electrical and/or pneumatic coupling connections shall be disconnected automatically during a mechanical uncoupling event. Use of manual quick-connect/disconnect electrical and pneumatic connections shall not be permitted.

Electrical trainlines connections shall prevent incorrect alignment of trainline connections and shall have positively-retained, weather- and moisture-resistant covers to protect contacts when not in use. High voltage circuits shall not be trainlined between Vehicles, but may be trainlined between Cars in a Vehicle if that connection cannot separate or permit shorting during normal operations. Electrical connections between coupled Vehicles shall include circuit and shield grounds as appropriate. To prevent ground loop currents, electrical grounds shall not be connected between Vehicles and shielded cables shall have shields grounded only at one end.
Pneumatic trainlines between Vehicles shall have automatic sealing valves for mechanical couplers to shut off the lines when not coupled to another Vehicle. If more than one pneumatic trainline is required, they shall be configured so that misconnection is not possible.

Trainlines shall prevent damage to Vehicle-borne equipment and connectors if Vehicles, which have trainlines connected but are mechanically uncoupled, are moved apart. The weak link shall be the connector so that damage does not occur to Vehicle wiring or piping.

11.3.7.17 Train Interaction

Trains shall not interact with one another to adversely affect acceleration and braking rate limits, jerk limits, stability, stopping precision, or in any way degrade the operating efficiency or safety of each other.

Controls and coupling slack within individual Vehicles or Trains shall ensure that when two (2) or more Cars or Vehicles are coupled together, they shall not interact with one another in any way to cause hunting, instability, overheating, degradation of operating efficiency or safety, or acceleration and jerk limits in excess of those specified in Part 2B, Section 11.3.7.6.3. This requirement shall be met in all operating modes and for any combination of allowable passenger loading within the individual Cars or Vehicles.

11.3.7.18 Switching

Vehicle switching requirements are specified in Part 2B, Section 11.3.11.6.

11.3.7.19 Communications

On board public address speakers shall be located in each Car to provide undistorted messages at a sound level of at least 5 dBA above the ambient noise levels of Part 2B, Section 11.3.4.3.2 everywhere in the passenger compartment. It shall be possible for maintenance personnel, but not passengers, to adjust the volume of each on board speaker individually.

There shall be at least two (2) full-duplex communications devices on each Car or passenger compartment. These shall be located near diagonally opposite side doors of Cars with two (2) doors per side and on diagonally opposite sides of Car doors with one door per side. These locations shall be readily accessible to all riders. These devices shall: (1) be clearly identifiable; (2) be vandal-resistant; (3) have a push-to-call button, a recessed speaker and microphone and no handset; and (4) have clear instructions integral with the cover plate or immediately next to it.

The Vehicles shall be configured with an on-board public Wi-Fi access for use by passengers. This system shall provide seamless connection to the existing airport public Wi-Fi system at the terminal buildings. This Wi-Fi network shall be connected to LAWA’s existing passenger accessible network via the Train to wayside link as described in Part 2B, Section 11.3.10.6.

Other aspects of Vehicle communications, including on board video surveillance, emergency intercom, public address, and automatic announcements, are specified in Part 2B, Sections 11.3.7.6.4, 11.3.7.13.9, 11.3.10.1.3, 11.3.10.1.4, and 11.3.10.1.5.

11.3.7.20 Vehicle Control

Normal operation of the APM Operating System shall be fully automatic and without drivers or attendants on board. Provisions for manual control of the Vehicles/Trains are required only for purposes of failure retrieval and maintenance. The features for manual operation are not intended for the operation of regular passenger service.
11.3.7.20.1 Automated Mode

The APM Operating System shall be designed primarily for automated operation in passenger service satisfying the requirements of the Automatic Train Control system defined in Part 2B, Section 11.3.9.

11.3.7.20.2 Manual Mode for Self-Propelled Vehicles

Vehicles and Trains shall be capable of manual operation in both directions and shall be operable in either direction throughout the APM System with either end of the Vehicle in the forward orientation in accordance with the requirements of Part 2B, Section 11.3.3.6.

The Developer shall determine the applicability of CPUC GO 172, and the requirement for inward facing cameras to record the operator during any manual operation of the vehicle. Recording shall be in accordance with the stated General Order.

11.3.7.20.2.1 Manual Operations of Self-Propelled Vehicles

A manual mode of operation shall be incorporated as required by Part 2B, Section 11.3.3.3 for failure management, but not for normal passenger service operations. The manual control equipment shall be interlocked with the Vehicle propulsion control system so that only the manual control equipment at the forward (direction of travel) end of the Train can be used to move a Train manually. It shall not be possible to move, drive under power, or coast unpowered, a Train in the reverse direction from the manual control panel in the forward end of the Train.


It shall be possible to manually operate all Vehicles/Trains at speeds up to the maximum speed permitted by ATP and under ATO control when operating over the passenger carrying portions of the APM Operating System.


It shall also be possible to operate the Vehicle manually but not subject to any ATP restrictions (Part 2B, Section 11.3.9.1); however, the speed of such a manually operated Vehicle that is not subject to ATP shall be limited to the crashworthy design speed and the Vehicle shall be detected by the ATP system (Part 2B, Section 11.3.9.1.1). In addition, the emergency brakes shall be actuated by trip-stops if they are employed in the APM Operating System. All other Vehicles not coupled to the manually operated Vehicle shall remain subject to all ATP safety restrictions. The maximum speed, at which a Vehicle may be operated, not subject to ATP, shall be 10 mph.

11.3.7.20.2.2 Manual Control Panel

Controls for manual operation of self-propelled Vehicles shall be located in special, locked control panels at each end of the Vehicle. An operator at this position shall have a field of view necessary to perform all manual operations anywhere in the APM Operating System and during all weather conditions specified in Part 2B, Section 11.3.4. Window and operator position design shall meet the clear, no-fogging, no-reflection requirements of Part 2B, Section 11.3.7.13.6.

The control panels shall be unlocked and the key switch shall be activated by the same key, which may be the same key as that used for other Vehicle compartments and equipment cabinets. Each panel shall control all Vehicles in a Train and have at least braking and propulsion thrust level controls; a stop button to disable propulsion power and operate the emergency brakes; a speedometer; an Automatic Train Control speed command indicator; alarm indicators; door, lighting, windshield wiper, and coupling (if automatic couplers are provided) controls; communications devices; and a key switch to activate/deactivate the panel. The propulsion control
shall have a "dead man" control to prevent Train movement without positive manual actuation by the operator. If that control is released, propulsion shall be disabled and emergency braking shall be immediately applied. Where the speed in manual control is limited to the crashworthy design speed the speedometer and Automatic Train Control speed command indicator may be deleted from the panel.

Where the Developer does not provide manual control subject to ATP, the ATP aspect signal indicators may be deleted from the manual control panel, if wayside ATP aspect signals are provided along all sections of the Guideway where line of sight operations cannot be safely performed at speeds greater than the crashworthy design speed of Part 2B, Section 11.3.7.4.5.

Where automatic couplers are provided coupling/uncoupling controls shall be provided on the manual control panel to control only the coupler at that end of the Vehicle. The door switch and uncoupling controls shall be covered by spring-loaded, hinged covers or be otherwise suitably protected to prevent inadvertent actuation.

Each on board control panel shall have a microphone and speaker that can be used for two-way, Vehicle-to-CCF communications and to make announcements over the Train public address system. Train announcements made by operators from the manual control panel shall be simultaneously broadcast to all Vehicles in the Train (or coupled Trains, in the case of a Train recovery by pushing or pulling with another Train).

If the Vehicle has on board switching capability, the control panel shall have a means of operating the switch and a clear indication of switch position.

**11.3.7.21 On Board Diagnostics**

**11.3.7.21.1 Malfunction Annunciation**

An annunciator device shall be provided on each Vehicle to indicate the Priority I and Priority II Vehicle malfunctions as defined in Part 2B, Section 11.3.9.3.4.1. Each malfunction shall be uniquely indicated on an on board status panel readily accessible to maintenance personnel. Each indicator shall continue to annunciate the specific malfunction until the indicator is reset. For malfunctions that are remotely reset, the indications shall also be remotely reset at the same time. Where said Priority II malfunctions are alarmed and recorded at Central Control, only those malfunctions needed for safe manual operation of the Vehicle are required to be annunciated on board the Vehicle.

Those malfunctions that are "manually reset only" shall have their indications also reset when the emergency brakes are reset. All Priority II malfunction indications shall be resettable by a separate means on board the Vehicle.

**11.3.7.21.2 Malfunction Classifications**

The specific level of classification and report messages for Vehicle faults shall be developed by the Developer according to the requirements of Part 2B, Section 11.3.9.3.4.1. It shall be sufficiently detailed to allow operating and maintenance personnel to make rational decisions in reacting to the reports.

**11.3.7.22 Provisions for Bulky Item and Luggage Carts**

The Vehicle interior shall facilitate the use of strollers, large bags, golf bags, wheel chairs or similar mobility aids, and luggage carts by passengers. The interior design shall be reinforced to mitigate damage to the Vehicle interior elements due to the use of these items. Vehicle interior provisions shall include:
A. Protection of interior panels from deflection of wainscot panels due to impact from bulky objects. The impact zone will be from the floor level to 12 inches above the floor.

B. Stainless steel kick plates on the interior of the sliding doors suitable for the impact zone defined in item "A" above.

C. Stainless steel protection at the door jambs and sills.

D. Protection of any access door located in the impact zone defined in item "A" above.

E. Stanchions shall be located to facilitate passenger and luggage cart circulation through the Vehicle. Stanchion locations shall be submitted to LAWA as part of the Vehicle Preliminary Design Audit.

F. Provide signs in each Vehicle instructing passengers to secure their carts to prevent injuries to passengers and damage to the Vehicles.

11.3.8 APM Operating System Power Distribution System and Backup Power Supplies

The Developer shall provide all power conditioning equipment, circuit protection equipment, and switchgear required to supply electric power to all APM Operating System equipment and APM Fixed Facilities, such as stations, the M&SF and the TPSS as specified herein and in accordance with Chapter 9, Electrical Equipment of ASCE 21. The Developer shall provide and install all necessary power panels, wiring, conduit, and other electrical equipment to power Developer-provided equipment. Power substation facilities will be provided by the Developer in accordance with the Developer’s requirements. These power substations shall be the source of all power for propulsion and other APM Operating System equipment. The Developer shall provide and install all facilities required for the Power Distribution System (PDS) and equipment grounding. The Developer shall provide power to Stations (including the mezzanine level), Pedestrian Walkways, and Facilities as needed to meet requirements of these Technical Provisions.

The propulsion and auxiliary power systems shall be networked throughout the APM Operating System so that the loss of any one Los Angeles Department of Water and Power (LADWP) primary feeder does not affect overall APM Operating System performance. In the event that primary and secondary power is lost, emergency back up power shall be supplied by the Developer as stated in Section 11.3.8.5. All APM Operating System operations specified in these Part 2B, Design & Construction Technical Requirements shall be possible with one LADWP primary feeder at any and all substations out of service or with one APM Operating System substation completely out of service as defined in Part 2B, Section 11.3.8.1.

The PDS shall be sized to withstand peak loads encountered during the normal start-up and operation of Trains based on the following criteria:

A. Trains of the maximum length required to meet the specified requirements;

B. Trains loaded at the AW1 weight;

C. Trains operating at the non-interference headway specified in Part 2B, Section 11.3.3.1.2;

D. All on board electrical equipment that could be operated simultaneously, operating and without any restrictions; and

E. All Guideway and other ancillary power equipment on, including power required for normal maintenance.

F. All loads identified above multiplied by a factor of 1.10.
The PDS shall have a level of voltage regulation as specified in Section 9.1.7, Voltage Regulation of ASCE 21.

All primary power equipment, voltages, ratings, capacities, and feeder locations shall be as coordinated between LAWA, LADWP, and the Developer and meet the provisions of IEEE 519.

The Developer shall provide a Power Distribution Loads Analysis showing the real power requirements and reactive (VAR) requirements; the harmonics and their magnitudes; any voltage flickers and dynamic over voltages in case of AC/DC conversion failures for all APM Operating System equipment and operations, and estimated power demands and maximum power surges at each substation.

Ratings for all proposed transformers, rectifiers, and switchgear shall be included, as shall short circuit, circuit protection coordination, grounding, and cathodic protection analyses. All of these analyses and information shall be for the APM System. These analyses shall be submitted to LAWA as part of the Power Distribution System Design Audit in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

The PDS as initially installed shall be capable of satisfying the APM System Operational requirements.

11.3.8.1 APM Operating System Power Distribution System

Vehicle propulsion power and auxiliary power shall be supplied through power substations. Each substation shall include all power conditioning equipment, circuit protection equipment, and switchgear required to provide Vehicle propulsion, other Guideway equipment operation, and auxiliary power to all Guideway lanes. The power substations shall be self-sufficient in terms of auxiliary and control power requirements and shall include grounding of all equipment therein. The Developer grounding grid shall be separate from the LADWP ground grid and separated by the minimum distance required by LADWP.

LAWA has coordinated specific power connection locations near each of the TPSS locations identified in Part 2B Section 12.3.7.1 that will provide two (2) redundant 34.5 kV feeds. The Developer shall transform and rectify power at these substation locations. The Developer shall not use the APM Guideway for the distribution of high or medium voltage power between TPSS locations.

In addition, all power required for the operation of the APM Operating System shall normally be monitored and controllable from the CCC, and shall not be controllable by non-APM Operating System entities.

The Developer is responsible for connecting the primary feeders to the Developer-supplied and installed primary switchgear in close coordination with LADWP. The Developer shall provide, install, and connect all equipment within each substation, including, at a minimum, transformers, primary and secondary switchgear, cabling, wiring, wireways, conduits, rectifiers, and any other equipment required for APM Operating System performance as specified herein.

During a primary preferred source outage, switchover to the alternate primary source shall be accomplished automatically and interlocked so that paralleling of independent primary sources by Developer equipment does not occur under any circumstances. Switch back to the preferred primary source when its voltage is restored shall be selectively controlled from the CCC. The loss of any single primary source, or primary feeder, or any single failure within a PDS substation, shall not cause the loss of propulsion power to any Guideway section except that a momentary disruption in service shall be allowed. Breaker controls shall energize the substation sequentially; using the LADWP preferred primary source, then the LADWP alternate primary source.
primary feeder switchover equipment design and control shall be closely coordinated with LADWP and meet all of the LADWP requirements for such function, control and interlocking.

In addition, the CCO shall be able to remotely accomplish this switchover of primary sources, provided also that the switchover is interlocked so that paralleling of independent primary sources by Developer equipment does not occur under any circumstances. When switching of primary sources is accomplished remotely by the CCO, switch back to the preferred primary source when voltage is restored shall be selectively controlled from the CCC.

There shall be sufficient redundancy in the design of the substations and switchgear that no single-point failure (such as a loss of a single primary feeder) can result in more than a transitory disruption in service nor cause any degradation in APM Operating System and Train performance or impose any restriction on Trains or auxiliary equipment. Where such redundancy is provided within the design of each substation and the APM Operating System has more than one substation, the loss of a complete substation (e.g., both transformers or transformer/rectifiers) shall not impose any restrictions on Trains or Vehicle auxiliary equipment due to voltage regulation or substation capacity, except that Train performance over the affected portion of the APM Operating System may be degraded to twice the non-interference headway (see Part 2B, Section 11.3.3.1.2).

If power to any Guideway lane or segment is interrupted for any reason, except for the loss of a primary feeder or momentary arcing faults power shall not be restored without action either by the CCO at the CCC or by maintenance personnel at the appropriate substation(s). Restoration of power shall be done in accordance with operational procedures.

The PDS shall impose no restriction on Train operations or on Vehicle auxiliary equipment required to meet the APM System requirements. The PDS design shall facilitate APM Operating System and PDS maintenance as well as all of the operating modes of Part 2B, Section 11.3.3.2 and failure management procedures of Part 2B, Section 11.3.3.3.

Redundant secondary feeders are not required. Power to an affected power rail segment may be restored by closing the appropriate tie breakers to connect two (2) segments temporarily until the problem is resolved. See the segmentation requirements of Part 2B, Section 11.3.8.1.4.

The PDS shall protect passengers and O&M personnel from contact with lethal currents as well as isolate faults to minimize damage and interruptions to service.

Power regeneration, if provided as in Part 2B, Section 11.3.7.7.3, shall be in accordance with the requirements of Section 9.2.5, Power Regeneration Equipment of ASCE 21. Under no circumstances shall regenerative power be permitted back to the LADWP primary source. In addition, the hazard of regenerating power into a de-energized power rail shall be analyzed in accordance with the Hazard Identification, Analysis and Resolution Process specified in Part 2A, Section 8.2.2.

All PDS components, devices, wires, cables and assemblies shall be UL labeled or based on other demonstrated measures of quality accepted by LAWA and meet all requirements of the Contract Documents. The feeder, interconnecting, and branch cables shall be single, copper, thermosetting insulated conductors rated at the appropriate voltage and 90°C, with an allowable capacity as given in the appropriate tables of the NEC. The Developer shall verify that the PDS as designed and installed complies with all applicable industry standards and IEEE 519.

In addition to the above requirements, each TPSS shall be equipped with an Automated External Defibrillator (AED) device.
11.3.8.1.1 Metering, Alarms, and Data

Metering, alarms and data shall be provided in accordance with Section 9.2.4, System Monitoring and Alarms of ASCE 21. However, in addition to voltage, current, and power demand; power factor also shall be reported by means of indicating instruments within each substation.

Meter sockets and utility instrument transformer compartments shall be provided by the Developer for LADWP-provided and installed kilowatt-hour meters with a demand register and kilovar-hour meters. All metering arrangements shall conform to the requirements of the applicable LADWP schedule.

LADWP is a member of the Electric Utility Service Equipment Requirements Committee (EUSERC). The design and fabrication of primary and secondary service entrance and metering facilities and equipment shall conform to EUSERC requirements.

All PDS data transfer, data logging, alarms, and supervisory control features and functions of Part 2B, Section 11.3.9.3.2.2, Part 2B, Section 11.3.9.3.2.3, Part 2B, Section 11.3.9.3.4, and Part 2B, Section 11.3.9.3.6 shall be incorporated in the PDS.

11.3.8.1.2 Power Factor and Harmonics

APM Operating System requirements for power factor and harmonics shall be in accordance with Section 9.2, Traction Power Substation Equipment of ASCE 21, except as follows:

The APM Operating System power factor when averaged over any two-hour period shall be at least 0.90 in lagging power factor and leading power factor shall not be permitted. The power factor shall be measured at the point of interface between the APM Operating System and the primary distribution system. The Developer shall provide automatic power factor correction equipment required to achieve this power factor performance. The Developer shall guarantee this minimum and maximum power factor averaged over normal operating conditions.

11.3.8.1.3 Switchgear

Each substation shall have dead front, draw-out type primary and secondary switchgear controlling the power to its power supply arranged to permit manually initiated, power-assisted closure and tripping of all circuit switching and protective devices by local control. Signal circuits shall be provided to the CCC for remote operation and display of any circuit breaker or switch status change for Guideway propulsion power and auxiliary power. Signal and timing delays shall meet the requirements of Part 2B, Section 11.3.10.3.

All switchgear provided by the Developer shall use electrically operated, draw-out circuit breakers. Primary switchgear shall be equipped with vacuum circuit breakers, unless SF6 or air circuit breakers are accepted by LAWA and LADWP for the specific installation. Secondary switchgear shall have metal-clad power circuit breakers.

Switchgear features shall include:

A. Four (4) positions: "connected", "test", "disconnected", and "removed". The front door of the breaker cubicle shall be capable of being closed when the breaker is in any of these positions. Interlocks shall be provided to ensure that the breaker is open before it can be moved from any position.

B. Interlocks for the applicable control/protection supervisory control scheme. Each separate switchgear element shall have a lockout switch allowing local control of the switchgear, locking out remote control when in local mode.

C. Local manual controls (open/close) in addition to remote control, position indicators and annunciation of local mode at Central Control.
D. Provisions for padlocking with up to three (3) padlocks.

E. Adjustable solid state trip units for all over-current protective devices.

F. Copper buses.

G. A control power subsystem on UPS in accordance with Part 2B, Section 11.3.8.2.1.

H. Protective relays, breaker trip units, and interconnecting wiring to provide a coordinated subsystem for fault, overload, and PDS protection.

I. Fuses, power auxiliary transformers, potential transformers, current transformers, heaters, relays, meters, and all other accessories required to provide a complete and operable switchgear assembly.

J. Assemblies fully assembled and tested at the factory prior to shipment that conforms to applicable NEMA, ANSI, and IEEE standards.

K. Equipment constructed and assembled such that it can reasonably be moved to installation locations through doorways provided in the building design.

L. Switchgear assemblies and major components shall comply with the requirements given in ANSI and NEMA and shall be tested in accordance with the requirement given in ANSI as applicable. Circuit breakers shall be capable of performing within the applicable rating and operating characteristics limits established in accordance with ANSI. Materials used for circuit breaker insulation shall be of a type that is non-combustible and non-hygroscopic. The mechanical strength and physical characteristics of the insulation structure shall match the stresses imposed by the circuit breaker required closing and latching current capability.

M. Secondary DC circuit breakers, when used, shall be high speed type.

11.3.8.1.3.1 Circuit Interrupting Devices

All circuit interrupting devices not in the switchgear line-up shall have, at a minimum, the following features:

A. Interlocks for the applicable control/protection supervisor control scheme. Each separate switchgear element shall have a lockout switch allowing local control of the switchgear, locking out remote control when in local mode.

B. Local manual controls (open/close) in addition to remote control, position indicators and annunciation of local mode at Central Control.

C. Provisions for padlocking with up to three (3) padlocks.

D. Adjustable solid state trip units for all over-current protective devices.

E. Copper buses.

F. A control power subsystem on UPS in accordance with Part 2B, Section 11.3.8.2.1.

G. Protective relays, breaker trip units, and interconnecting wiring to provide a coordinated subsystem for fault, overload, and PDS protection.

H. Fuses, power auxiliary transformers, potential transformers, current transformers, heaters, relays, meters, and all other accessories required to provide a complete and operable circuit interrupting assembly.

I. Assemblies fully assembled and tested at the factory prior to shipment that conforms to applicable NEMA, ANSI, and IEEE standards.
J. Equipment constructed and assembled such that it can reasonably be moved to installation locations through doorways provided in the building design.

K. Circuit interrupting assemblies and major components shall comply with the requirements given in ANSI and NEMA and shall be tested in accordance with the requirement given in ANSI as applicable. Circuit breakers shall be capable of performing within the applicable rating and operating characteristics limits established in accordance with ANSI. Materials used for circuit breaker insulation shall be of a type that is non-combustible and non-hygroscopic. The mechanical strength and physical characteristics of the insulation structure shall match the stresses imposed by the circuit breaker required closing and latching current capability.

11.3.8.1.3.2 Blue Light Stations

Blue light stations with emergency telephones shall be provided as specified in Sections 6.4.2 and 10.4.3 of NFPA 130 for each Guideway segment as described in Part 2B, Section 11.3.8.1.4.1. Specific requirements for emergency access points at emergency access stairs, and fire truck ladder access are provided in Part 2B, Section 11.3.11.8.1. Blue light stations shall be located at all points of entry to the Guideway to permit manual lockout by maintenance personnel to ensure that any power rails are not active and to prevent movement of any Vehicles/Trains on the segment as defined in Part 2B, Section 11.3.8.1.4. Vehicle reaction to loss of propulsion power shall be as defined in Part 2B, Section 11.3.9.2.3. It shall not be possible for a CCO to override or reset power turned off at these stations from the CCC or any other remote location.

A blue light station for emergency Guideway power shut-off in the platform power zone, as defined in NFPA 130 shall be located adjacent to and at the Guideway side of the emergency walkway doors. An emergency telephone set (see Part 2B, Section 11.3.10.1.2.1) shall be located next to the power shut-off device in a weather and vandal resistant enclosure.

All emergency Guideway power shut-off switch exposed surfaces shall be stainless steel and designed, furnished and installed by the Developer. The telephone sets shall be in a weather and vandal resistant enclosure.

The Developer’s selection of number and location of the blue light stations shall be submitted as part of the APM Operating System Power Distribution System Design Audit. Proposed blue light station locations shall also identify and address Guideway and/or system access points required for access by emergency response personnel and requirements of the AHJ.

11.3.8.1.4 Power Rails

11.3.8.1.4.1 Power Rail Requirements and Segmentation

Power distributed to the Vehicles shall be by rigid power rails mounted on the Guideway. An overhead or catenary distribution system shall not be used.

The requirements of Section 9.3, Wayside Power Collection of ASCE 21, and of Part 2B, Section 11.3.8.1.4.2 and Part 2B, Section 11.3.8.1.4.3 shall apply in the design of the power rail system.

The power rail system shall be sized for its current/voltage drop requirements. The rails and mountings shall be of sufficient size to withstand Vehicle dynamic loads, wear, and electromagnetic and thermal loads due to short circuits. The power rails shall be solidly supported to prevent lateral or vertical motion, while allowing longitudinal movement as necessary for thermal expansion. Expansion joints shall minimize collector wear, acoustic noise, and arcing.
Power rails shall be of stainless-steel-clad aluminum as used on automated Guideway transit systems.

Power rails shall withstand arcing caused by normal operations and corrosion due to all environmental conditions of Part 2B, Section 11.3.4.

All rails shall be suitably insulated from each other and from adjacent structures, as determined by the operating voltage, to prevent electrical interaction and the possibility of a short circuit by the Vehicle power collector. Coverboards protecting the rails and other insulators shall prevent accidental contact by personnel on the Guideway and prevent short circuits caused by wind-blown conductive debris or deposits. Such shielding and insulating material shall be rated either self-extinguishing or non-burning per ASTM D635, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position and shall meet the wind load requirements of the California Building Code and requirements of the Contract Documents.

The power rail subsystem shall be segmented to allow isolation of Guideway sections for fault isolation, maintenance, and other purposes. Each segment/section of Guideway, such as those for the Guideways between Stations, each Station lane, any storage lanes, and the test track in the M&SF, shall be individually powered so that power may be removed from any one or a combination of sections without affecting power to any other section. Segmentation shall be such that de-energized sections correspond efficiently with Guideway access locations and in full consideration of the proposed failure modes of operation. Two adjacent segments may be temporarily tied by switchgear as a means to continue power to a segment that has lost power due to a failure in the secondary distribution system. This feature shall not defeat the deactivation of a power rail segment by manual lockouts or a blue light station. Segmentation shall prevent bridging by a Vehicle or a Train from the adjacent powered sections when a segment is deactivated. This feature shall be activated by the use of interlocked gap sections of greater length than the electrical length of the maximum length Train, as determined in Part 2B, Section 11.3.3.1.6.4. The use of permanently unpowered “dead rail” sections shall not be permitted. Power zone boundaries and sections/segmentation shall be defined by the Developer and submitted as part of the APM Operating System Power Distribution System Design Audit.

Near Stations and emergency egress points, power rails shall be located and protected to preclude accidental contact by passengers.

11.3.8.1.4.1.2 Power Rails Design Data

The Developer shall provide a conductor rail system. The Developer shall provide the following technical data, at a minimum, in support of its system:

A. Conductor rail current rating for 40°C ambient and 60°C conductor temperature.
B. DC resistance in ohms/1,000 ft. at 60°C.
C. Contact surface material and life (number of Vehicle passes).
D. Ability to withstand forces due to short circuit currents versus maximum available short circuit currents.
E. Minimum arcing distances (conductor rail to conductor rail, conductor rail to ground, between current collector shoes, current collector shoe to conductor rail, and current collector shoe to ground).
F. Rail expansions characteristics (coefficient of expansion, interval of expansion joints, and details of expansion joints and anchor strain insulators).
G. Power taps (current ratings and design details).
H. Splice joint resistance (percent efficiency relative to same length conductor rail).
I. Isolating gap (if applicable) design details.

11.3.8.1.4.1.3 Power Rail Connections
All wire and cable connections to the power rails shall be bolted; exothermic weld (i.e. CADWELD) connections shall not be used. Connections other than to power or ground rails may be exothermic welds.

11.3.8.1.5 Electrical System Protection and Grounding
Section 9.1.3, Electrical System Protection of ASCE 21 shall apply. The requirements contained in this Part 2B, Section 11.3.8.1.5 are in addition.

All equipment and individual circuits shall be provided with overload, surge and ground fault protection as appropriate.

The fault protection subsystem may incorporate an arc-quenching feature to provide for a brief, automatic interruption of power to quench momentary arcing faults. Automatic reclosing of PDS equipment shall be permitted only on the basis of a thorough hazard analysis in accordance with Part 2A, Section 8.2.2. If implemented, such reclosing shall occur only when line testing verifies that the short circuit condition does not exist and any arcing is eliminated. Such automatic reclosing means shall automatically lock out the reclosing function after three (3) attempts. The fault protection subsystem shall ensure positive interruption of the power supply for permanent faults. Starting currents and fault currents shall be coordinated.

Ground current detectors shall be provided between propulsion Power Distribution System transformer secondaries and the ground to monitor ground current. Ground current detection shall be provided for DC propulsion systems to detect faults between the positive and negative power busses and the ground. The detectors shall initiate the interruption of that part of the PDS in which excessive ground currents are detected. Detectors of all such fault and overload conditions shall trigger alarms and indications at the CCC.

The Developer shall demonstrate by analysis, that the design of its proposed electrical system and the corresponding grounding will not be unsafe under normal and fault conditions of operations. See Part 2A, Section 8.2.2 for Hazard Identification, Analysis and Resolution Process.

Additional requirements for grounding and cathodic protection are given in Part 2B, Section 11.3.14.

11.3.8.1.5.1 Protection
Over-current protection shall be assured. Over-current protection devices from primary switchgear to branch circuit devices shall be coordinated with LADWP. The selection of over-current devices shall reflect the protection scheme. Settings shall be provided for all adjustable over-current protective devices.

The short circuit current at all protective devices and switchgear shall be determined and apparatus selected with short circuit ratings greater than available short circuit currents. Proper selection and setting of all protective devices shall be provided to ensure that the electrical system is coordinated internally and with LADWP’s over-current protection requirements. Each level of coordination shall be selected for proper downstream protection without compromising APM Operating System operational capabilities.
Time current characteristic curves and overlays shall be provided to show that the over-current device curve characteristic between the primary switchgear and major feeder over-current protective devices are properly coordinated.

All equipment shall be surge protected. Lightning protection shall be provided in accordance with Part 2B, Section 11.3.4.9.

11.3.8.1.5.2 Grounding

General requirements for grounding shall be in accordance with Section 9.1.4, Grounding of ASCE 21, and as specified in Part 2B, Section 11.3.14.5. The following exceptions and additional requirements shall apply.

The enclosures of all PDS equipment shall be connected to the grounding subsystem using conductors having a minimum cross section equal to or larger than the sizes shown in Table 250.122 of the NEC. The worst-case fault current shall not permit a voltage of greater than 50 volts to appear on any enclosure when measured between the enclosure and its connection to the grounding electrodes in the substation.

Cars within a Vehicle shall be connected to achieve grounding requirements throughout the Vehicle. Vehicles shall be grounded to ensure that under conditions of the worst-case operating current and/or Vehicle fault current a voltage (touch potential) greater than 50 volts shall not appear anywhere on the Vehicle when measured between the Vehicle and earth ground and any adjacent Station platforms, metallic enclosures, or metallic Guideway structure. The metal structural elements of the passenger Station and Guideway, and the exposed metal at the passenger/Vehicle interface shall be connected to the ground rail at intervals not greater than 100 feet, with connections having a minimum cross section equal to or larger than the minimum sizes shown in Table 250.122 of the NEC. In no case shall a conductor smaller than a cross section electrically equivalent to 4/0 copper be used. See also Part 2B, Section 11.3.7.8.7.

For DC power distribution systems, the current-carrying return rails for each substation shall be electrically isolated from and not be connected to the APM Operating System ground. For DC systems deletion of the non-current carrying ground rail may be considered as described by Section 9.1.4.1, Traction Power Grounding of ASCE 21. However, in addition to the ASCE 21 requirement, the Developer shall provide a design and analysis that sufficiently mitigates potential hazards including step and touch potential along the entire Guideway and at Stations and Station platform doors. The grounding and cathodic protection designs of any direct current power distribution system shall be submitted as part of the APM Operating System Power Distribution System Design Audit.

11.3.8.1.5.3 Cathodic Protection

A cathodic protection subsystem shall be provided by the Developer in accordance with Part 2B, Section 11.3.14.

11.3.8.1.6 Substation Transformers and Rectifier Units

11.3.8.1.6.1 Substation Transformers

Substation transformers, and rectifier units if required, shall be complete with all standard and specified accessories, auxiliaries, controls, and all necessary hardware, interconnecting buses, wiring, and devices. Design, material, construction and testing shall be in accordance with ANSI C34.2 and C57.12.01 and C57.12.91. These units shall conform to the requirements of IEEE 519, the LADWP Service Installation Manual, as applicable and shall meet the Heavy Traction Duty service requirements of NEMA RI-9, Table 1-1; or alternatively: 100 percent continuously, 150 percent for 2 hours, and 300 percent for 1 minute.
Transformers shall be: dry type; 125 kV BIL; copper winding; sealed against moisture utilizing a pressure-encapsulation, vacuum-sealant process or other equivalent process; high efficiency; constructed for indoor use; self-air-cooled with provisions for forced air cooling; and mounted on vibration isolators.

The transformers shall have:

A. No-load tap changer with 2-2½ percent above and below normal rated voltage taps and an external padlockable operating device;
B. Ground pads;
C. Provisions for lifting and jacking;
D. Winding hot spot temperature dial-type thermometer with adjustable range alarm contacts;
E. Provisions for fans to achieve the standard forced air rating; and
F. Low voltage winding neutral (if applicable).

The overall efficiency of each substation transformer, and rectifier unit if required, shall be greater than 98 percent at the kilowatt rating. Each transformer and rectifier unit shall eliminate effectively any ac harmonic currents from being transmitted to the primary power supply.

Harmonic content as measured on the primary of each substation shall not exceed the Table 2, Current Distortion Limits for General Distribution Systems, as presented in IEEE-519 for the \( I_{\text{ac}} \) over \( I_i \) ratio limits between 100 and 1000. Should any interference problems arise due to ac harmonic currents generated by the unit to the primary power supply, then the Developer shall provide proper corrective measure.

11.3.8.1.6.2 Rectifier Units

Rectifiers shall be outdoor rated for 12 pulse output, natural convection air-cooled, free-standing, and metal enclosed. Indoor rectifiers having equal performance and protection shall be permitted. Air filters, if required, shall be easily replaceable. Each rectifier shall be complete with internal buses, connections and flanges for external bases, negative disconnect switch, protective devices, control wiring, terminal blocks, and all other necessary accessories.

The rectifier shall comply with IEEE 1653.2 “IEEE Standard for Uncontrolled Traction Rectifiers for Substation Applications up to 1500V DC Nominal Output” and JEDEC Standard JESD282B.01 “Silicon Rectifier Diodes”.

11.3.8.2 APM Operating System Equipment Backup Power Supply

11.3.8.2.1 Uninterruptible Power Supply

Equipment requiring uninterrupted power, in the event that primary power is unavailable, shall be supported by uninterruptible power supply (UPS) devices designed and provided by the Developer in accordance with Section 9.5, Uninterruptible Power Supply (UPS) of ASCE 21, and the requirements of this Part 2B, Section 11.3.8.2.1. The Developer shall identify those APM Operating System functions requiring UPS backup as part of the APM Operating System Power Distribution System Design Audit. Other safety-related functions and equipment shall have backup power that does not need to be uninterruptible, but will restore electrical power within fifteen (15) seconds.

Uninterruptible and normal backup power shall be provided for at least the following functions:

A. Automatic Train Control;
B. CCF;
C. Central Control to/from Vehicle communications;
D. Video Surveillance;
E. Station public address and emergency telephones;
F. Emergency walkway/path lighting;
G. PDS control power subsystem;
H. Radio systems;
I. Fire and other appropriate safety and security equipment;
J. PBX telephone system in the CCF;
K. Emergency lighting on passive Vehicles, if applicable;
L. Station dynamic signs/preprogrammed announcements;
M. Any data transmission system;
N. All APM Operating System alarms;
O. Automatic passenger counting system;
P. Station door controllers, alarms, and operating mechanisms; and
Q. Intrusion alarms.

Per the above referenced ASCE 21, UPS equipment shall be sized to provide power for all of the above functions plus an additional twenty percent (20%) for at least two (2) hours or longer if determined to be necessary by the hazard analysis. The hazard analysis of Part 2A, Section 8.2.2 shall be used in this determination. A battery discharged for the defined operating period in accordance with the hazard analysis or for a minimum of two (2) hours (whichever is higher) shall be capable of being recharged in ten (10) hours such that the normal discharge capacity is again available.

All batteries for the UPS subsystem shall be Valve-Regulated Lead-Acid (VRLA) type and shall comply with the requirements of IEEE Standard 1187 – Recommended Practice for Installation Design and Installation of Valve-Regulated Lead-Acid (VRLA) Storage Batteries for Stationary Applications.

UPS status (e.g., on-line, by-pass, etc.) shall be indicated at Central Control. Changes in status, such as load on battery, load on auxiliary source, low battery, shall be alarmed and logged in accordance with Part 2B, Section 11.3.9.3.4 and Part 2B, Section 11.3.9.3.6.

The Developer shall install and connect input power to the UPS equipment, and provide and install all power wiring for Developer-equipment connected to the UPS equipment.

The battery/UPS power supply is not required to provide power for Vehicle propulsion.

11.3.8.3 Housekeeping Power

All housekeeping electrical power for Stations, M&SF, CCF, substations, equipment rooms, HVAC, exit signs, office equipment, and maintenance equipment shall be provided in accordance with the applicable subsections of Part 2A, Section 12, Part 2B Sections 11.3.8, 11.3.12, and 11.3.13.

However, any air conditioning and ventilation equipment required to cool System equipment necessary for APM Operating System operation shall be powered by the APM Operating System PDS.
11.3.8.4 PDS Data Communications Delay

All data communications equipment provided as part of the power distribution subsystem shall meet the communications delay requirements specified in Part 2B, Section 11.3.10.3.

11.3.8.5 Backup Emergency Power

The Developer shall provide a standby emergency power system, independent from the normal primary feeders, such that the APM Operating System can be operated at reduced capacity (fifty percent of the System Line Capacity specified in TP Section 11.3.3.1.5.1) for an indefinite time. The emergency power system shall be started automatically and breakers closed by a manually initiated signal from CCC. There shall be no need for a human operator in the emergency power system facility for startup and normal operation. The time from the starting signal to full availability of emergency power shall not exceed one hundred and twenty (120) seconds. Once the emergency power system is on-line, it shall also power all escalators and 50% of the elevators in the stations, APM System auxiliary loads, including those served by the UPS system and any other Station loads required to ensure ADA compliance. The emergency power facilities shall be located in the vicinity of the TPSS. Any fuel storage tanks shall be installed outside buildings. Generators do not require metering, but recording of fuel consumption and duration of operation shall be automatically reported to CCF. The Developer shall submit the design of the emergency power generator as part of the Power Distribution System Design Audit.

11.3.9 Automatic Train Control

The Developer shall design, provide, install and test an Automatic Train Control system with all hardware and software necessary to comply with the requirements of this section. The Automatic Train Control system shall provide performance that is compatible with the requirements of the APM System Guideway and Train length configurations.

The Automatic Train Control system shall include Automatic Train Protection (ATP), Automatic Train Operation (ATO) and Automatic Train Supervision (ATS) subsystems and their means of communication. The Automatic Train Control system shall automatically regulate the movement of all Trains, except those temporarily under onboard manual control.

The ATP subsystem shall provide protection against collisions between Trains and with end of track buffers, unsafe switch operations, overspeeds, unsafe door operations, and other potential hazards of operations in automatic mode.

The ATO subsystem shall provide the automatic control of Vehicle/Train motion, including speed, acceleration, deceleration, and jerk control; Station stops; and door operations.

The ATS subsystem shall provide the interface between the Central Control Operator (CCO) and the APM Operating System, giving all pertinent information about the APM Operating System and means for the CCO to control various APM Operating System functions. The ATS subsystem shall also provide APM Operating System supervision, including automatic routing, schedule keeping, and MMIS data acquisition and reporting.

11.3.9.1 Automatic Train Protection (ATP)

The ATP subsystem shall perform the following operating functions, the requirements for which are given in subsequent subsections:

A. Presence detection;
B. Safe Train separation assurance;
C. Unauthorized motion prevention;
D. Overspeed protection;
E. Parted Train protection;
F. Lost signal detection;
G. Unscheduled door opening protection;
H. Vehicle/Station alignment and door interlocks;
I. Departure interlocks;
J. Direction reversal interlocks;
K. Obstructed motion detection;
L. Switch interlocking protection; and
M. Zero speed detection.

All ATP functions shall be performed in accordance with the safety principles of Part 2B, Section 11.3.5.1.1 and they shall be verified and validated in accordance with Part 2B, Section 11.3.5.1.2.

The safety provided by the ATP subsystem shall exist under all circumstances of Guideway power, Vehicle power, automatic operations, and with malfunctions in the ATP subsystem itself. Should a failure occur, or should the ATP subsystem become inoperable, no unsafe condition shall result. The ATP subsystem shall react appropriately, in a safe manner, whether or not an indication is provided to the CCF, and it shall react to an indication regardless of whether a failure has actually occurred or not.

11.3.9.1.1 Presence Detection

The ATP subsystem shall continuously detect, throughout the entire APM Operating System, the presence and progress of all Vehicles; including passenger Vehicles/Trains, and any maintenance Vehicles that are designed for use during passenger service operations, including the maintenance and recovery Vehicle (MRV), whether moving or stationary, or under automatic or manual control. No undetectable Vehicles, trailers or carts shall be used over the passenger-carrying Guideway once passenger service operations have begun.

The presence detection function shall be self-initializing in the event of any interruption to power, Automatic Train Control computers or Automatic Train Control communications. After any such interruption occurs, when the interruption is cleared, the location of all Vehicles in the APM Operating System shall automatically become known to the ATP subsystem, within five seconds, to the degree of resolution normally known to the APM Operating System. Presence detection shall not depend on manual input of Vehicle location.

All Vehicles, regardless of their operational status (reference Part 2B, Section 11.3.7.20 Vehicle Control), shall be automatically detected by the ATP subsystem when entering an area where Automatic Train Operation is permitted (for example, entering the APM Operating System from a non-signaled area such as a maintenance facility).

The ATP subsystem shall detect the loss of presence detection if ever the presence of a previously detected Vehicle of any kind becomes undetected. If there is a loss of presence detection, the APM Operating System shall assume a safe state such that the undetected Vehicle, if being operated under automatic control, shall stop (preferably at the next Station) and any following Vehicles operating under automatic control shall stop clear of the point at which detection was lost, in accordance with the safe Train separation assurance requirements of Part 2B, Section 11.3.9.1.2. There shall be no reset action(s) that permits the ATP subsystem to detect or indicate an unoccupied (no presence detected) status for any Guideway section that is actually occupied. During the recovery from a loss of presence detection, the ATP subsystem shall ensure that safe Train separation assurance (per Part 2B, Section 11.3.9.1.2) is provided for any
undetected Vehicle(s). Recovery from Vehicle presence detection failure shall be subject to a
hazard analysis performed in accordance with Part 2A, Section 8.2.2. Any procedures utilized
during the recovery from a loss of presence detection shall include design aspects that mitigate
human errors to an acceptable level in accordance with ASCE 21 Sections 3.1.2 and 3.2.

Non-vital Train location information shall be provided to ATO/ATS, if required, for the automatic
control of Train operations and for the display of Train locations on the System Schematic Display
of Part 2B, Section 11.3.9.3.2.1.

11.3.9.1.2 Safe Train Separation Assurance

The ATP subsystem shall maintain safe separation between Trains traveling in the same or
opposing travel directions, between Trains and switch conflicts, and between Trains and end-of-
track buffers. This protection shall accommodate the allowed maximum speed limit (see Part 2B,
Section 11.3.9.1.4) and be based upon the assumption that any detected entity may instantly stop
("brick wall stop").

Train speed commands shall be dynamically controlled on the basis of detected Train presence
(Part 2B, Section 11.3.9.1.1) and detected switch position/status (Part 2B, Section 11.3.9.1.12).
ATO Train movement control (Part 2B, Section 11.3.9.2.3) shall affect normal service braking of
Trains so that they stop at a point that is short of the safe separation distance. In the event that
ATO control fails or otherwise allows encroachment on the safe separation distance, the ATP
subsystem shall enforce safe Train separation assurance by the application of emergency brakes
and the removal of Train propulsion power. Both remote (from Central Control) and local onboard
manual brake reset are required.

The worst-case performance of emergency brakes must be capable of stopping Trains to prevent
collision and shall be a fundamental consideration in the implementation of safe Train separation
assurance design. The ATP subsystem design shall account for stopping distances and worst-
case performance conditions determined in accordance with Part 2B, Section 11.3.7.7.4 and Part
2B, Section 11.3.7.7.5 plus appropriate margins.

11.3.9.1.3 Unauthorized Motion Prevention

The ATP subsystem shall ensure that irrevocable emergency brakes are applied if there is Train
movement when the Train is supposed to be stopped (zero-speed condition as defined in Part
2B, Section 11.3.9.1.13) or when the Train moves more than twenty (20) inches (or to safe limits
as justified by hazards analysis performed in accordance with Part 2A, Section 8.2.2) in a direction
other than the commanded direction of travel (rollback). Reset and restart is required both
remotely from Central Control and manually on board the Train.

11.3.9.1.4 Overspeed Protection

The ATP subsystem shall provide an overspeed protection function to preclude a Train’s speed
from exceeding the safe speed limit at any point on the Guideway. The safe speed limit shall be
determined by ATP based on Guideway alignment, civil constraints and Guideway/Train traffic
conditions. To accomplish this, the overspeed protection subsystem shall include fail-safe or
checked redundant speed measuring subsystems that furnish signals that are a measure of the
actual speed of the Train. If the actual speed of the Train is below the safe speed limit, the
emergency brakes shall be held off. If the actual speed of the Train unsafely encroaches upon
or exceeds the safe speed limit, the overspeed protection subsystem shall cease holding off the
emergency brakes so that they are applied to bring the Train to a full stop. Reset of emergency
brakes shall be possible both remotely from Central Control and manually on board the Train.

Certain sections of Guideway may have civil speed restrictions requiring Trains to reduce speed
when traversing them. If a Train is traveling within such a restricted zone, all portions of the Train
must maintain a speed not greater than the zone speed limit. If two (2) or more speed restricting conditions exist, the Train shall be governed by the lowest of these.

At the Guideway ends, the overspeed protection function shall ensure that under the worst-case conditions the Train shall not overshoot the stopping point and strike the buffer at a speed greater than the crashworthy design speed (see Part 2B, Section 11.3.7.4.5).

11.3.9.1.5 Parted Train Protection

The ATP subsystem shall ensure that if a Train is parted, each of the separated units shall immediately and irrevocably brake to a full stop. Only local (onboard the Train) manual brake reset shall be possible. ATP presence detection (Part 2B, Section 11.3.9.1.1) shall detect the individual presence and location of each of the separated units and ATP safe Train separation assurance (Part 2B, Section 11.3.9.1.2) shall protect the separated units from other Trains operating in automatic mode on the APM Operating System.

11.3.9.1.6 Lost Signal Detection

All signals that are critical to the ATP subsystem shall be continuous or of such a repetitive nature that interruption of any such signal shall initiate braking. The maximum allowable time to initiate such braking shall be determined by hazards analysis, performed in accordance with Part 2A, Section 8.2.2, such that none of the safe braking requirements of Part 2B, Section 11.3.9.1 and its subsections are violated. Reset of brakes shall be possible both remotely from Central Control and manually on board the Train.

11.3.9.1.7 Unscheduled Door Opening Protection

The ATP subsystem shall ensure that no automatic mode failure shall result in the unlocking or opening of any Train door. The ATP subsystem shall also prevent the unsafe opening of Train emergency exit doors in accordance with the requirements of Part 2B, Section 11.3.7.10.5.

Except where Train doors are being operated in Stations as part of passenger operations, if any Train door or emergency exit unlocks for any reason while a Train is in motion or is stopped anywhere in the APM Operating System, the Train shall irrevocably apply service brakes. Actuation of the emergency release on any regular Train door or the unlocking of any Train emergency exit at any time shall also cause irrevocable application of service braking. For all Train door instances, only local manual reset of brakes shall be permitted. Remote reset by the CCO shall not be permitted.

If any automatic Station platform door, maintenance emergency walkway access door or Station emergency egress door or gate is unlocked for any reason, Trains shall be prohibited from entering or leaving that area. If any Station emergency door or gate is unlocked for any reason, after a Train has entered the Automatic Train Control-defined door protection area, but before the Train has stopped in the area, then that Train shall emergency brake to a stop. For all Station door instances, a local manual reset by authorized personnel at the Station platform shall be required prior to the restoration of an automated Train operation. Remote reset of affected Trains by the CCO shall not be permitted.

For all instances in this section, restart shall not be permitted until all doors (Train and/or Station) are properly closed and locked and a local check by APM Operating System staff ascertains that no person is on the Guideway.

For any unscheduled unlocking or opening of a Train door or automatic platform door, maintenance or emergency walkway access door, Station emergency egress door or gate, regardless of the cause, an alarm shall be sent to Central Control. Opening any facility door that leads onto the Guideway shall result in the sounding of a local alarm in addition to the alarm that is sent to Central Control.
11.3.9.1.8 Vehicle/Station Alignment and Door Interlocks

The ATP subsystem shall ensure that automatic opening of Train doors and matching Station platform doors shall occur only if all of the conditions listed below are satisfied. Any other conditions shall cause the doors to be commanded closed.

A. The Train speed is zero as defined in Part 2B, Section 11.3.9.1.13;
B. The Train is properly aligned with the Station platform; and
C. The brakes have been properly applied and power has been removed from the propulsion motor(s).

Train-Station misalignment or failure of doors to open shall initiate the actions required in Part 2B, Section 11.3.9.2.1.

11.3.9.1.9 Departure Interlocks

The ATP subsystem shall ensure that a Train stopped in a Station shall not be allowed to move unless all Train doors and any platform doors are properly closed and locked and the Train brakes have been released. Once these conditions are satisfied, if the Train does not then move within ten seconds of being commanded to do so, brakes shall be applied and a “Train failed to depart” alarm shall be sent to Central Control in accordance with the requirements of Part 2B, Section 11.3.9.3.4.1.AA. Reset of the service brakes shall be possible both remotely from Central Control and manually on board the Train.

11.3.9.1.10 Direction Reversal Interlocks

Reversing Train direction shall be possible at all locations where Automatic Train Operation is possible. Except for reversing at Stations and/or other Developer-designated automatic reversing zones, as part of normal or Automatic Train Control-governed failure management operations, the Train reversing command shall originate with the CCO. Reversal shall occur only after zero speed has been detected in accordance with Part 2B, Section 11.3.9.1.13. Once commanded, the Train shall proceed automatically. ATP interlocks shall ensure that an automatically controlled reversing Train does not violate the safe Train separation assurance requirements of Part 2B, Section 11.3.9.1.2.

Interlocks on each Train shall prohibit manual operation in the reverse direction from the forward end of that Train, in accordance with the requirements of Part 2B, Section 11.3.7.20.2.

11.3.9.1.11 Obstructed Motion Detection

The ATP subsystem shall monitor the response of the Train to Automatic Train Control commands for propulsion. If Train movement is not detected after being commanded within a predetermined time, as determined by hazards analysis performed in accordance with Part 2A, Section 8.2.2, the Train shall be safely stopped and the condition shall be annunciated at Central Control. Reset and restart shall be possible both by remote command from Central Control and by manual reset on board the Train.

11.3.9.1.12 Switch Interlocking Protection

Switching shall be implemented in accordance with the requirements of Part 2B, Section 11.3.11.6.

The ATP subsystem shall provide switch interlocking protection in accordance with Section 5.1.14, Guideway Switch Interlocks of ASCE 21. Hazards analyses, if required as stipulated in the ASCE reference, shall be conducted in accordance with Hazard Identification, Analysis and Resolution Process of Part 2A, Section 8.2.2.
Both power-actuated and manually-actuated switches shall be interlocked with the ATP subsystem to assure safe operation of Trains through the switches.

The ATP subsystem shall prevent a Train from entering a switch that is unsafe and shall prevent a switch from becoming unsafe once a Train is committed to traverse it.

11.3.9.1.13 Zero Speed Detection

Zero speed shall not be registered until a speed of one foot per second or less is attained and braking is commanded. The ATP subsystem shall ascertain when a Train reaches zero speed in accordance with Part 2B, Section 11.3.5.1.1.

11.3.9.2 Automatic Train Operation (ATO)

The ATO subsystem shall include the equipment necessary to automatically perform the following functions within the constraints of the ATP subsystem:

A. Programmed Station stop;
B. Door operation and Station dwell time control;
C. Train movement control;
D. Operating mode control; and
E. Train location determination.

11.3.9.2.1 Programmed Station Stop

A programmed Station stop is the control of Train speed and final application of brakes, under jerk and acceleration limits, to make a precise Station stop. Programmed Station stops shall be made so that the centerlines of the Train doors and the corresponding Station platform doors, or designated passenger boarding/discharging zones, are aligned to within 6 inches of each other. Trains shall be properly aligned for not less than 99 percent of all Station stops. Brakes shall apply when zero speed (Part 2B, Section 11.3.9.1.13) is detected and remain applied until the Vehicle is ready to depart the Station.

If, during a programmed Station stop the Train brakes to a stop for other reasons and the conditions that caused the stop are subsequently removed and the brakes are properly reset, the Train shall reacquire the programmed speed-distance profile under jerk and acceleration limits and proceed to complete the programmed Station stop as though the premature stop had not occurred.

The stopping positions at each Station platform shall be designed for the maximum length Trains as shown in the Part 5, Contract Drawings/Engineering Data.

Whenever the Train doors and Station stopping points are not properly aligned as required above, but portions of the Vehicle doorways are within the Station platform doorway openings and at least a 32.5 inch wide clear opening is provided and where the opening is only onto the platform, then the doors shall be allowed to open automatically but an alarm shall be sent to Central Control. This alarm shall indicate the misalignment and identify the Train and Station involved. At the conclusion of the specified Station dwell time, the Train doors shall close and the Train shall automatically depart the Station.

For all other misalignments, the Train shall remain at the Station with all doors remaining closed until a decision is made by the CCO regarding the disposition of the Train. During this time, it shall not be possible to open the doors remotely by CCO command. Automatic announcements shall be made on the Train and in the Station involved. At the option of the CCO, maintenance personnel may be summoned to manually open the Train doors and assist passengers in exiting
the Train. In any case, when the Train is dispatched by the CCO, it shall automatically depart the Station.

Any Train jog movements implemented in the Developer's design to allow recovery from an initially misaligned Station stop shall comply with the requirements of Part 2B, Section 11.3.9.1.10. Such maneuvers shall be invoked only upon command from the CCO and the moves accumulated by one or more successive jog commands shall not collectively exceed 4 feet of reverse direction distance. Jog maneuvers shall not be considered to satisfy the 99 percent Station stop alignment requirement specified above.

11.3.9.2.2 Door Operation and Station Dwell Time Control

The ATO subsystem shall automatically control Train and Station platform doors during Station stops so that they open and close together.

As defined in Part 2B, Section 11.3.3.1.3, Station dwell time is the amount of time during which the Train is stopped in the Station, measured from when the Train doors are commanded to open until the Train doors are closed and locked. The ATO subsystem shall control Station dwell time and the ATS subsystem shall manage it for headway regulation purposes in accordance with the requirements of Part 2B, Section 11.3.9.3.3.1. ATO shall have default Station dwell times defined for each individual Station platform that shall be used in the absence of dwell time management/override commands from ATS. The CCO shall have the capability to adjust dwell times on an individual Station platform basis for all modes of operation.

Train and Station platform doors shall operate in accordance with the following requirements:

A. An ATP function shall be implemented as described in Part 2B, Section 11.3.9.1.8 such that it shall not be possible for the ATO to automatically open any Train door anywhere in the APM Operating System except when the Train is properly stopped and aligned at a Station platform. Further, it shall not be possible to automatically open any Train door unless the door is properly aligned adjacent to a Station platform door.

B. Train doors and corresponding platform doors shall be controlled as a set. Each such door set shall open and close as a coordinated movement when signaled to do so by the ATO subsystem. It shall not be possible to automatically open any Train door unless there is a corresponding platform door to comprise a complete and functioning door set. Furthermore, if any door of a door set is cutout or otherwise rendered inoperable by maintenance, then ATO shall not signal that door set (platform and Vehicle) to open.

C. Automatic platform doors shall be powered independently of Train doors. Train and platform doors shall not share any mechanical linkages, operating mechanisms or physical components. Secured access panels, associated with the automatic platform door operating mechanisms, shall be accessible from the Station side of the automatic platform doors to provide access for maintenance.

D. The Train doors and corresponding automatic platform doors shall be commanded to open automatically only after the successful completion of a programmed Station stop in accordance with Part 2B, Section 11.3.9.2.1.

E. After the predetermined time for which the doors are to remain open, or upon removal of any door hold command that has been placed on the Station, all Train and corresponding automatic platform doors shall be commanded to close.

F. If, during the closing cycle, an obstruction is detected on any Train door or any corresponding automatic platform door, all door panels of that door set shall be
recycled in accordance with Part 2B, Section 11.3.7.10.3. The unobstructed door sets shall not be recycled.

G. If, for any reason, any Train or platform door fails to open or close as commanded, an alarm shall be sent to the CCC. The CCO shall be able to attempt to open or close the door(s) remotely (conditioned on the requirements of Part 2B, Section 11.3.9.1.8). If the CCO is successful in remotely operating the doors, the Train shall depart the Station at the end of its normal Station dwell time. If the CCO is not successful in remotely operating the doors, the Train shall remain at the Station until it is remotely dispatched by the CCO.

H. The ATO subsystem shall generate an individual control signal for each Train/platform door set. The door sets to be opened and closed at each Station platform shall be determined automatically by the ATO based on the route identity of the Train at the Station.

11.3.9.2.3 Train Movement Control

Train starting, stopping and speed regulation shall be controlled by ATO so that acceleration, deceleration and jerk are within the ride comfort limits of Part 2B, Section 11.3.7.6.3 and speed is maintained within the speed limits imposed by the ATP subsystem.

Upon loss of propulsion power, Train(s) shall coast under ATO control and under the protection of the ATP subsystem. Should the Train(s) reach zero speed, then brakes shall be irrevocably applied. Normal Train operation shall automatically resume upon restoration of propulsion power as permitted by the ATP and ATO subsystems. If zero speed occurs and parking brakes are set, or if the Train brakes to a stop, restart shall be possible by remote CCO command or by manual reset on board the Train, subject to ATO and ATP restrictions. Train propulsion power loss shall be automatically alarmed at the CCC. The Train number, location, and fault condition shall be identified.

The Automatic Train Control system (including the ATP, ATO and ATS subsystems) shall incorporate all design features and equipment to assure the bi-directional operation of Vehicles and Trains in accordance with Part 2B, Section 11.3.3.6.

11.3.9.2.4 Operating Mode Control

When the operating mode is selected by the CCO in accordance with Part 2B, Section 11.3.9.3.3.2.E, the operation of the APM Operating System in that mode shall be accomplished automatically through the ATO subsystem. Operating mode commands shall be initiated from the CCC and assigned to Vehicles anywhere in the APM Operating System subject to the safety constraints of Part 2B, Section 11.3.9.3.1. Routes and Station stops for all of the modes of Part 2B, Section 11.3.3.2 shall be predetermined and included in the ATO subsystem for CCO/ATS selection. Station dwell times shall be controlled by the ATO subsystem and supervised by ATS in accordance with Part 2B, Section 11.3.9.3.3.1. The dwell time at each Station shall be individually adjustable by the CCO.

11.3.9.3 Automatic Train Supervision (ATS)

In the following sections, the ATS portion of Central Control is generally described as if it is fully integrated with the Power Distribution System (PDS) and other similar systems (e.g., access control and intrusion detection) that could alternatively be handled by commercially available systems such as a supervisory control and data acquisition (SCADA) system. Separation of functions (and separation of workstations and monitors) to take advantage of such commercially available systems may be permitted if they: (1) provide for efficient and logical APM Operating System operation by the CCO, (2) provide all of the required CCO interfaces, (3) comply with the
redundancy requirements of Part 2B, Section 11.3.9.4.1 and (4) are fully described in accordance with the Summary of Submittals list in Part 2A, Section 6.7 as part of the Automatic Train Control System Design Audit.

The ATS subsystem shall monitor and manage the overall operation of the APM Operating System. The ATS subsystem shall not be essential to continuing automatic APM Operating System operations by the ATO and ATP subsystems once such operations have been started. The ATS subsystem shall provide the interface between the APM Operating System and the CCO. Through audio and visual displays, information shall be presented to the CCO describing the status of the APM Operating System on a real-time basis. This information shall allow the CCO to assess conditions throughout the APM Operating System and to take appropriate actions. The CCO shall be able to issue commands to initiate and terminate APM Operating System operations; override any normal and failure management operating modes; and perform other APM Operating System management functions subject to the safety constraints of Part 2B, Section 11.3.9.3.1.

The ATS subsystem shall provide the following functions, the requirements for which are given in subsequent subsections:

A. Performance monitoring;
B. Performance control and override adjustments;
C. Alarms and malfunction reporting;
D. CCO communications subsystem interfaces;
E. Data recording and reporting; and
F. Weather Station and seismic monitoring.

Unless specifically stated otherwise, the functions and capabilities of the ATS subsystem described in this section shall be incorporated into the CCF. The Developer shall furnish all equipment, computer hardware and software, and associated efforts necessary to provide the functions and capabilities described in this section and its subsections. The ATS subsystem shall be designed with fully automatic modes of APM Operating System operation as the normal condition.

11.3.9.3.1 Safety Constraints on ATS

The ATS subsystem shall be such that no action or lack of action by the CCO, either purposeful or inadvertent, or any malfunction of the ATS equipment can subvert or compromise the ATP subsystem functions and thereby cause an unsafe condition. Thus, both the ATP and ATO subsystems shall take precedence over the ATS subsystem. If the ATS subsystem becomes completely inoperative for any reason, the APM Operating System shall be capable of continuing to operate in the automatic mode under the ATO subsystem and remain fully protected by the ATP subsystem.

Regardless of this capability, the APM Operating System shall not be operated for more than 20 minutes when critical ATS-related functions, including the audible and visual annunciation of all Priority I and Priority II alarms, are inoperative. Such a failure of the ATS subsystem shall not be permitted as exclusion for the service mode availability calculations of Part 2B, Section 11.3.6.2. The Developer’s provisions and procedures to continue APM Operating System operations during a failure of any critical ATS-related function shall be incorporated in the APM Operating System Operations Plan; see Part 2C, Section 3.2.

Emergency controls on the CCC shall provide at least two (2) independent APM Operating System emergency shutdown functions: (1) stop all Trains, and (2) remove all propulsion power.
Stop all Trains shall be an ATP-related function that is independent of the ATS. The emergency power shut off shall be a PDS-related function that is independent of the Automatic Train Control system. See Part 2B, Section 11.3.9.3.2.W.

11.3.9.3.2 Performance Monitoring

APM Operating System performance information at Central Control shall be provided on the displays and monitors required by this section and the subsequent subsections.

All of the related functional capabilities listed in this section, and Part 2B, Sections 11.3.9.3.3, 11.3.9.3.4, 11.3.9.3.5, 11.3.9.3.7 and 11.3.10, shall be incorporated in the CCC, which shall be designed for efficient use by the CCO(s). Generally there shall be a position to monitor and control each of the following: Automatic Train Control/APM Operating System operations, the Power Distribution System, audio communications and VSS. These positions may be operated by one or more CCOs at any given time, depending on the requirements of the particular operating period.

On the CCC, there shall be a minimum of three (3) redundant/interchangeable, color video monitors for the selectable display of APM Operating System information. Normally, one of these monitors will display the System Schematic Display (Part 2B, Section 11.3.9.3.2.1), one will display the Power Schematic Display (Part 2B, Section 11.3.9.3.2.2) and the other will be used to display alarms or other APM Operating System information (Part 2B, Section 11.3.9.3.2.4). The displays on these monitors shall be coordinated with the displays presented on the General System Display (Part 2B, Section 11.3.9.3.2.3).

The screens on the CCC monitors shall be 26-inch (diagonal) or larger and the size and resolution of the graphical displays on the screens shall permit them to be viewed with ease from the normal seating area at the CCC. The CCC design, layout, information displayed, controls, and CCO interfaces shall be developed by the Developer based on a human factors analysis and shall be submitted in accordance with the Summary of Submittals list in Part 2A, Section 6.7 as part of the CCC Design Audit.

Three additional redundant/interchangeable color video monitors shall be provided for the General System Display (GSD) of Part 2B, Section 11.3.9.3.2.3. The screens on the GSD monitors shall be 32-inch (diagonal) or larger. The GSD monitors shall be located such that they are visible to anyone in the Central Control Room, but particularly to the CCO(s) who shall use them along with the CCC monitors/displays to manage the APM Operating System.

11.3.9.3.2.1 System Schematic Display

The APM Operating System Schematic Display (SSD) shall provide a visual representation of real-time operating conditions throughout the APM System, and within the M&SF. The SSD shall:

A. Show approximately scaled graphical representations of the Guideway, Stations, switches, M&SF, and any other relevant physical features. It shall also show the locations of power distribution substations and other key APM Operating System and adjacent non-APM Operating System features.

B. Incorporate dynamic, colored displays that graphically depict at least the following for all parts of the APM Operating System designed for automatic operations:

1) The location and identification of all Trains. This shall be accomplished by dividing the schematic into zones representing the Stations, physical segments of the Guideway, and control blocks. These zones shall provide sufficient resolution (not to exceed 500 Guideway feet per zone) for rapid and accurate emergency and failure management identification of problem location, and they shall be correlated with physical elements/markings.
along the APM System right-of-way. The occupancy by any Train of a zone or block shall be identified.

2) The direction of travel of all active Trains.

3) The number of Cars/Vehicles comprising each Train.

4) The identification number that the CCO uses to interact with the Train.

5) The status of all switches in the APM Operating System, including: the direction that a Vehicle would follow through the switch, whether the switch is moving or is in its requested position and locked, whether the switch is in normal automatic or manual override control mode and whether the switch has any faults.

6) The operating mode and status of selected items of wayside equipment, such as Automatic Train Control and backup power equipment.

7) The active or inactive status of each Station, the currently active Station dwell time for each Station, and any significant Station equipment malfunctions.

C. Incorporate such other visual aids as may be necessary to permit the CCO(s) to monitor and manage the APM Operating System efficiently. Examples of such aids include: signal blocks, Train parking and storage locations, Train entry point(s), transition zones, speed zone areas, power zone boundaries, power feed points, and electrical switchgear locations.

D. Incorporate the capability of selecting and viewing any area and element, and its status, in more detail by a zoom feature to provide an exploded view with increased information.

E. Use clearly distinguishable colors to indicate normal conditions (e.g., green), abnormal conditions (e.g., red) and override conditions (e.g., amber). There shall be a consistent color and symbol convention on all monitors of the SSD.

11.3.9.3.2.2 Power Schematic Display

The APM Operating System Power Schematic Display (PSD) shall provide the CCO(s) with an immediate visual indication of the Power Distribution System status throughout the APM Operating System. All indications of power status on the PSD shall be by both voltage monitoring and breaker/switch position verification. The PSD shall be a separate screen display from the SSD.

The PSD shall:

A. Indicate the presence or absence of electrical power in each segment of the Guideway and M&SF storage lanes that may be individually energized or de-energized with propulsion power. This indication of power shall be shown with a color convention normally used for electrical power; that is, green for power off and red for power on.

B. Indicate the status of circuit breakers and switches in the power supply system (e.g., closed, opened, or positioned for local control). Status indications shall be provided for all breakers including breakers operated from Central Control, at the substations, or from blue light stations. (See Part 2B, Sections 11.3.5.1.6.E and 11.3.8.1.3.) Any breaker tripped condition shall be alarmed.
C. Indicate the presence or absence of power at each primary feeder at the propulsion power substations.

D. Indicate the presence or absence of backup power from the uninterruptible power supply.

E. Indicate the status of all devices and the presence of any alarm condition required in Part 2B, Section 11.3.8.

F. Incorporate the capability of selecting and viewing any area and element, and its status, in more detail by a zoom feature to provide an exploded view with increased information.

11.3.9.3.2.3 General System Display

In addition to the SSD and the PSD, there shall be an APM Operating System General System Display (GSD). The CCO shall have the capability of selecting any display (including zoom-ins) that can be displayed on the multiple redundant/interchangeable CCC monitors for display on any of the three (3) GSD monitors. The GSD shall be capable of serving as a backup for any failed CCC display, as a general display for displaying other information, and/or for use by LAWA or emergency personnel to monitor conditions during an emergency situation. Typically, one GSD monitor will have the APM Operating System overview display of the SSD, one will have the power distribution overview display of the PSD and the third monitor will be available for redundancy or to show any other SSD, PSD, or alarm display.

The GSD shall have the selectable capability of viewing any area and element, and its status, in more detail by a zoom feature to provide an exploded view with increased information.

11.3.9.3.2.4 Other Displays

Alarm information from various sources throughout the APM Operating System shall also be displayed at the CCC. See Part 2B, Section 11.3.9.3.4. This information may be displayed on the SSD or on a separate monitor/display; however, the alarm display(s) shall be available at the CCC position(s) where its related control functions are exercised. See Part 2B, Section 11.3.9.3.3.4. In addition to the above, the Developer shall provide for LAWA Police use a console equipped with a display for CCTV video feeds and other functions as coordinated with the AHJ.

11.3.9.3.3 Performance Control and Override and Adjustments

Management and operation of the APM Operating System shall be accomplished by the performance control and override functions described in this section. Certain functions shall be accomplished automatically by the ATS subsystem, as described in Part 2B, Section 11.3.9.3.3.1. Other functions shall be exercised manually by the CCO(s) as described in Part 2B, Section 11.3.9.3.3.2.

The software and hardware shall be designed for easy expansion of the APM System.

11.3.9.3.3.1 Automatic Train Management Control Functions

The ATS subsystem shall provide the capabilities for the CCO to initiate, monitor and manage the automated operation of the APM Operating System in any of the available normal and failure management modes as required by Part 2B, Section 11.3.3.2.

11.3.9.3.3.1.1 Normal Operating Modes

The following management control functions shall apply to the normal operating mode described in Part 2B, Section 11.3.2.1.

A. Pinched Loop Service Mode:
1) This mode shall be a fully automated regulated operation with equal headways between Trains in the operating mode accomplished by automatic adjustments to Station dwell times determined and imposed by the ATS subsystem. The CCO shall be able to select the desired nominal Station dwell for each Station. The ATS subsystem shall permit the preprogramming of desired nominal Station dwell times for different time periods of the day and week.

2) The ATS subsystem shall incorporate automatic “antibunching” and “debunching” capabilities to assure that equal headways are maintained between Trains throughout the APM Operating System. These features shall all operate without human intervention, but may be overridden or rescheduled by the CCO. Antibunching shall limit the maximum variation from equal headways to within twenty (20) seconds or ±15 percent of the average scheduled headway, whichever is less. Debunching shall restore the Train spacing to the above value within one round trip after a worst-case APM Operating System perturbation, i.e., all Trains stopped as close together as possible.

3) At any center platform end Station where Trains are to crossover to the opposite Guideway in front of the Station, the ATS subsystem shall have the capability to set the berth on either side of the platform as the normal stopping position as well as command each successive Train to stop in the berths on alternate sides of the center platform.

4) In the event of a failure that results in the inability to operate the APM Operating System in a fully automatic regulated mode, those Trains in operation at the time of failure shall continue to operate on their assigned routes. For these Trains, the APM Operating System shall automatically, without human intervention, revert to an unscheduled and unsynchronized mode of operation with Station dwell times being determined by the setting of the ATO Station dwell timers.

5) The ATS shall monitor the status of Guideway propulsion power, and if power is removed in any power zone the ATS shall stop Trains before they enter that zone. Subsequent Trains shall be held at Stations rather than stopping on the Guideway.

B. Shuttle Service Modes:

1) These modes, including synchronized double shuttle, single shuttle and on-demand shuttle, shall be fully automated, regulated operations. Regulation of shuttle operations shall be accomplished by automatic adjustments to Station dwell times determined and imposed by the ATS subsystem. The CCO shall be able to select the desired nominal Station dwell for each Station in any shuttle mode. The ATS subsystem shall permit the preprogramming of desired nominal Station dwell times for different time periods of the day and week. The CCO commands shall specify the specific route that Trains shall automatically follow for each specific shuttle mode. The selection of the specific routes shall be from a predetermined menu-driven list of routes.

2) In the event of a failure that results in the inability to operate the APM Operating System in a fully automatic regulated mode, those Trains in operation at the time of failure shall continue to operate on their assigned
routes. For these Trains, the APM Operating System shall automatically, without human intervention, revert to an unscheduled and unsynchronized mode of operation with Station dwell times being determined by the setting of the ATO Station dwell timers.

3) The ATS shall monitor the status of Guideway propulsion power and, should power be off in any power zone, it shall stop Trains before they enter that zone. Subsequent Trains shall be held at Stations rather than stopping on the Guideway.

11.3.9.3.3.1.2 Failure Operating Modes

The following management control functions shall apply to the failure operating modes described in Part 2B, Section 11.3.3.2.2:

A. Synchronized Double Shuttle Mode:

1) Synchronized double shuttle mode is a failure management mode if it is not the scheduled mode. Synchronized double shuttle mode shall be provided as specified in Part 2B, Section 11.3.3.2.1.2. This mode shall be a fully automated regulated operation with synchronization of double shuttle operations accomplished by automatic adjustments to Station dwell times determined and imposed by the ATS subsystem. The CCO shall be able to select the desired nominal Station dwell for each Station. The ATS subsystem shall permit the pre-programming of desired nominal Station dwell times for different time periods of the day and week.

2) CCO commands shall specify the specific route that Trains shall automatically follow for each specific shuttle mode. The selection of the specific routes shall be from a predetermined menu-driven list of routes.

3) In the event of a failure that results in the inability to operate the APM Operating System in a fully automatic regulated mode, those Trains in operation at the time of the failure shall continue to operate on their assigned routes. For these Trains, the APM Operating System shall automatically, without human intervention, revert to an unscheduled and unsynchronized mode of operation with Station dwell times being determined by the setting of the ATO Station dwell timers. The ATS shall monitor the status of Guideway propulsion power and, if power is removed in any power zone, it shall stop Trains before they enter that zone. Subsequent Trains shall be held at Stations rather than stopping on the Guideway.

B. Single Shuttle Mode:

Single shuttle mode is a failure management mode if it is not the scheduled mode. Single shuttle mode shall be provided as specified in Part 2B, Section 11.3.3.2.1.3, and shall be operable on either Guideway lane. The requirements of Part 2B, Section 11.3.9.3.2.1.A. shall apply to such operation except that synchronization is not applicable to single shuttle mode.

C. Single Tracking Mode:

Single tracking mode shall be provided as specified in Part 2B, Section 11.3.3.2.2.3. The requirements of Part 2B, Section 11.3.9.3.2.1.A shall apply to such operation.
D. Skip-Stop Mode:

The skip-stop mode shall be fully automated, regulated operation that may be used during failure mode operations as defined in Part 2B, Section 11.3.3.2.2.1. The specific skip-stop routes shall be programmed into the ATS/ATO software. This failure mode shall be from the West CTA Terminal Station to the ConRAC Station by-passing one or more of the other stations. The Station or Stations to be skipped shall be selectable by the CCO.

E. Short Turnback Mode:

1) In this mode, portions of the APM Operating System between two (2) crossovers shall be temporarily set up and operated as truncated routes.

2) Short turnback mode operation shall be initiated by the CCO, who shall select the two (2) end Stations to be served.

3) The Automatic Train Control system design shall provide for the operation of all possible short-turnback routes that the crossovers shown on the Part 5, Contract Drawings/Engineering Data will allow.

F. Other Failure Operating Modes:

Other failure operating modes shall be provided as specified in Part 2B, Section 11.3.3.2.2.5. The requirements of Part 2B, Section 11.3.9.3.3.2.A and B shall apply to such operations except that synchronization is not applicable to single shuttle mode.

The Developer shall review the above Train management control function requirements for applicability to its specific technology, and if necessary, develop additional (or modified) control functions for each specified mode that are consistent with the foregoing requirements of this Part 2B, Section 11.3.9.3.3.1.

Each failure operating mode shall be totally automated and regulated by the Automatic Train Control system, without the need for any manual intervention other than its selection and initiation. CCO commands shall specify the failure operating mode and the specific route Trains shall automatically follow for each specific mode. The selection of failure operating modes, specific routes under each mode, and any combinations of modes shall be from a predetermined list of modes, routes and combinations correlated with types of failures and specific points of lane blockage and of a menu-driven format.

The Developer may design the ATS software for single-tracking routes to permit platoons of Trains to operate, with headways as low as the minimum operational headway within a platoon as a means to maximize the line capacity during the single-tracking mode.

11.3.9.3.3.2 CCO Control Functions

The capabilities and functions described in this section shall be provided on the Central Control Console (CCC). All equipment, computer hardware and software, peripheral equipment, data storage equipment, other devices and associated efforts necessary to provide the functions and capabilities described in this section shall be furnished by the Developer.

Generally, the CCC controls and displays shall be separated into two (2) major functional groups: (1) APM Operating System operations, consisting of the Automatic Train Control, PDS and alarms; and (2) audio and video communications. Common CCO interface equipment, safety devices and switches, and voice communication capabilities shall be located at, or accessible to, each CCC position.
The CCC positions, the SSD, the PSD, and the other displays shall together constitute an ergonomically designed, well-coordinated, efficient, and easily operable system.

The CCO control functions described below shall be incorporated into the CCC in a manner that allows maximum flexibility of operation. Except for single event commands, once a command is imposed by the CCO and accepted by ATS, these actions shall remain operative until subsequently removed by the CCO.

Vehicle/Train identification numbers shown at the CCC, used by the CCO for input to the ATS subsystem, and used for the alarm event logs shall be the same as the numbers/markings on the Vehicles/Trains themselves. Similarly, the identifiers shown at the CCC for all other APM Operating System equipment including, at a minimum, PDS circuit breakers, Guideway switches, blue light stations etc. shall be the same as the markings on the equipment that they represent.

The Developer's design of the CCO control functions shall be submitted in accordance with the Summary of Submittals list in Part 2A, Section 6.7 as part of the CCC Design Audit.

Subject to the safety constraints on ATS required by Part 2B, Section 11.3.9.3.1, the CCC shall have at least the Automatic Train Control, power distribution, and communications control functions described below:

A. **Train Dispatching** - The CCO shall be responsible for dispatching Trains into the APM Operating System. Ready or standby Trains not in passenger service shall be located on the Train ready track or in active storage areas. The CCO shall be able to insert these Trains into service individually by initiating automatic dispatching procedures.

B. **Train Routing** - The CCO shall be able to assign each Train to a specific operating mode, lane or route. Changing the assigned route on a moving Train shall not cause the Train to stop or slow down while in route to its next scheduled stop. Route assignments shall take effect only at Stations or other designated stopping points (e.g., Train ready track, storage track, etc.) that are on the route being assigned.

C. **Initiation of Service** - The CCO shall be able to initiate APM Operating System service by proper actions at the CCC. This shall include multiple automatic Train dispatching operations in accordance with Part 2B, Section 11.3.9.3.3.2.A and subsequent automatic Train routing in accordance with Part 2B, Section 11.3.9.3.3.2.B.

D. **Termination of Service** - The CCO shall be able to terminate APM Operating System service by proper actions at the CCC. This shall include multiple automatic Train removal operations in accordance with Part 2B, Section 11.3.9.3.3.2.M.

E. **Operating Mode Selection** - The CCO shall be able to select any of the available operating modes of Part 2B, Section 11.3.3.2 to operate in accordance with Part 2B, Section 11.3.9.3.1. This shall include selecting the Trains, route, Stations, and Station dwell times for that mode.

F. **Station Graphics** - The CCO shall be able to activate preset messages from Central Control to override the ATO-activated messages at any and all dynamic signs in the Stations. See Part 2B, Section 11.3.12.1.2.1. The CCO shall be able to compose new messages for temporary or permanent use by these signs.

G. **Audio Announcements** - The CCO shall be able to make public announcements, in Vehicles and Stations, for any individual Train or Station, all Trains on a specific route, any set of Trains and/or Stations, in single or multiple zones within the
M&SF, or simultaneously throughout the APM Operating System. The CCO shall be able to control digitally prerecorded audio announcements and have them transmitted to any or all Trains, Stations, and other facilities. See Part 2B, Section 11.3.10.1.4.

H. **Video Surveillance** - The CCO shall have complete control of all video surveillance equipment. See Part 2B, Section 11.3.10.2.

I. **Video Recording** - The CCO shall have complete control of the video recording equipment. See Part 2B, Section 11.3.10.2.

J. **Guideway and Guideway Equipment Power** - The CCO shall be able to control the application and removal of propulsion power, other Guideway equipment power, auxiliary power, separately or in combinations, for the entire APM Operating System and for each individually powered segment of the APM Operating System Guideway. The CCO shall not be able to override local manual lockouts of power, but shall be informed of their status (see Part 2B, Section 11.3.5.1.6.E).

K. **Train-Station Door Actions** - The CCO shall be able to open, close, recycle and hold open/closed the Train doors and all matching Station platform doors subject to the requirements of Part 2B, Section 11.3.9.1.8 and for: (1) all door sets on the platform side of each Vehicle as a group; and (2) all door sets on the platform side of an entire Train, and any single door set.

L. **Modify Train Operations** - The CCO shall be able to issue the following commands that modify normal Train operations:
   1) Reset brakes on each Train, except as specified otherwise herein.
   2) Dispatch a Train from a Station and/or a specified location on the Guideway to another Station and/or specified location on the Guideway for: each Train, each Station, and all locations on the Guideway.
   3) Stop each Train individually, and all Trains simultaneously, anywhere in the APM Operating System.
   4) Modify Train speeds for each Train and for all Trains.

M. **Remove Train** - The CCO shall be able to remove Trains from the APM Operating System by two (2) methods, as follows:
   1) Method 1 - The CCO shall be able to remove a Train from service at any Station. This command shall initiate automatic announcements and dynamic signage in the affected Trains and Stations about the Train going out of service. After the CCO ascertains through a local check by an APM Operating System staff member that the Train is empty, and issues a separate command, the Train shall close all doors and either remain stopped in the Station, or proceed automatically to a predetermined storage location.
   2) Method 2 - The CCO shall be able to direct a Train to proceed out of service to the Train receiving track at the M&SF. This command shall initiate automatic announcements and dynamic signage in the affected Trains and Stations about the Train going out of service. The Train shall continue to the next Station to allow passengers to exit the Train. After the CCO ascertains through a local check by an APM Operating System staff
member that the Train is empty, and issues a separate command, the Train shall proceed automatically to the Train receiving track and stop.

N. **Failure Mode** - The CCO shall be able to convert the APM Operating System from its normal operating mode to a lesser operating mode for failure management purposes.

O. **Stop and Proceed** - The CCO shall be able to stop any Train at any location in the APM Operating System for an indefinite period, and then restart that Train.

P. **Modify APM Operating System Dwell** - The CCO shall be able to vary the Station dwell time for each Station independently, and for any service mode. The range of dwell times and adjustment increments shall be in accordance with Part 2B, Section 11.3.3.1.3.

Q. **Bypass Station** - The CCO shall be able to command any or all Trains to proceed without stopping at any Station platform or set of Station platforms in the APM Operating System. This shall automatically invoke a corresponding change in the on board audible destination announcements.

R. **Hold Trains and APM Operating System Hold** - The CCO shall be able to hold any Train in any Station with a "hold Train" command. Also, with one “APM Operating System hold” command, the CCO shall be able to command all Trains to hold in Stations.

The APM Operating System hold command shall automatically send successive Trains ahead to unoccupied Stations, as necessary, until all Trains are stopped in a Station and no Trains are stopped between Stations.

A. **Zero Speed** - The CCO shall be able to impose a zero speed constraint on any Guideway segment, effectively blocking that segment to traffic.

B. **Train Location Log** - On command from the CCO, the Automatic Train Control printer shall print Train identification and location by Guideway section or Station, on all operating Guideway of the passenger-carrying APM Operating System and in the M&SF. Such a report shall be printed on the command of the CCO, or automatically at an interval to be selected by the CCO. Alternatively, at the CCO's option, the Train location log shall be time-stamped and stored on electronic media, to be printed if desired at a later time.

C. **Alarm, Fault, or Change of State Message Display Processing** - The CCO shall be able to receive, acknowledge, store, and recall alarm message displays and acknowledge accompanying audible alarms from all Automatic Train Control, power, and communications subsystems. See Part 2B, Section 11.3.9.3.4.

D. **Status a Vehicle/Train as Available or Unavailable** - The CCO shall be able to select as available or unavailable a Vehicle or Train for a particular state or mode of service. See Part 2B, Section 11.3.3.2.

E. **Emergency Controls** - (See also Part 2B, Section 11.3.9.3.1)

1) **Stop All Trains** - The CCO shall be able to irrevocably service brake all Trains on the Guideway by activation of a single-action button or switch. One button shall be located at each of the CCO work positions at the CCC. A deliberate and positive action shall be required to release the button to eliminate the imposed condition.
2) Remove All Propulsion Power. The CCO shall be able to irrevocably remove all propulsion power from the APM Operating System by activation of a single-action button or switch. One button shall be located at each of the CCO work positions at the CCC. A deliberate and positive action shall be required to release the button to eliminate the imposed condition.

F. **Automated Vehicle Storage Area Operation** - The CCO shall be able to automatically: (1) route Trains out of passenger service to the Train receiving track at the M&SF, (2) dispatch Trains from the Train ready track in the M&SF into passenger service, and (3) control the movements of Vehicles and Trains in the automated Vehicle storage area.

G. **Guideway Lighting** - The CCO shall be able to turn Guideway emergency walkway lighting on and off by Guideway section.

H. **Other** - The Developer shall provide any other performance control functions necessary for proper operation, maintenance, and failure management of the APM Operating System. The Developer shall identify and describe these not later than, and in association with the APM Operating System Automatic Train Control System Design Audit.

### 11.3.9.3.4 Alarms and Malfunction Reporting

For safe and efficient operation of the APM Operating System, major components shall be automatically monitored for malfunctions, failures, fire/life safety problems, and/or security intrusions. The CCC shall incorporate both an incident message display and audible alarms for the benefit of the CCO. Within two (2) seconds of detection, the occurrence of an incident or condition shall be reported on a display, indicating the time of the occurrence, the alarm type, and the identification and location of the APM Operating System element involved. An audible alarm shall also sound. The audible alarm for all fire-related and/or smoke-related incidents shall be distinctively different from the audible alarms for other incidents. Acknowledgment of an alarm by the CCO shall cause the audible alarm to cease; however, the malfunction indication shall persist until the malfunction is cleared.

Data communications between Central Control and Trains shall be maintained and confirmed by a Train polling loop. Persistent failure of any Train to respond to a poll shall be alarmed and annunciated at Central Control.

Alarms shall be displayed individually, by priority and by order of occurrence. Alarms shall have the capability of bearing filtered and displayed by priority or by type (e.g. Train, substation, passenger Station, switch, etc.) All alarms, acknowledgements and clearings reported to the CCO shall be recorded and archived in accordance with the requirements of Part 2B, Section 11.3.9.3.6. The CCO shall have the capability to print all alarm data. The CCO shall be able to select archived alarm data and print an associated summary report as required by Part 2B, Section 11.3.9.3.6.1.

Where the Developer proposes, in accordance with Part 2B, Section 11.3.9.3, to separate Central Control functions, workstations and/or monitors to take advantage of commercially available systems, a unified/consolidated presentation of alarms to the CCO, including the ability to generate a single summary report of all alarms from all subsystems shall be provided.

#### 11.3.9.3.4.1 APM Operating System Alarms

APM Operating System alarms are primarily for annunciation of security, safety, and unscheduled stoppage problems.
At a minimum, APM Operating System alarms shall be reported in at least two (2) priority classifications, as described below. The level of classification and reporting shall be sufficiently detailed to allow operating and maintenance personnel to make rational decisions in reacting to the reports, consistent with the functions required of them in the operation and maintenance plans, procedures, and manuals.

Priority I alarms are those that pose an immediate threat to passenger safety and/or APM Operating System operations; and thus require immediate action. Priority I alarms shall include at least the following:

- A. Loss of presence detection for any Vehicle or any uncertainty regarding its location;
- B. Train violation of safe separation assurance distance;
- C. Unauthorized Train motion detected;
- D. Train overspeed or improperly high acceleration rate;
- E. Train speed measurement failure;
- F. Train unexpected loss of zero speed;
- G. Parted Train detected;
- H. Train obstructed motion detected;
- I. Train emergency brake application;
- J. Train loss of propulsion power;
- K. Train stopped (by fault) on the Guideway;
- L. Train failed to respond to poll for data communications;
- M. Vehicle fire/smoke detected;
- N. Vehicle parking, service or emergency brake failure;
- O. Vehicle propulsion system failure;
- P. Vehicle suspension system failure, including deflated airbags and flat tires;
- Q. Vehicle loss of ground brush connection to the ground rail;
- R. Vehicle unsafe side door blocking failure;
- S. Automatic Train Control signal loss detected;
- T. Unscheduled door unlocking or opening;
- U. Loss of propulsion or auxiliary power from a substation;
- V. Emergency call request from Vehicle or emergency telephone (ETEL);
- W. Loss of Vehicle voice or Station emergency telephone communication;
- X. Facility fire/smoke detected;
- Y. Facility intrusion detected;
- Z. Detection of Seismic activity; and

Priority II alarms are those that do not pose an immediate threat to either passenger safety or APM Operating System operations, but that could cause a potential threat to safety or APM
Operating System operation if not corrected quickly. Priority II alarms shall include at least the following:

AA. Train failed to depart a Station within ten (10) seconds after all doors are closed and locked and brakes are released;
BB. Train/Station doors failed to open within ten seconds after Train stops;
CC. Train/Station doors failed to close and/or lock when commanded;
DD. Train/Station doors recycled three times or obstructed for more than ten (10) seconds;
EE. Train to Station alignment tolerance exceeded;
FF. Train more than ten seconds late arriving at Station;
GG. Train operating mode change (auto/manual);
HH. Vehicle batteries low;
II. Vehicle battery charger failure;
JJ. Vehicle HVAC failure;
KK. Low Vehicle tire or air bag pressure;
LL. Removal of a Vehicle fire extinguisher;
MM. Vehicle or Train overload condition (see Part 2B, Section 11.3.7.9.7);
NN. Attempted switchover to redundant Automatic Train Control equipment failed;
OO. PDS breaker tripped;
PP. PDS overload or fault;
QQ. PDS transformer over-temperature;
RR. Loss of public address in Vehicles or Stations;
SS. UPS status, as required by Part 2B, Section 11.3.8.2.1;
TT. Loss of VSS in a Station; and
UU. Weather conditions beyond limits for safe operation.

The Developer shall develop a complete list of Priority I and II alarms in accordance with the Summary of Submittals list in Part 2A, Section 6.7. The list shall reflect any unique characteristics of the Developer's equipment. The Developer shall determine appropriate response actions and procedures for all such alarms and include those in the Operations Manual required by Part 2C, Section 3.2.

11.3.9.3.4.2 Facility Alarms

Facility fire, intrusion and other alarms, including those provided as part of Related Projects shall be annunciated at the CCC. These alarms shall be shown at the most appropriate CCO position(s). The location of the alarm point shall be indicated. Reporting shall be in accordance with Part 2B, Section 11.3.9.3.4 and Part 2B, Section 11.3.9.3.6.

Facility alarms shall include at least the following:

A. Facility fire and smoke alarms as provided in accordance with the requirements of Part 2B, Section 11.3.5.1.3.4. These shall be annunciated separately and redundantly.
B. Facility intrusion alarms as provided in accordance with the requirements of Part 2B, Section 11.3.5.2.1

11.3.9.3.5 CCO Communications Subsystem Interfaces

The CCC shall incorporate all controls and monitoring devices associated with the audio and video communications subsystems specified in Part 2B, Section 11.3.10.

11.3.9.3.6 Data Recording and Reporting

The ATS subsystem shall automatically keep a record of the Train length, including the identification numbers of the Trains and the Vehicles operating in each Train; the operating mode in which the APM Operating System is functioning; and the Guideway/route to which each Train is assigned. It shall also record any unscheduled stoppage or delay, including time of occurrence and time of resumption of operation, with the identification number(s) of any Train(s) affected.

The ATS subsystem shall record other operationally significant data events between Central Control and other portions of the APM Operating System. These events shall include, at a minimum, all: Vehicle/Train reports of location and status; alarms, acknowledgments and clearings; CCO console commands; Train insertions and removals; operating mode changes and any ATS-initiated actions. All such data shall be recorded in a format that includes the date and exact time of each event.

The CCO shall have the capability to print archived data on demand, and generate detailed report in media acceptable to LAWA. Data shall be printed in chronological order of event occurrence with a description of the condition being reported, the report’s index number and the time the event was detected.

Data events shall be recorded in a suitable format to a permanent file residing on the ATS subsystem and shall remain readily accessible (i.e., random retrieval) for 90 days for use in compiling reports (see Part 2B, Section 11.3.9.3.6.1). The ATS subsystem shall provide the capability to automatically or manually archive such data to removable digital media for storage.

The Developer shall provide a one-year supply of digital storage media and suitably protective storage space. One permanent copy of all recorded data events shall be provided to LAWA.

Other media proposed by the Developer may be acceptable, subject to acceptance by LAWA.

The Developer shall provide appropriate procedures, hardware, and software to store, retrieve, and analyze these data. The Developer shall train LAWA personnel to use this data analysis system as part of the training program (see Part 2C, Section 3.1.3).

11.3.9.3.6.1 APM OS Availability and Operations Reports

The ATS subsystem shall support a reports function for the computerized analysis of accumulated recorded data and the preparation of APM Operating System operations reports. This function may be performed on-line by the ATS, off-line by a separate computer-processor or by the MMIS (see Part 2B, Section 11.3.13.7).

The APM Operating System operations reports shall be prepared automatically using data automatically accumulated from the data records described above. The CCO shall be able to request such reports for any selected period (daily, weekly or monthly) within the last 90 days. The APM Operating System operations reports for each period shall include at least:

A. Service mode availability ($A_m$) of Part 2B, Section 11.3.6.2;
B. Fleet availability ($A_f$) of Part 2B, Section 11.3.6.3;
C. Station platform door availability ($A_s$) of Part 2B, Section 11.3.6.4;
D. Cumulative system service availability ($A_c$) of Part 2B, Section 11.3.6.5;
E. Mode Downtime Event of Part 2B, Section 11.3.6.6.2;
F. Alarms summary of Part 2B, Section 11.3.9.3.4; and
G. Weather Station report of Part 2B, Section 11.3.9.3.7.

The Developer shall develop a list of data storage, analysis, and reporting capabilities and submit this to LAWA for acceptance as part of the APM Operating System Automatic Train Control System Design Audit.

In addition to the above, the Developer shall develop procedures and formats for manually reporting on other aspects of daily, weekly, monthly, and annual operations activities. Such reports shall include at a minimum: (1) any incidents, accidents, and other unusual events or problems and (2) all CCO manual log entries.

The Developer shall develop a list of all reports to be provided, including descriptions of their contents, and submit this to LAWA as part of the APM Operating System Automatic Train Control System Design Audit.

**11.3.9.3.7 Weather Station and Seismic Monitoring**

The APM Operating System shall include a central weather data display on the CCC.

The Developer shall provide remote weather sensing stations that shall be installed at no greater than two-mile intervals along the length of the APM Operating System. The Developer shall conduct a weather study along the Project ROW to determine the number and locations of such sensing stations. The sensing stations may be located at passenger stations, and one shall be located at the M&SF. The weather sensing stations shall automatically sense wind speed and direction and other aspects of Part 2B, Section 11.3.4 that are critical to APM Operating System operations and APM OS Availability calculations. Data from these sensing stations shall be provided to the CCC continuously over communications subsystem data transmission links.

Remote sensing stations that monitor seismic activity shall also be provided. The number and location of these seismic stations shall be determined by the Developer through analysis. Seismic activity shall be displayed on the CCC. In addition, the Automatic Train Control system shall redundantly monitor the seismic sensing devices and issue an APM Operating System-wide service brake stop when ground accelerations exceed ten (10) percent of gravity. The detection subsystem shall have a complete subsystem self-test feature that provides frequent working status verification.

The central weather and seismic data display on the CCC shall provide a digital readout of all data taken at each of the remote sensing stations and shall identify the location from which the data are being received. The display shall show the data for at least two (2) remote sensing stations at any time. The sensing stations shall be automatically sequenced at a CCO-selectable interval of between fifteen (15) seconds and five (5) minutes, with fifteen (15) second increments. A CCO command to show data on either display for any sensing station shall override the automatic sequencing until the CCO commands a resumption of that sequencing. The other display shall continue providing sequential data for all stations.

These data shall be recorded at 15-minute intervals, (or as requested by the CCO), by the ATS subsystem and processed for report purposes in accordance with the requirements of Part 2B, Section 11.3.9.3.6.1. These data shall also be printed on an ATS printer at such intervals or upon CCO command.
When seismic or weather conditions exist beyond limits for safe operation as defined in Part 2B, Section 11.3.4, audible and visual alarms shall be annunciated at the CCC (Part 2B, Sections 11.3.9.3.4.1.Z and 11.3.9.3.4.1.UU).

11.3.9.4 Automatic Train Control System Reliability

11.3.9.4.1 Redundancy

To provide for Automatic Train Control system reliability, all Automatic Train Control computers/processors, data communications equipment, essential peripherals, and wayside transmission equipment (except for physical signal coupling devices) that are required to sustain normal APM Operating System operations and information flow shall be configured with fault-tolerant design features, such that no single failure shall cause a disruption of APM Operating System operations or the loss of full Central Control Facility display and command capabilities for a period exceeding one minute. This design feature may be accomplished by automatic switchover to hot standby equipment or by manual switchover command from the CCO to standby redundant equipment, provided the one minute disruption criterion is satisfied. Additionally, diagnostic features shall be provided to automatically detect such failure or loss of function and to notify the CCO by audible alarm and displayed message identifying the failure.

All Automatic Train Control data transmission equipment shall meet the data communications delay requirements and redundancy requirements of Part 2B, Sections 11.3.10.3 and 11.3.10.4.

11.3.9.4.2 Software Requirements

Existing proven software shall be used when available. All computer software used in the Automatic Train Control system shall be structured in a functional hierarchical system. In this top-down approach to software design, successive levels within the hierarchy shall be obtained by desegregating and partitioning the software into blocks with progressively greater functional detail. In accordance with the Summary of Submittals list in Part 2A, Section 6.7, a Software Requirements Manual shall be provided to LAWA in association with the APM Operating System Automatic Train Control System Design Audit. The Software Requirements Manual shall document the System-level requirements that describe all of the System-level functions, operational concepts, and performance parameters for the Automatic Train Control System, including how they are traceable to the Technical Provisions. The Software Requirements Manual shall include Software Requirements Specifications, which shall be developed in accordance with IEEE Standard 830 for the ATP, ATO, and ATS subsystems. The Software Requirements Manual shall explain the connection between the Automatic Train Control subsystem functions and the Software Requirements Specifications. The Software Requirements Manual shall also include traceability from the Automatic Train Control system-level requirements to the Software Requirements Specifications.

11.3.10 Communications

This section addresses communications requirements for the APM Operating System. In addition to the requirements of this section, the Developer is also required to provide additional communications equipment that is specified in Part 2B Section 17. The Developer shall design, provide, install and test a communications subsystem for all data, audio, and video communications with all hardware and software necessary to comply with the operating requirements of the APM Operating System, and any necessary integration with any of the equipment specified in Part 2B Section 17.

11.3.10.1 Audio Communications

Facilities and equipment shall be provided to permit voice communications between CCF, CUP, LAWA telecommunications building, and the Airport Response Coordination Center (ARCC) and:
(1) passengers, (2) operations and maintenance personnel located throughout the APM Operating System, and (3) emergency services (police, fire, medical) as set forth in this section.

Audio communications subsystems to be provided by the Developer shall include:

A. Public address;
B. Telephone communications;
C. Vehicle voice communications;
D. Audio announcements;
E. Operations and Maintenance radio communications; and
F. Audio recording and playback.

Audio communications shall meet the requirements of Chapter 10 of NFPA 130.

11.3.10.1.1 Public Address (PA)

Part 2B Section 17 identifies three Public Address systems. The requirements of this section are related to PA System 2 of that section.

PA System 2 shall be provided to enable both the CCO and ARCC to make direct announcements and to initiate automatic, digitally prerecorded announcements (see Part 2B, Section 11.3.10.1.4) to (1) all Stations; or (2) any combination of Stations; or (3) any combination of Vehicles/Trains; (4) any and all zones within the M&SF and associated storage areas; and (5) in the pedestrian bridges and mezzanines.

PA System 2 shall provide moderate sound levels and high intelligibility speech reproduction at a level of 5 feet above finish floor throughout each facility. All PA speakers in a given Station (or M&SF zone) shall deliver announcements simultaneously when that Station or zone is selected. The PA subsystem shall provide full coverage in all public areas of each Station and all areas of the M&SF.

The PA System 2 shall selectively receive and broadcast audio announcements provided by LAWA’s public address system. LAWA’s emergency announcements shall have priority over the PA subsystem announcements, and shall have the capability to suppress the PA subsystem announcements by muting the PA subsystem announcements entirely. The PA subsystem announcements shall have priority over LAWA’s non-emergency announcements, in the areas of the Operating System where these announcements provide essential information about the train operation. The Developer shall be responsible for coordinating the PA Interface requirements with LAWA and shall include the interfaces and/or integration as part of the D/CiD.

PA System 3 as identified in Part 2B Section 17 is the emergency PA system. If the System 2 PA is used as the part of the primary Emergency Voice Communications system in some of the spaces in or adjacent to the APM Operating System, it shall meet the requirements of NFPA 72 National Fire Alarm Code, Chapters 18 and 24. PA System 2 is subject to review and acceptance by the AHJ. PA System 2 shall meet the following minimum performance characteristics:

A. In the frequency range of 70 to 15,000 Hz, the amplifier signal gain shall be linear to plus or minus 5dB.
B. Harmonic distortion level shall be three (3) percent, maximum.
C. Ambient noise detection shall be provided that automatically adjusts amplifier output to maintain announcement volume levels at 10 dB above ambient levels up to a maximum of 85 dBA.
D. Speakers shall be UL1480 fire resistant.
E. PA System 2 shall include at least the following major components:

1) CCF equipment, including microphones, speakers, preamplifier, announcers, switching hardware, and power amplifier.

2) Station equipment, including speaker units, preamplifiers, and power amplifiers. Each Station shall be, at a minimum, one separate zone.

3) Each Station zone shall incorporate two (2) separate amplifiers, each driving half of the zone speakers such that the loss of an amplifier will not result in the loss of the entire zone.

4) M&SF equipment similar to that in the Stations. There shall be a sufficient number of inside and outside zones. The CCF and the administrative area shall each be a separate zone. A paging function provided by the internal telephone system described in Part 2B, Section 11.3.10.1.2.2 may be used for coverage of M&SF office areas provided that the requirements for transmission equipment of Part 2B, Section 11.3.10.1.6, intelligibility of Part 2B, Section 11.3.10.1.8, and delay of Part 2B, Section 11.3.10.3 are met.

PA System 2 shall meet the requirements for transmission equipment of Part 2B, Section 11.3.10.1.6, intelligibility of Part 2B, Section 11.3.10.1.8, delay of Part 2B, Section 11.3.10.3 and redundancy of Part 2B, Section 11.3.10.4.

11.3.10.1.2 Telephone Communications

11.3.10.1.2.1 Emergency Telephone (ETEL)

The Developer shall provide a two-way ETEL subsystem for linking the Central Control Console with passenger Stations, blue light stations and other locations as specified in accordance with the requirements of NFPA 130.

Each ETEL shall automatically call the CCF when activated by its user. A display on the CCC shall indicate which ETEL is calling and the number of ETEL calls in the queue. The CCO shall have the capability to connect any incoming call to “911” or LAWA’s emergency service. The ETEL subsystem shall provide the connected service with the information necessary to identify the caller’s location.

All ETEL equipment shall be of heavy duty, vandal-resistant design and construction, including being flush mounted in a tamper and weather resistant enclosure.

ETELs shall have push-to-call buttons and integral microphones/speakers for two-way communications between the ETEL and Central Control. When the push-to-call button is activated, the person operating the telephone shall receive an audible indication that the unit is calling. Instructions for use shall be provided on vandal resistant signs integral with or adjacent to each ETEL.

The ETEL subsystem shall meet the requirements for transmission equipment of Part 2B, Section 11.3.10.1.6, intelligibility of Part 2B, Section 11.3.10.1.8, delay of Part 2B, Section 11.3.10.3 and redundancy of Part 2B, Section 11.3.10.4.

11.3.10.1.2.2 Internal Telephones

The Developer shall provide an internal telephone subsystem to connect Central Control with the M&SF, administrative offices, TPSSs and other APM Operating System equipment rooms. The telephone system shall be IP-based using Voice over IP (VoIP). The internal telephone subsystem shall include a fully programmable, flexible telephone control subsystem to operate the internal and external telephone links.
The internal telephone subsystem shall be controlled from a multi-button keyset/console or computer workstation on the CCC. Programming of the telephone control subsystem shall be possible from the CCF and remotely, but shall be only by authorized personal and require the use of security protocols (e.g. passwords and encryption) to prevent unauthorized access. It shall be possible to transfer some or all internal telephone control during selected hours to an administration office/reception area location. The console or computer workstation and related connecting and interfacing equipment for the administration area shall be supplied, installed, and tested by the Developer.

The telephones on the CCC, in the Maintenance Supervisor’s office, and in other selected administration offices shall have access to the public telephone system. Other telephones in non-public areas shall be direct inside dialing only. The final determination of restricted and non-restricted telephones shall be made by LAWA prior to final programming of the telephones by the Developer.

The telephones of the Operations Manager, Operations Supervisor, Maintenance Supervisor, and at least five others shall have the ability to access the PA system in the M&SF. All M&SF zones and all Stations shall be accessible in individual zones and on an all-call basis.

The telephone consoles on the CCC shall have access to the Vehicle voice communications, O&M radio, ETEL, and PA subsystems. This shall include a direct phone connection to LAWA’s ARCC. The Developer shall include interface requirements in the D/CID; and coordinate interfaces with LAWA.

The internal telephone subsystem shall include at least the following major components:

A. Central Control equipment, including the console or workstation, servers, and transmission equipment.

B. Remote equipment, including hardware such as multi-button VoIP phones and transmission equipment located in administration offices, the M&SF, PDS substations and other APM Operating System equipment rooms. Telephones/intercoms not located in administration offices shall be of heavy duty, vandal resistant design, including tamper and weather resistant enclosures.

The internal telephone subsystem shall meet the requirements for transmission equipment of Part 2B, Section 11.3.10.1.6, intelligibility of Part 2B, Section 11.3.10.1.8, delay of Part 2B, Section 11.3.10.3 and redundancy of Part 2B, Section 11.3.10.4. The internal telephone subsystem shall utilize the Data Transmission System (DTS) described in Part 2B, Section 11.3.10.6.

**11.3.10.1.3 Vehicle Voice Communications**

A full-duplex Vehicle voice communications subsystem shall be provided to permit two-way voice communications between both Central Control and ARCC and passengers or personnel within each passenger compartment of each Train. Activation of two-way voice communications between either Central Control or ARCC and the Train(s) shall only be possible from either Central Control or ARCC. Passenger initiated communications requests from a Train shall be automatically displayed on the CCC. The display shall show the passenger compartment identification number, and any queue of such communication requests. The CCO shall be able to activate the communications link to the Train upon receiving the request indication, or at any time the CCO deems it necessary to receive communications from any passenger compartment (i.e., eavesdropping feature). A passenger initiated communications request shall include an audio and visual on-board indication that the call has been requested. No on-board indication shall be provided if the CCO initiates an unrequested communications link.
The Developer shall provide a Train announcement subsystem for the CCO and ARCC to make live announcements and to initiate prerecorded announcements (including LAWA’s prerecorded announcements) to all passenger compartments of any one Train or to all passenger compartments of all Trains or any combination of Trains in the APM Operating System. Live announcements by the CCO and ARCC shall always interrupt and override any recorded announcements, messages or music (see Part 2B, Section 11.3.10.1.4). Prerecorded announcements shall be subject to acceptance by LAWA.

The Developer shall be responsible for all voice and data communications links with the Vehicle. In designing these links, the Developer shall be cognizant of the availability of FCC-licensed radio channels and other Airport communications in the APM System area. If the Developer proposes a radio design, the Developer shall be responsible for all preliminary work including the preparation of applications to allow LAWA to file for and obtain an FCC license(s) within sufficient time that Developer Work shall not be delayed. The Developer shall not claim for any damages due to any delays in its Work due to the absence of said FCC license for which LAWA has applied.

The Vehicle voice communication subsystem shall guarantee that an open communications path exists between the Trains and Central Control at all times and that any calls that cannot be answered at the time they are received are held in queue until they can be answered.

The Vehicle voice communication subsystem shall meet the requirements for transmission equipment of Part 2B, Section 11.3.10.1.6, intelligibility of Part 2B, Section 11.3.10.1.8, and delay of Part 2B, Section 11.3.10.3.

11.3.10.1.4 Audio Announcements

The Developer shall provide an audio announcement subsystem that shall interface with PA System 2 and Vehicle voice communications subsystems. The audio announcement subsystem shall have a sufficient number of prerecorded announcements to be used for regular APM System and failure management operations, as well as LAWA’s prerecorded messages. Some prerecorded announcements shall be automatic (i.e., automatically initiated by the Automatic Train Control system) and others shall be selectable by CCO and AOC. Programing of the audio announcement subsystem shall be possible from the CCF by authorized personal and require the use of (non-proprietary) security protocols (e.g. passwords and encryption) to prevent unauthorized access. Prerecorded announcements shall include at least the following:

A. Automatic Prerecorded Announcements On-board Trains:
   1) Synchronized to the location of the Train over its route.
   2) As required by Part 2B, Section 11.3.7.13.9.1.

B. Automatic Prerecorded Announcements in the Stations:
   1) Announce the imminent arrival of a Train and its destination.
   2) Announce the imminent departure of a Train from the Station and its destination.
   3) As required by Part 2B, Section 11.3.12.1.2.3.

C. Selectable Pre-recorded Announcements On-board Trains and in Stations:
   1) Announce the removal of a Train from service.
   2) Announce appropriate messages for temporary delays and/or operating mode changes.
   3) Announce appropriate messages in response to the conditions described in Part 2B, Section 11.3.9.3.4.1.
4) Announce LAWA specified prerecorded messages.

Announcements shall be stored in the languages specified in Part 2B, Section 11.3.1.4. The audio announcement subsystem shall also have the capability to allow the sequential repetition of each prerecorded announcement in the languages specified in Part 2B, Section 11.3.1.4.

A specific feature of the audio announcement subsystem shall be the capability of playing prerecorded advertising messages and/or prerecorded music on-board the Vehicles. The subsystem shall provide for storage and playback of at least five prerecorded advertising messages, each thirty (30) seconds long. Also, the subsystem shall provide for storage and playback of at least thirty (30) minutes of prerecorded music.

The audio announcement subsystem shall include all hardware and software necessary to record additional or modified announcements for subsequent use.

The numbers of announcements, specific wording, and expansion capabilities shall be submitted as part of the APM Operating System Audio Communications System/Equipment Design Audit.

The use of synthesized voice system is acceptable to generate the audio announcements described above provided that all other requirements are met.

11.3.10.1.5 Operations and Maintenance (O&M) Radio Communications

The Developer shall provide a half-duplex or full-duplex O&M radio communications subsystem for communications between Central Control and maintenance personnel. The Developer shall be responsible for all preliminary work, including at a minimum: (1) determining the number of talk groups needed (which shall be at least three (3); two (2) for O&M communications and one for emergency communications); (2) determining the appropriate frequency range; and (3) preparing applications to allow LAWA to file for and obtain the necessary FCC license(s) within six months after NTP. Developer shall coordinate with LAWA all radio communications necessary to meet the Developer’s needs.

The O&M radio communications subsystem shall include at least the following major components:

A. Central Control/M&SF equipment, including base Station, antenna, audio recording subsystem interface, radio transceiver, radio console control head with microphone and speakers, and all interconnecting cable and wiring.

B. Equipment for maintenance and rover personnel, including enough hand-held radios for each person expected to be in the field with a spare factor of 25 percent, but not less than 12 hand-held radios. Twice as many rechargeable batteries as radios that use them shall be supplied. The number of battery chargers provided for the portable radios shall be at least 25 percent more than the number of radios.

C. The MRV and all other O&M support Vehicles shall be supplied with compatible mobile radios securely affixed to the Vehicle and located for easy use by the driver. Antennas and related radio equipment shall be permanently installed in these Vehicles.

D. Repeater Stations, special antennas and/or radiating cables shall be provided and located so that 97% of the entire APM System and adjacent areas within one-half mile receive radio coverage. This shall also include roadways, pedestrian surfaces, underground spaces, parking lots, Stations, TPSS, and equipment rooms that APM System personnel will occupy during the course of Operation and Maintenance of the APM System.

E. The Developer shall provide 6 additional hand-held radios, battery sets and chargers for use by LAWA during testing and commissioning of the APM Operating...
System. These will be returned to the Developer upon completion of testing and commissioning, and may be included in the 25% spares count. These radios shall be tuned to the same frequencies as the Developer's radios.

The power to operate all fixed radio equipment shall be from an uninterruptible power supply in accordance with Part 2B, Section 11.3.8.2.1. Portable radios shall have sufficient power to provide clear, comprehensible communications throughout the APM System. Coverage shall be as required by NFPA 130, Chapter 10.3.

All communications over the O&M radio subsystem shall be continuously recorded in accordance with Part 2B, Section 11.3.10.1.7. The audio signals shall be compatible with the recorder input circuitry.

The radio base Station shall be located in the CCF or M&SF and as required by NFPA 130, Chapter 10.2. The antenna type and location shall be determined by the Developer and coordinated with and accepted by LAWA to be compatible with other nearby signal sources.

The O&M radio subsystem shall meet the intelligibility requirements of Part 2B, Section 11.3.10.1.8.

11.3.10.1.6 Transmission Equipment for Audio Communications Subsystems

Audio transmission of pre-amplified audio (e.g. including PA, telephone, audio announcements, and Vehicle voice communications) shall utilize standard (non-proprietary) protocols. Amplified audio signals (e.g. between the PA amplifiers and speakers) shall be at an appropriate voltage to minimize interference from other sources and to allow for efficient use of cabling.

All transmission equipment used by the audio subsystem shall meet the communications delay requirements and redundancy requirements of Part 2B, Sections 11.3.10.3 and 11.3.10.4.

The transmission link shall provide for audio communications that meet intelligibility requirements of Part 2B, Section 11.3.10.1.8. All transmission equipment shall meet the temperature and humidity conditions of Part 2B, Section 11.3.4.1.

11.3.10.1.7 Audio Recording and Playback

The Developer shall provide an audio recording and playback subsystem with capabilities to record and playback: (1) all Central Control room audio, (2) all communications with the CCO(s) and ARCC, (3) all live Train announcements, (4) all ETEL communications, and (5) all PA announcements.

The audio recording and playback equipment shall be capable of recording at least thirty (30) hours of continuous audio separately and simultaneously for each audio communication subsystem, with indication of the sources of communication, date and time. This device shall interface with all audio communications subsystems in the CCF and shall include appropriate transmission equipment. Sufficient recording media shall be provided so that each day's recordings can be stored for 90 days before being re-used. Audio recording data shall be provided to LAWA as specified in Part 2B, Section 11.3.10.2.

11.3.10.1.8 Intelligibility Requirements for Audio Communications Subsystems

All audio communications subsystems shall meet the intelligibility requirements of Section 6.1.6 of ASCE 21. Additional requirements regarding test conditions shall be specified below.

All audio communications subsystems shall be tested for intelligibility as follows:

A. **PA System 2 (Part 2B, Section 11.3.10.1.1)** - In verifying the above intelligibility requirement for the PA System 2, measurements shall represent the entire passenger space at Stations, and provide the average result of all reflected signals
and reverberations. All auxiliary systems shall be in normal operation, and the noise of passengers shall be simulated by test personnel such that the ambient noise will be at typical maximum levels. Sound measurements and testing shall be made at the maximum distance from the speakers and at a height of five feet above the floor surface.

B. **Emergency Telephones (Part 2B, Section 11.3.10.1.2.1)** - ETELs shall meet the above intelligibility requirements at all locations within the APM Operating System at ambient noise levels with all auxiliary systems in normal operation and the noise of passengers shall be simulated by test personnel.

C. **Internal Telephone Subsystem (Part 2B, Section 11.3.10.1.2.2)** - The internal telephone subsystem shall meet the above intelligibility requirement at all locations within the APM Operating System at ambient noise levels.

D. **Vehicle Voice Communication Subsystems (Part 2B, Section 11.3.10.1.3)** - In meeting the above intelligibility requirement for the Vehicle voice communications and the Train announcement subsystems, the interior noise level in the Vehicle shall be at least 3 dB above the maximum interior level specified for the Vehicles in Part 2B, Section 11.3.7.6.2. Measurements in Vehicles shall represent the entire passenger compartment and provide the average result of all reflected signals and reverberations. Measurements shall be made at the maximum distance from the speakers, at a height of five feet above the floor surface. A representative number of Vehicles shall be tested, as proposed by the Developer as part of the Acceptance Test Procedures required in Part 2C, Attachment C.

E. **O&M Radio Communications (Part 2B, Section 10.3.10.1.5)** - The O&M radio communication subsystem shall meet the above intelligibility requirement at all locations within the APM System at ambient noise levels. Measurements shall represent the typical spaces within the APM System where radios will be used and provide the average result of all reflected signals and reverberations. All auxiliary systems of such spaces shall be in normal operation, such that the ambient noise will be at typical maximum levels.

Each of the tests above shall be repeated for a representative number of locations throughout the APM System to ensure that no areas of poor intelligibility exist. The number of locations shall be proposed by the Developer as part of the Acceptance Test Procedures required in Part 2C, Attachment C.

### 11.3.10.2 Video Surveillance

The requirements of this section are intended to address the specific operational requirements of the APM Operating System. The Developer shall also provide extensive Video coverage of the APM System as described in Part 2B Section 17.4.6, as part of the D&C Work, which is not part of the APM System O&M Limits. Specific performance requirements of the Video Surveillance System (VSS) including the simultaneous dual feed to LAWA and the APM CCF are provided in Part 2B Section 17.9.

The Developer shall provide an IP network-based color video surveillance subsystem (VSS) to permit the CCO to monitor passenger and other activities in all Stations, in all Cars, the M&SF, APM Operating System power distribution substations and at all points along the APM System Guideway; and in other selected areas throughout the APM System as specified herein. The Developer-provided VSS shall provide a system that integrates fully with the LAWA DVMS specified in Part 2B Section 17.9.
A. IP cameras: fixed, fixed mobile, and pan/tilt/zoom (PTZ) types.
B. Network video and mobile video recording hardware and software.
C. Video monitoring hardware and software.
D. Video management and analytical software.

The VSS shall utilize the DTS described in Part 2B, Section 11.3.10.6. The Developer shall provide a secure functional and physical interface within a termination cabinet in the CCF and at the Telecommunications Building to allow LAWA to connect to, and transmit any or all VSS video images and related alarms to an LAWA specified monitoring network. The Developer provided equipment shall provide a minimum bandwidth of 1Gbps between the VSS and LAWA’s monitoring network.

The VSS equipment shall include cameras, camera mounts, servers, workstations, displays, video recorders, video management software, and all other equipment as required to provide a state-of-the-art VSS.

The Developer shall provide an open API for LAWA’s access to video, related metadata analytic capabilities, and control. The Developer shall be responsible to coordinate with LAWA on VSS protocol and other interface and/or integration requirements as part of the Design Process.

The Developer shall design, provide, install and test the VSS, including all equipment and all associated transmission equipment and interconnects.

The VSS shall provide coverage of all areas in Part 2B, Sections 11.3.10.2.2, 11.3.10.2.3, 11.3.10.2.4 and 11.3.10.2.5.

The image resolution available for recording shall not be less than the resolutions of the cameras. All VSS equipment located in public areas shall be tamper proof and vandal resistant. All outdoor VSS equipment shall operate so as to provide the required surveillance coverage in all environmental conditions as specified in Part 2B, Section 11.3.4.

The Developer’s VSS shall meet the requirements of Part 2B Section 17.9 for compatibility with LAWA’s requirements. The Developer’s VSS designs and equipment, including cameras, and camera locations, video displays/monitors, video recorders, transmission equipment, video management software and all other aspects of the VSS shall be submitted to LAWA as part of the Video Surveillance System/Equipment Design Audit.

Specific requirements for video surveillance equipment are provided below.

11.3.10.2.1 Central Control Equipment

The CCF shall be equipped with LED flat screen video displays as required in the following sections for displaying the VSS images. The video displays shall be grouped together and organized in a logical order with identifying information displayed on each screen to orient the CCO and to facilitate identification and location of the displayed images. The monitor layout shall include provisions for expansion.

11.3.10.2.1.1 Video Wall Monitors

Video wall monitors shall be LED type, shall measure at least 50 inches diagonally and shall provide a clear image in the ambient light level of the CCF. A minimum of two (2) video wall monitors shall be mounted in such a manner as to provide clearly visible images to the CCO from the VSS workstation and from other normal working positions at the CCC.

At a minimum, there shall be a sufficient number of dedicated VSS monitors to constantly display images from cameras viewing the passenger Station platforms and each operating Vehicle Car
compartment. The layout of the video wall monitors shall be arranged in a matrix or "video wall" configuration in the CCF. Guideway and maintenance/emergency walkway camera images may be sequentially and/or selectively displayed.

All video sequencing hardware and software shall meet criteria specified in Part 2B, Section 11.3.10.2.1.3.

11.3.10.2.1.2 VSS Workstation Monitors

Additional displays shall be provided in sufficient number at a dedicated VSS workstation on the CCC to simultaneously view the images from all of the cameras in the Station having the maximum number of cameras plus the Guideway/emergency walkway section to the next Station. Each workstation monitor shall be a LED type, shall measure at least twenty-four (24) inches diagonally and shall be capable displaying from 1 to a minimum of 16 camera views in selectable or equal sizes.

The VSS workstation equipment and the associated video management software shall allow the CCO to select the following images, or groups of images, from a GUI menu for display:

A. The images from all cameras in any one Station and adjacent Guideway/emergency walkway sections.

B. By automatic sequencing, the group of images from all cameras in each Station and their associated adjacent Guideway/emergency walkway sections; or from all cameras in a selected set of Stations/walkway sections. The sequencing of successive images shall be at time intervals selectable by the CCO between 2 and sixty (60) seconds.

C. By automatic sequencing, the group of images from all cameras along the Guideway. The sequencing of successive images shall progressively sweep the entire alignment from end to end and shall be sequenced at time intervals selectable by the CCO between 2 and sixty (60) seconds.

D. Automatic sequencing of the images from cameras located in the passenger compartments of Trains that are operating in passenger-carrying service on the main Guideway and in the Stations (not at the M&SF or other storage areas).

E. The full screen image from any single camera in the APM Operating System for viewing on any one workstation monitor.

F. By automatic call-up, the images from any camera or cameras that are coordinated with the location of any Station-related fire or intrusion alarm, incident on a Train, or other APM Operating System alarms. Such automatic call-up shall not interrupt any specific camera image selected by the CCO or any image being recorded. As a default, the image called up shall be displayed on the next available workstation monitor. Successive Station alarms shall be queued chronologically and the queue displayed to the CCO.

G. By automatic sequencing, all cameras in the M&SF.

All video sequencing hardware and software shall meet criteria specified in Part 2B, Section 11.3.10.2.1.3.

11.3.10.2.1.3 Video Sequencing Hardware and Software

The Developer shall provide all necessary hardware and software required to provide manual and automated sequencing of all APM Operating System cameras. Sequencing hardware and software shall allow custom sequencing scripts controlling the sequence, viewing intervals and
screen mode of images on monitors defined in Part 2B, Sections 11.3.10.2.1.1, 11.3.10.2.1.2 and 11.3.10.2.1.3.

11.3.10.2.1.4 Video Management and Storage

Video Storage hardware and software shall be capable of recording the images from all APM Operating System cameras as follows:

A. Camera resolutions as needed to meet the requirements of Part 2B, Sections 11.3.10.2.2 and - 11.3.10.2.5.

B. Image complexity and motion consistent with the camera views as needed to meet the requirements of Part 2B, Section 11.3.10.2.2 through Part 2B, Section 11.3.10.2.5.

C. Routine recording of all images at a minimum of 30 fps.

D. On-Board cameras in the Cars shall automatically upload recordings stored on the on-board video storage devices automatically to both CCF and LAWA when removed from service and returned to the M&SF.

E. Event recording of images at 30 fps per Part 2B, Section 11.3.10.2.1.6.

F. Thirty-one (31) days of storage for all video images.

G. The recording frame rate and resolution shall be adjustable for each camera. Each video input shall include a watermark. Each watermark shall include, at a minimum, camera identification and the date and time.

H. The video management and storage system shall be multi-tasking, permitting the simultaneous recording, playback, live viewing, downloading, and archiving of video without degrading the performance of any functions. The image resolution available for recording at Central Control shall not be less than the resolution of the cameras. The image resolution and frame rate for live viewing shall be selectable and distinct from the resolution and frame rate for recording.

I. The video recording equipment shall provide:

1) Hard drive storage means for video and operating software configured for fault tolerant operation. The system shall use multiple drives for video image storage and retrieval. The drives shall be configured in a RAID Level 6 or an accepted better configuration.

2) A means to export select video in a standard (non-proprietary) format to a DVD disc or other suitable storage media. It shall be possible to download the previous 24 hours of recorded data onto storage media while the system is simultaneously recording current image activity.

3) Power failure protection, which may be provided by the UPS system. The VSS management and storage equipment shall be powered from multiple dedicated breakers such that a single tripped breaker will not result in total loss of the VSS. The power failure protection shall be addressed in the Communication Design Audit.

11.3.10.2.1.5 Video Management Software

The video surveillance system shall utilize a PC based GUI to select and control cameras for viewing or positioning via the pointing device of the PC.
The GUI shall provide the CCO with the following capabilities and features as a minimum:

A. An overlay drawing of the Stations and Guideway showing icons representing the locations of the APM Operating System cameras. The icons shall allow the operator to select individual or multiple cameras for viewing.

B. An overlay drawing of a Car, Vehicle and Train showing icons representing each camera, and a method of isolating cameras in each Car or Train. The icons shall allow the operator to select individual or multiple cameras for viewing.

C. The GUI shall include icons for pan/tilt/zoom (PTZ) control that will allow the operator to position the view of cameras so equipped to suit the surveillance needs of the operator at that time.

D. The system shall provide the means for assigning cameras to monitors utilizing standard “drag-and-drop” actions.

E. The GUI shall allow for fully integrated operation of the video recording system. The GUI shall include radio style buttons for instant replay of alarm events as well as for other NVR related functions, including but not limited to, searching, archiving and playback of recorded video.

F. Pause of live video and easy access to archive review of the associated camera’s video.

G. On-screen camera and location identification.

H. On-screen date/time display.

11.3.10.2.1.6 Event Identification and Reaction

The VSS shall provide a means of automatic identification of and reaction to predefined events. The VSS shall be capable of the following upon the detection of a predefined event:

A. Tag the video of the predefined cameras for easy retrieval.

B. Modify the recording settings (e.g. increase the recorded frame rate) of the predefined cameras.

C. Provide an alarm at the CCF and display the associated camera view(s).

D. At a minimum, the VSS shall be capable of reacting to the following events by changing the cameras view settings to record events triggered by:
   1) A call initiated at a Station ETEL or Vehicle voice communication device.
   2) Monitoring for activity or motion in user defined areas such as entrances to equipment rooms and substations at predefined times.
   3) Left objects in the passenger areas of Stations.
   4) Activation of the on-board emergency door handle.
   5) Activation of Automatic Electronic Defibrillator (AED). See Part 2B Section 17.10.
   6) Activation of intrusion alarm.
   7) Unscheduled or obstructed platform door opening (including end doors).
   8) Gunshot detection and notification. See Part 2B Section 17.
   9) Platform door notifications
   10) ACAMS
11.3.10.2.2 Passenger Station Equipment

The number and placement of cameras provided for the passenger Stations shall permit the CCO a clear view of the public areas of each Station, including the following areas:

A. Passenger platform boarding zones including all automatic platform doors, and emergency egress doors. The resolution at the platform boarding zones shall be sufficient to recognize an individual with a minimum resolution of 50 pixels / foot.

B. Station platform entrances, exits, and vertical corridors including all stairways, escalators, and elevators as required to accommodate the specified automatic call-up function (Part 2B, Section 11.3.10.2.1.6.C). The resolution at Station entrances and exits shall be sufficient to recognize an individual with a minimum resolution of 50 pixels / foot.

C. The resolution at all other Station public areas shall be sufficient to detect the presence of a person with a minimum resolution of 10 pixels / foot.

D. The Developer shall install a gunshot detection system in all public areas of the APM System including Pedestrian Walkways, Station platforms, and at the M&SF. The detection system shall have the capability to pinpoint the location within the designated area that the gunshot occurred. Upon detection of the gunshot, the video system shall zoom to the gunshot location. Any gunshot notification shall be transmitted to the CCF as well as LAWA Police. See Part 2B Section 17.

11.3.10.2.3 Guideway and Emergency Walkway Equipment

The number and placement of cameras provided throughout the APM Operating System shall permit the CCO a clear view of all Guideway areas and all emergency walkways. The resolution shall be sufficient to detect the presence of personnel or trespassers on the Guideway with a minimum resolution of 10 pixels / foot.

11.3.10.2.4 M&SF Equipment

The number and placement of cameras in the M&SF shall be sufficient to provide unobstructed viewing of all areas where Trains may move automatically (including the Train ready track, the Train receiving track and the Vehicle wash area), all storage areas, maintenance bays, and the entire continuous perimeter of the M&SF.

The resolution shall be sufficient to detect the presence of personnel or trespassers on all areas where Trains may move automatically with a minimum resolution of 10 pixels / foot.

11.3.10.2.5 Vehicle Equipment

Each passenger compartment of each Vehicle shall be equipped with sufficient cameras arranged such that the entire passenger space is viewed. The video transmission system between the Trains and wayside shall provide clear and interference free transmission of the camera images to the CCC, regardless if primary power is interrupted and if the interior is lit with emergency lighting. The video transmission system shall permit the simultaneous live viewing of all Cars in a maximum length trainset with a minimum of two (2) cameras per Car. The actual radiated power of each transmitter shall be below the limits required for licensing by the FCC. Selected Vehicle alarms, including an on-board passenger call request, shall automatically trigger selection of the same Vehicle’s image on the monitor where the image is portrayed at Central Control.

The minimum resolution of all Vehicle interiors shall be 10 pixels / foot. The resolution for coverage of the Vehicle doors and emergency voice communication devices shall be sufficient to recognize an individual with a minimum resolution of 50 pixels / foot.
11.3.10.2.6 Cameras

All APM Operating System cameras shall be IP network based cameras. The cameras and associated mounting hardware shall be tamper proof and vandal resistant for all applications and weather resistant for outdoor applications. All cameras and associated hardware shall meet the temperature and humidity conditions of Part 2B, Section 11.3.4.1, except that, cameras in climate controlled spaces shall be rated for operation in conditions of relative humidity from ten (10) percent to eighty-five (85) percent, non-condensing. Cameras installed outdoors shall have an integral sun shield as well as ventilation and cooling as required for maintaining the temperature of the camera to within the manufacturer's specified operating range. Camera mounts and housing shall be constructed for dependability, long life and attractive appearance.

Cameras shall be day/night types to automatically adjust to the ambient light conditions at each location throughout the operating day. Cameras shall have a usable picture with a minimum scene illumination of the lesser of 0.2 lux and the lowest emergency lighting levels (at the end of the specified 1.5 hour period) as required by Section 7.9.2.1, NFPA 101. Cameras shall use automatic light compensation and shall be placed to provide a usable picture even in bright sunlight. Infrared Illuminators shall be provided to provide a usable picture in occupied locations where emergency lighting levels are not sufficient. Cameras shall be provided with auto iris feature.

Camera mounts for fixed cameras shall be the universal type (wall or ceiling) and shall permit adjustment by manual means. All cameras for viewing the Station areas in accordance with Part 2B, Section 11.3.10.2.2 shall be the fixed type, not PTZ. Guideway cameras and M&SF cameras may be fixed or PTZ type cameras provided that all required areas are covered in accordance with Part 2B, Sections 11.3.10.2.3 and 11.3.10.2.4 when the PTZ camera is in its preset home position. All PTZ cameras shall be controllable by the CCO and shall automatically revert to a preset home position view within thirty (30) seconds of inactivity unless actively overridden by CCO in case of emergency. Such PTZ activity shall be alarmed and recorded.

All cameras shall:

A. Provide a minimum of 720p;
B. Be capable of operating at a minimum of 30 fps in all resolutions;
C. Be capable of operating at a selectable frame rates down to 1 fps;
D. Be capable of multiple, individually configurable video streams;
E. Be capable of audio recording in locations where required per Part 2B, Sections 11.3.10.2.2 and 11.3.10.2.5; and
F. Be powered by a low voltage DC power supply or by Power Over Ethernet.

G. PTZ cameras shall:
   1) Be dome style construction with integral drive and communication circuits;
   2) Have minimum zoom capabilities of 25X optical zoom;
   3) Have 360° continuous pan rotation with 90° tilt and auto-flip to provide proper picture orientation during continuous tilt; and
   4) Provide an "Auto Home" feature. This feature shall return a camera to a pre-programmed orientation after the camera is left idle for a programmable duration. The CCO shall be capable of disabling the "Auto Home" feature for a pre-defined duration.
11.3.10.2.7 Transmission Equipment for Video Communications Subsystems

The VSS shall be designed to utilize the DTS efficiently with regard to managing bandwidth. The VSS shall, as appropriate, use multicasting techniques where the same image(s) will be streamed to different devices or users.

The Developer may locate video storage required in Part 2B, Section 11.3.10.2.1.4 at one or more locations in addition to the CCF in order to optimize the utilization of the DTS.

11.3.10.2.8 Automatic External Defibrillators

The Developer shall provide Automatic External Defibrillators as described in Part 2B Section 2, Part 2B Section 4, Part 2B Section 5, Part 2B Section 11 and Part 2B Section 17. The Developer shall coordinate all required permits for the installation of the Automatic External Defibrillators.

11.3.10.3 Data Communications Delay

For audio and video communications subsystems, the worst-case end-to-end data communications delay shall be no more than one second, except as noted in the paragraph below. For all other subsystems, including Automatic Train Control, PDS, facilities fire and intrusion detection or SCADA (if provided), the nominal end-to-end data communications delay shall not exceed one second, and the worst-case end-to-end communications delay shall not exceed two (2) seconds. For the purposes of this requirement, end-to-end shall mean from point/time of origin of the event (i.e., condition detected/command initiated) to final point/time of output (i.e., alarm displayed/command executed).

Any request to establish two-way communications from a Vehicle or an emergency telephone (ETEL) shall be alarmed at Central Control within two (2) seconds in accordance with the requirements of Part 2B, Section 11.3.9.3.4. Similarly, once the CCO initiates the action to activate the communications link, the connection shall be established within two (2) seconds.

11.3.10.4 Communications Systems Redundancy

The following requirements for system redundancy shall apply to all audio, video and data communications equipment in the APM Operating System

A. Redundant transmission cables shall be provided to interconnect the communications subsystems at Central Control and the Stations, M&SF, APM Operating System substation, such that, upon failure or loss of one path or link, the transmission equipment automatically transfers to an alternate path or link.

B. The redundant transmission cables described in A above shall be physically isolated and separately routed in different enclosures to minimize the chances of a common catastrophic failure.

11.3.10.5 Software/Hardware Calendar and Time Considerations

No software provided for the APM Operating System shall be limited by calendar events that would require editing or replacement of the software and/or hardware. The hardware and software shall properly handle all date and time representations that can be expected to occur within the maximum design life of the APM Operating System.

The Developer shall provide an APM Operating System master clock. Date and time of display shall be obtained from an accurate, reliable source. The APM Operating System master clock shall be used to synchronize date and time of day information for all equipment that requires it.
11.3.10.6  Data Transmission System

The Developer shall provide a Data Transmission System (DTS) that will be utilized to transport audio, video, and data for the use by other subsystems. DTS equipment shall meet the requirements of the Structured Cabling System specified in Part 2B Section 17.4.1. DTS equipment and cabling shall, at a minimum, include:

A. Redundant core switches at each primary equipment room at the Central Control, Stations, and/or M&SF.
B. Redundant path cabling between core switch locations (e.g. routed in a ring or mesh topology), such that, upon failure or loss of one path, link, or switch, the transmission equipment automatically transfers to an alternate path or link.
C. Edge switches at each primary equipment room and at communications cabinets as needed to connect to all APM Operating System network-connected devices.

The DTS shall be designed to satisfy the communications delay requirements and redundancy requirements of the Part 2B, Sections 11.3.10.3 and 11.3.10.4. The transmission system shall provide sufficient quality, and interference-free transmission to serve Developer provided equipment in the temperature and humidity conditions of Part 2B, Section 11.3.4.1, except that, equipment in climate controlled spaces shall be rated for operation in conditions of relative humidity from ten (10) percent to eighty-five (85) percent, non-condensing.

All DTS equipment shall be powered by redundant UPS backed power supplies.

11.3.10.6.1  Network Switches

Each switch shall be sized (e.g. bandwidth, number of ports, etc.) to aggregate all connected equipment and devices plus a minimum spare capacity of 25%. Spare capacity planning shall account for the worst case failure management operating modes. Each link between core switches and between a core switch and an edge switch shall provide a minimum, bi-directional, full-duplex, bandwidth of 1 Gbps. Where multiple edge switches are connected to a core switch, redundant path cabling between edge switches shall be provided in a ring or mesh, such that, upon failure or loss of one path, link, or switch, the transmission equipment automatically transfers to an alternate path or link. Edge switches shall provide a minimum bandwidth of 100 Mbps to edge devices.

11.3.10.6.2  Network Management

All DTS network switches shall be managed switches and shall utilize industry standard management protocols such as SNMP. Core and edge switches shall employ managed Ethernet protocols to create secure VLANs, provide Quality of Service (QoS), and a guaranteed Committed Information Rate (CIR) for each device or subsystem. The Developer shall determine the appropriate CIR and QoS settings for each device and/or subsystem and shall submit this information as part of the DTS design effort to LAWA. At a minimum, traffic for the following subsystems shall be assigned to a separate and secure VPN: Automatic Train Control (if using the DTS), VoIP, VSS, SCADA, and Passenger Information Systems.

IT (non-proprietary) Network Traffic Engineering protocols shall be utilized to reliably provision, manage and respond to DTS data congestion, restore service if a link is damaged or cut and create failover paths through the DTS. The network shall be tested to pass industry standard QoS and IT Network Traffic Engineering protocols and demonstrate failover times of less than 50 milliseconds.
11.3.10.6.3 Wireless Networks

The use of wireless networks required for the safe operation of the APM Operating System shall be limited to Car-to-wayside communication only. Wireless networks shall not be used for communications where wired networks are physically possible (i.e. along the Guideway, within the Stations, and at the MS&F).

Wireless networks shall be designed in such a fashion that adding additional applications based on open and industry accepted IP network protocols shall be seamless and not require network modification, upgrade, or redesign. The wireless network shall support automatic handoff operations between adjacent wireless nodes as Cars move along the entire length of the Guideway. Any delays in the handoff between adjacent wireless nodes shall be considered in the end-to-end delay requirements as per Part 2B, Section 11.3.10.3.

The actual radiated power of each transmitter shall be equal to or less than the limits required for licensing by the FCC.

The wireless network shall also support the use of public on-board Wi-Fi access to LAWA’s existing passenger accessible network as required by Part 2B Section 17.5. The wireless network system shall support simultaneous connection for 10% of the peak number of passenger occupants. This consists of passengers onboard the Trains, queuing at the Station, and users at the pedestrian-bridges.

The wireless network at the MS&F shall provide sufficient bandwidth to automatically download all video and data from each APM Car to storage located at the MS&F. The Developer shall determine the appropriate bandwidth and procedure for transferring Car-recorded video and data to the wayside and shall submit this information as part of the DTS design audit.

11.3.10.6.4 Connection to LAWA’s Network

The connection to and integration with LAWA’s network is provided in Part 2B Section 17.4.1. The functional interface shall provide a minimum, bi-directional, full-duplex, bandwidth of 1 Gbps.

The connection to LAWA’s network shall support on board Wi-Fi access to LAWA’s existing passenger accessible network. This connection shall provide real-time public Wi-Fi access at all locations throughout the APM System.

11.3.11 Guideway Equipment

This section provides the requirements for Guideway equipment to be provided by the Developer. Guideway equipment shall be provided in accordance with the applicable sections of Chapter 11, Guideways of ASCE 21 and requirements specified herein. The Developer shall ensure that: (1) trackwork (i.e., running and guidance surfaces and appurtenances), switches, other Guideway equipment, Vehicles, construction loads and anything placed on the Guideway structure by the Developer does not overstress the Guideway structure and foundations; (2) all Developer-provided Guideway structures and equipment are correctly designed for their functions and structural loads; (3) through the design audit process and the (D/CID), all Guideway structure and APM Operating System design elements are properly interfaced and coordinated.

All Guideway equipment shall be designed for the APM System alignment using maximum length Trains. All Guideway equipment testing shall be for all Train lengths from the single Car/Vehicle unit up to the maximum length Train.

Guideway equipment shall not impede necessary access to the Guideway, other Guideway equipment, or the emergency walkway.
Guidance equipment at the ConRAC Station shall be mounted to the running surface or the primary structural deck to the roof and/or the walls as accepted by LAWA. All connections to the primary structural deck shall be coordinated through the Guideway Equipment Design Audit and the (D/CID).

Guideway Equipment and its connections/anchoring shall be designed in a manner such that the APM Operating System can initiate passenger service no more than 24 hours after a seismic event up to and including ODE levels per Part 2B, Section 11.3.4.11.

In accordance with all safety and operational requirements, Guideway equipment that requires testing, servicing, adjusting, removal, replacement, or repair shall maximize accessibility by: (1) locating items requiring visual inspection so that they can be directly viewed with removal of covers or other components, and (2) locating components requiring maintenance in such a manner as to provide direct access without removal of other components.

The design and installation techniques used for Guideway-mounted equipment shall allow for field adjustments necessary to be compatible with normal construction tolerances in the Guideway structures and maintain the proper tolerances for optimum APM Operating System performance through the life of the APM System.

All Guideway equipment described in this Part 2B, Section 11.3.11 shall incorporate all design features and equipment required to assure the capabilities of Part 2B, Section 11.3.3.6, Bi-Directional Operation and Train Orientation.

11.3.11.1 Running and Guidance Surfaces (Trackwork)

The Developer shall provide all aspects of the track, including final Vehicle running and guidance surfaces and appurtenances (including all necessary guidance equipment, such as running rails (tracks), lateral guidance rails or beam(s) and/or other devices and equipment required to guide the Vehicles while in motion), either as an attachment to the Guideway structure or as a separate structure, depending on the Developer's basic APM Operating System design. The Developer shall establish alignment, design, and construction criteria, including construction tolerances, for the track and its installation in accordance with the minimum requirements specified in this section and the design criteria for the Guideway structure. However, if additional and more restrictive trackwork installation and construction tolerances are required by the proposed technology, the Developer shall establish these installation and construction tolerances and include these requirements in its trackwork design criteria.

The Developer shall verify the accuracy of the as-constructed trackwork and other Guideway equipment by field survey, to assure that the ride quality, noise, vibration, alignment and other requirements of these Part 2B, Design & Construction Technical Requirements are met.

If the running and guidance surfaces and appurtenances are painted or otherwise coated, the coating shall ensure that adequate traction is provided for safe stopping distances and normal acceleration/deceleration. The coating shall match any other paint or coating on the Guideway in color, and shall be installed to provide complete coverage. The running surface coating and application shall ensure that it and its tractive ingredients do not spall or otherwise separate from the Guideway for at least five years. This coating shall be identified, and data describing its tractive ingredients, color, application process, manufacturing sources, locations where currently in use, maintenance requirements, and other pertinent information shall be submitted, with a sample, to LAWA as part of the Guideway Equipment Design Audit.
11.3.11.1.1 Construction Tolerances
The Developer shall construct the running and guidance surfaces to at least the following minimum construction tolerances, regardless of the degree of contact experienced during Vehicle guidance:

A. The variation in gauge of running surfaces and lateral control surfaces or structures shall not exceed ±0.125 inches.

B. The deviation in cross level of designed super elevation shall not exceed ±0.125 degrees.

C. The total horizontal or vertical deviation from the designed position shall not exceed ±0.25 inches.

D. The total horizontal deviation in passenger Stations shall not exceed 0.0 inches toward the platform edge and 0.125 inches away from the platform edge.

E. The local roughness of running and guidance surfaces shall not deviate more than 0.125 inches from a ten (10) foot straightedge.

F. If construction to these tolerances is not required for Developer’s APM System to meet all ride comfort, noise, vibration, durability, design life and related requirements of the Contract Documents, under all operating conditions in the Contract Documents, adjustments to these criteria may be considered upon the submittal and review of the following:

1) Detailed construction tolerances used on at least one currently operating APM system using Vehicles, bogies and running surfaces substantially similar to those proposed for the APM System.

2) Test results from this currently operating system verifying that all noise, passenger comfort and vibration requirements in these Part 2B, Design & Construction Technical Requirements are met using the construction tolerances proposed for use on the APM System.

11.3.11.1.2 Running and Guidance Surface Durability
Running and guidance surfaces shall be constructed to avoid surface deterioration. The Developer shall take actions to prevent surface cracks from developing in concrete running surfaces, and shall submit these proposed actions to LAWA as part of the Guideway Equipment Design Audit. All maintenance procedures required to maintain the minimum running and guidance surface conditions consistent with the structural design, ride comfort criteria, operational and safety requirements shall be identified by the Developer and included in the Maintenance Manuals for the APM Operating System in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

11.3.11.1.3 Superelevation
The Developer shall construct the Guideway structures with cross slope as required to provide for Guideway drainage.

Superelevation values and curve radii shall be determined by the Developer for each horizontal curve such that the lateral acceleration limits (parallel to the Vehicle floor) specified in Part 2B, Section 11.3.7.6.3 are satisfied at any speed from zero up to the maximum speed for the curve, including the effects of Vehicle roll about its longitudinal axis. Actual super elevation in curves shall not exceed 6 percent. Lower super elevation limits may be imposed on certain curves within the alignment due to transition length restrictions imposed by technology and site constraints. Super elevation transition (run-out) shall occur uniformly, only in the length of spiral transitions.
11.3.11.1.4 Reserved
11.3.11.2 Reserved
11.3.11.3 Overtravel Buffer

The Developer shall provide end-of-track overtravel buffers at every Guideway terminus on the passenger-carrying parts of the APM Operating System to prevent a maximum length Train from leaving the Guideway in the event all braking systems of the Train fail. Buffers shall not include any active control elements. Buffers shall stop and retain one AW2-loaded maximum length Train traveling at the maximum speed for which the APM Operating System can be operated manually. Buffers shall also meet the requirements of Part 2B, Section 11.3.7.4.5.2.

In the M&SF or other non-passenger-carrying parts of the APM Operating System, end-of-track overtravel buffers shall be provided to stop and retain two AW0-loaded maximum length Train traveling at the maximum speed at which a Train can be manually operated, without any damage to the Train.

11.3.11.4 Wayside Equipment

The Developer shall provide any required cable trays, wireways, conduit, and equipment enclosures to be mounted along the Guideway for power distribution, Automatic Train Control, communications, or other subsystems. Conduit shall conform to NFPA 70 for specific types of locations.

The Developer shall submit the locations, installation and aesthetic treatment of this wayside equipment to LAWA as part of the Guideway Equipment Design Audit.

The Developer shall define its requirements for propulsion feeder wire/conduit installation, including that between the Power Distribution System substations and the power rails, and the location and aesthetic treatment of this wayside equipment, in the APM Operating System Power Distribution System Design Audit.

11.3.11.5 Barriers and Fences

The requirements of Section 11.2, Intrusion Protection and Detection of ASCE 21 shall apply.

The Developer shall ensure that the Guideway, emergency walkways, and other Guideway equipment preclude access by unauthorized personnel.

11.3.11.6 Switching

Guideway switches shall be provided and installed by the Developer to enable the APM Operating System to operate as specified in Part 2B, Sections 11.3.1 and 11.3.3. Switches also are required in conjunction with the M&SF, departure test track, and storage areas. Switch locations are shown in the Part 5, Contract Drawings/Engineering Data. The Developer shall submit switch information including proposed final switch locations, switch operations, reliability, and design information to LAWA as part of the Guideway Equipment Design Audit.

Switches shall comply with the construction tolerances and adjustment ranges specified in this Part 2B, Section 11.3.11.

11.3.11.6.1 General Requirements

Switching may be performed by onboard equipment, in-Guideway equipment, or a combination. It shall be possible to operate Trains through all switches in either travel direction.

Spiral transitions are not required for switches, provided the ride comfort requirements of Part 2B, Section 11.3.7.6.3 are met. Speed reduction is permissible while traversing switches, provided travel time requirements of Part 2B, Section 11.3.3.1.4 are satisfied.
An indication of the switch aligned and locked status shall be provided at all entrances to each switch either on the wayside or the Vehicle manual control panel. A status indication of onboard switching equipment shall be provided on the Vehicle manual control panel. Switch status indications shall also be provided at Central Control.

Switch operation, including speed of movement and reliability, shall meet the APM Operating System operational and APM OS Availability requirements of Part 2B, Sections 11.3.3 and 11.3.6. The Developer shall provide switches that permit full APM Operating System operation in all environmental conditions of Part 2B, Section 11.3.4.

Switches used for normal passenger service operations shall be proven by duty cycle tests of one million cycles, or by prior installation and operation for a comparable time at a similar system, before their installation in the APM Operating System. For the purpose of this test, a cycle shall be defined as: unlock, move, lock (in opposite position), unlock, move (return to the initial position) and lock again.

11.3.11.6.2 Basic Principles for Switching

All switching systems shall comply with the following principles:

A. Any switching mechanism(s) with powered actuation, either on the Vehicle or in the Guideway, must comply with the following:
   1) The switch must be set in a position corresponding to the commanded position;
   2) The power must be removed from the mechanism; and
   3) A mechanical lock must be in position.

B. All of these conditions must be verified through continuous locking detection and point detection before the approaching Train reaches a position less than a safe separation assurance distance (Part 2B, Section 11.3.9.1.2) from the diverging or converging switch point. Loss of electrical power to the switch shall not cause any change of switch status and the mechanical lock shall remain in position. As long as the switch verification, including locking detection and point detection, is continuously received, the Train may proceed normally through the switch. "Continuous" shall include monitoring of a repetitive nature that accomplishes the same function. If a repetitive signal is used, the time between repetitions must be considered in block length or safe stopping distance calculations. If switch verification as defined above is not received, the ATP subsystem shall ensure that approaching Trains stop before reaching the switch. If switch verification is lost while a Train is in the switch zone, the ATP subsystem shall emergency brake that Train immediately. Brake reset shall be by remote command from Central Control or locally onboard the Vehicle. Switch verification and its use, and all other actions of the Automatic Train Control system relating to the safe operation of switches, shall satisfy the interlocking requirements of Part 2B, Section 11.3.11.6.3 and Part 2B, Section 11.3.11.6.5.

C. Non-powered, onboard guidance mechanism(s) shall satisfy at least one of the following conditions:
   1) They must be set and locked in the commanded position and must meet all of the conditions specified in Part 2B, Section 11.3.11.6.2.A.
   2) They and the Guideway must be so designed that the onboard mechanism(s) is positively entrapped by the Guideway mechanism.
throughout the length of the switch in a safe and reliable manner so that the Train must follow the intended route.

D. All elements of the switch control system shall be in accordance with the safety principles and Automatic Train Control system fail-safe design requirements of Part 2B, Section 11.3.5.1.1.

11.3.11.6.3 Mechanisms

All switching mechanisms shall provide continuous, positive guidance to Trains as they are traversed, with minor exception for proven special trackwork components where loss of positive guidance may be momentary. Loss of positive guidance by entering, from any direction, a switch aligned to either Guideway route shall not be possible. All switching equipment, whether part of the Vehicle or the Guideway, shall meet the relevant design loads criteria of Section 7.4.4.1, Design Loads of ASCE 21.

Switches that operate during any of the APM Operating System operating modes or during a transition between operating modes shall be fully automatic. Power-actuated switch mechanisms shall be operated by electric, hydraulic, or pneumatic actuators. To minimize noise, hydraulic equipment shall be insulated or encapsulated and any pneumatic exhausts shall be muffled.

All switches shall meet the following interlocking requirements:

A. Alignment Detection - A means shall be provided to detect that the main element(s) of the movable portion of the switch is at either end of the physical displacement it undergoes during actuation. For purposes of this section, these positions shall subsequently be called the tangent and turnout positions.

B. Actuating Power Removal - A means shall be provided for removing power from the switch actuator.

C. Mechanical Locking - A means shall be provided to mechanically lock the position of those switching elements that directly interact with the Train and Guideway to cause the switching of the Train, and that move to change the state of the switch from tangent to turnout. This means of locking shall keep the switch safely locked under the full force of a moving Train in the switch and the full force, in either direction, of the actuator. A means shall also be provided to remove power from the mechanical lock after its actuation is completed.

D. Locking Detection - A means shall be provided to detect that the switch mechanical lock is in the locked position. The position of the lock shall be sensed directly from the lock itself. Detection of the lock in the locked position shall ensure the switch is locked.

E. Point Detection - A means shall be provided to detect that each switch point on any switch whose accurate positioning is essential to safe initiation of the switching interaction between Train and Guideway and that moves to change the state of the switch, is positioned with sufficient accuracy to ensure safe travel through the switch.

11.3.11.6.4 Manual Operation

All switches shall allow for local manual operation without normal switch activation power. Switches shall be manually operable by one person. Manual activation equipment shall be secured and locked to prevent unauthorized use.

A power disconnect device shall be provided to enable maintenance personnel to disconnect and lock-out power to the switch and prevent switch actuation.
11.3.11.6.5 Switching Safety

Switch interlocking protection shall be provided in accordance with the requirements of Part 2B, Section 11.3.9.1.12.

11.3.11.7 Aesthetics, Protection, and Drainage

All Guideway equipment, walkways, conduits, wiring, signage and other items along the Guideway shall be designed and installed to present a visually appealing, non-cluttered appearance, and to minimize the collection of debris. All such equipment shall be hidden from view from below and along the sides of the Guideway and shall match the Guideway aesthetically.

All metal surfaces, except running rails and others on which there is frequent friction, shall have corrosion protection in accordance with Part 2B, Section 11.3.14.

All Guideway equipment designs shall minimize surface joint conditions. Connections shall be detailed to prevent accumulation of water and debris. Surfaces shall be caulked with an appropriate and compatible epoxy material to seal out moisture and air. Round or tube type steel sections with continuous seal welds shall be used instead of channel or wide flange sections. Edges of steel members shall be rounded to a 1/16th inch radius curve.

Guideway equipment that requires painting for corrosion or other protection, or for aesthetic reasons, shall be painted a color that harmonizes with the Guideway. Painting shall meet the requirements of Part 2B, Section 11.3.14.4.1.2. The list of Guideway equipment to be painted, the color to be used, and the proposed painting process shall be submitted to LAWA for acceptance as part of the Guideway Equipment Design Audit.

All nuts, bolts, washers, screws, and connectors shall be galvanized. Dissimilar metals shall be insulated to prevent galvanic corrosion. Should damage occur to the galvanic coating during installation, the Developer shall replace or repair the coating.

Guideway drainage shall be provided in accordance with Section 11.8.3, Drainage of ASCE 21. Guideway equipment shall allow moisture to drain from its surfaces and shall not impede or restrict any drainage flow patterns established in the basic design of the Guideway. Water draining from Guideways shall not cause harm to persons or property below or beside the Guideways. The Developer's Guideway drainage components shall be connected to the Guideway structure drainage facilities. All interface requirements shall be included in the Guideway Design Audit as well as the (D/CID). The Developer's Guideway drainage components and similar appurtenances shall be concealed from view from below and from the sides of the Guideways. Any Developer-provided Guideway drainage downspouts shall be embedded in Guideway columns or similarly hidden from public view.

The visual appearance of Guideway equipment shall be included in APM Fixed Facilities Design Audit Submittal of Part 2B, Section 11.4. In addition, the visual appearance of Guideway equipment shall be included in BIM visualization packages per Part 2B, Section 16.

11.3.11.8 Emergency Evacuation

The APM System Guideway emergency evacuation and access shall be designed in accordance with Section 11.3 Emergency Evacuation and Access of ASCE 21, except that an emergency walkway shall be provided.

11.3.11.8.1 Emergency Walkway

The Developer shall design, provide, and install a separate emergency walkway along the entire Guideway length in accordance with the requirements of Part 2B, Section 11.3.5.1.6, this Part 2B, Section 11.3.11.8.1, and associated requirements of NFPA 130.
The emergency walkway shall be continuous through switches and other Guideway elements that would act as barriers. If switches or any Guideway equipment create an unavoidable barrier, the Vehicle design and barrier shall still provide unimpeded egress to the emergency walkway, and egress facilities to the ground or a bypass walkway shall be provided so that there are no dead ends to the emergency walkway. These egress or bypass facilities shall not permit unauthorized access to the Guideway, and the use of any exit door, gate or other suitable exiting mechanism shall be alarmed at the CCC. Access to Stations and other egress points shall be controlled in accordance with Part 2B, Sections 11.3.11.5, 11.3.12.1.1 and 11.3.12.1.1.3.

The emergency walkway and any associated railings shall satisfy the clearance requirements specified in Part 2B, Section 11.3.7.1.2, unless LAWA accepts a design that includes using the unobstructed Guideway or running surface in conjunction with a refuge area.

The Vehicle dynamic envelope (see Part 2B, Section 11.3.7.1.1) operating along the Guideway(s) adjacent to the walkway shall leave a clear cross sectional envelope at least thirty-two (32) inches wide for a forty-four (44) inch wide walkway and at least thirty (30) inches wide for a thirty (30) inch wide walkway to a height of six (6) feet, eight (8) inches above the walkway surface. The walkway shall be at approximately the Vehicle floor height. The maximum vertical distance between the Vehicle floor and walkway surface shall be less than six (6) inches under both normal and worst-case Vehicle suspension failure conditions, except at crossover locations, or where Vehicle clearance precludes this dimension. The gap between the Vehicle emergency door threshold and the emergency walkway shall not be greater than twelve (12) inches except in curves where the minimum feasible gap shall be maintained. The Developer shall provide the emergency walkway including handrails and/or guardrails as required by the AHJ.

The walkway shall be designed for a minimum live load of 100 pounds per square foot. The walkway shall provide a solid concrete walking surface. Open grating is not acceptable. Wooden structures are not acceptable.

The emergency walkway shall provide both visual and tactile indications of the walkway edges to passengers on the walkway. The emergency walkway and all appurtenances shall be insulated from power rails and other Guideway power and shall not present an electrical safety hazard.

Emergency lighting all along the walkway shall be provided by the Developer in accordance with Section 11.6, Emergency Lighting and Ventilation of ASCE 21. Emergency lighting shall be controlled from the CCC, and shall provide a minimum of 0.25 foot-candles over the entire emergency egress route, including the walkway surface, and 2 foot-candles at all locations of a walkway discontinuity in elevation or direction. Lighting shall illuminate the walkway and not shine directly into the eyes of evacuating Section passengers.

The walkway shall have signage in accordance with Part 2B, Section 11.3.11.9.

The design of the emergency walkway shall be submitted as part of the preliminary and final Guideway Equipment Design Audits.

In addition to the above requirements, the Developer shall provide three emergency access points designed to allow LAWA fire department personnel access to the emergency walkway. One of those access points shall allow access from the roadways below using their ladder trucks. The access points shall be equipped with either a hatch or swing gate or other means of emergency access depending upon the Developers technology and guideway design. The access points shall be located where the guideway crosses over 98th Street and the new A Street; This access point shall be equipped with Blue Light stations in accordance with Part 2B, Section 11.3.8.1.3.2, Blue Light Stations and shall be equipped with intrusion detection devices that are to be interlocked with the ATP system of the Automatic Train Control System in accordance with Part 2B, Section 11.3.5.2.1, Facilities Security. The Developer shall provide all necessary access
control for these emergency access points including ACAMS, AOA fencing, and CCTV monitoring at these locations. Additional requirements for ACAMS are provided in Part 2B, Section 17.4.3. Refer to Part 5 Contract Drawings/Engineering Data for the general locations.

### 11.3.11.9 Signage

The Developer shall provide all signage along the Guideway and in the adjacent right-of-way for the following functions in accordance with Section 11.5, Signage of ASCE 21 and the additional requirements of this Part 2B, Section 11.3.11.9. Additional signage shall be provided as follows:

- **A.** To provide warnings and for passenger and operations and maintenance personnel safety.
- **B.** To facilitate maintenance, failure management (see Part 2B, Section 11.3.9.3.2.1.B.1) and manual Vehicle operations, such as: power zone and Automatic Train Control block (if used) boundaries, Station stopping points, and switch zones.
- **C.** To identify communication devices located along the Guideway.
- **D.** In lieu of the referenced ASCE standard requirement, signs for directions to emergency exits and location information shall be provided on and visible from the Guideway at intervals of no more than every 100 feet.

Signage shall comply with ANSI Z535.1 through Z535.5. Proposed signage shall be submitted as part of the Guideway Signage Plan in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

### 11.3.12 APM Operating System Station Equipment

This Part 2B, Section 11.3.12 addresses Station facilities Work and equipment that is the responsibility of the Developer, including its relationship to Related Projects. The Developer shall be responsible for all necessary coordination with APM Fixed Facilities work and Related Projects and this coordination shall be in accordance with Exhibit 10 of the DBFOM Agreement. The APM Stations, with the exception of the ConRAC Station, are provided as part of the APM Fixed Facilities by the Developer. The ConRAC Station will be provided as Related Projects. APM Fixed Facilities Requirements are provided in a separate section of the Contract Documents.

The Developer shall provide all Station-related components necessary for Train operations and certain components necessary for passenger handling at all Stations in accordance with Chapter 10, Stations of ASCE 21, this Part 2B, Section 11.3.12 and the Part 5, Contract Drawings/Engineering Data.

#### 11.3.12.1 APM Operating System Station Components

The Developer shall design, furnish and install components as set forth in this Part 2B, Section 11.3.12.1.

#### 11.3.12.1.1 Station Safety Components

The Developer shall design, furnish and install all Station safety devices as described in this section.

#### 11.3.12.1.1.1 Platform Edge Safety Protection

Platform edge barrier walls and Vehicle-to-platform coordinated barrier wall doors (platform doors) shall be designed and provided in accordance with Section 10.2.1, Intrusion Prevention System of ASCE 21 for the full length of the platform edge as shown on the Part 5, Contract Drawings/Engineering Data, to separate passengers on the platform from the Guideway. The
Platform doors, breakaway panels, and all associated appurtenances as required for safe operation of APM Operating System, shall be provided by the Developer.

Platform doors shall open automatically and in coordination with Train doors and shall allow passengers to board all Vehicles of up to a maximum length Train whose doors are properly aligned with the platform doors in accordance with Part 2B, Sections 11.3.9.2.1 and 11.3.9.2.2. They shall have an opening width wider than the Vehicle doors to accommodate Train stopping accuracy variations and to preclude infringement on the minimum door width used for egress specified in Part 2B, Section 11.3.7.10.1. Vehicle stopping positions are shown in the Part 5, Contract Drawings/Engineering Data.

All Station platform doors shall be installed and fully operable as part of the APM System so as to accommodate maximum length Trains. Dynamic signs shall be provided in accordance with Part 2B, Section 11.3.12.1.2.1 and shall indicate if a door is operational or not.

The platform door system shall be able to function based on desired berthing locations at each Station in accordance with Part 2B, Sections 11.3.3.2 and 11.3.9.3.3.1.

All equipment located at open air Station platforms shall be weather resistant to corrosion and moisture. Equipment within the headers over the platform doors shall be protected from precipitation.

The barrier wall structure, headers, and non-door wall sections at the ConRAC Station will be provided as Related Projects in which the Developer shall install platform doors, breakaway panels and other APM Operating System equipment as required. Platform wall interfaces with platform doors and other APM Operating System equipment as required shall be coordinated with the ConRAC design team.

Barrier walls and doors shall be glazed and consistent in finish and quality of materials as the Station architectural cladding/finishes and subject to LAWA’s acceptance. The glazing shall be single pane, free of visual distortions, laminated, tempered safety glass. All glazing shall minimize external glare as well as reflections from inside the Station. The glass shall comply with the requirements of Section 10.2.1, Intrusion Prevention System, Item 3 of ASCE 21. Glass shall be tinted a neutral color that is complementary to the Station design and colors. Light transmittance through the windows shall be sufficient for the Station interior to be visible from the Vehicle given Vehicle and Station lighting. All glass and doors shall be easily replaceable without disturbing adjacent glass or doors. All frames and hardware shall be stainless steel or anodized aluminum. Door threshold plates shall be at the same level as the platform floor. The platform doors shall be aesthetically coordinated with Station barrier walls. The door opening mechanisms shall not be visible.

Barrier walls and doors shall be provided with protective shields/guards to limit damage to the doors from baggage carts. These shields/guards shall also be consistent with the architectural cladding parts of the Station.

Cladding products and product assemblies must resist the applicable wind pressures and meet all applicable standards. Platform door operation, including at least door open commands, dwell, door close commands, and door recycling, shall be controlled by the ATO subsystem as described in Part 2B, Section 11.3.9.2.2. Vehicle doors and platform doors shall be interlocked to prevent opening until all conditions for door opening have been satisfied (see Part 2B, Section 11.3.9.1.8). The platform doors shall meet the safety and performance requirements specified for the Vehicle doors in Part 2B, Sections 11.3.7.10.2, 11.3.7.10.3 and 11.3.7.10.4.

Station platform doors shall be designed with a “non-contact” door obstruction detection system as the primary door obstruction detection system. An option shall be provided to locally disable
the non-contact system for ease of maintenance and trouble shooting. Sensitive edges shall be provided as a secondary means of door obstruction detection. The sensitive edge system shall be active at all times including when the non-contact system is enabled. The non-contact door obstruction detection system shall be subject to acceptance by LAWA.

Corresponding Train and Station platform doors shall be operated as a set for all normal and recycling operations.

Platform doors shall be manually operable without electric power to permit opening of the doors from the Guideway/Train side in the event of a door activator malfunction. The procedures for this manual operation shall be clearly marked on the door. A means shall be provided to permit manual opening of the platform doors from the Station platform side, whether a Train is present in the Station or not. This control shall be located in a locked panel or otherwise secured from operation except by authorized personnel, and it shall permit manual door opening independent of platform door power sources. Manually opening a Station platform door shall result in the facility door detection and response requirements specified in Part 2B, Section 11.3.9.1.7.

Provisions for evacuation from a Train misaligned with the Station platforms shall be provided in accordance with Section 10.3, Evacuation of Misaligned Trains of ASCE 21. Emergency doors used for this purpose shall meet the same requirements as the platform doors as specified in the previous paragraph.

Station platform edge barrier walls and doors, if intended to serve as a fire barrier, shall comply with the requirements of Section 10.5.2, Fire Containment of ASCE 21, except that the Hazard Identification, Analysis and Resolution Process of Part 2A, Section 8.2.2 shall be used in lieu of the hazard analysis cited in the ASCE reference.

It shall be possible for authorized personnel to access the interior of each Car of a Train at any location along the Guideway. At Stations, auxiliary egress doors or gates shall be provided in the barrier wall for the ready access of authorized personnel from the Station lobby to the interior of each Car for any possible Train misalignment. These auxiliary egress doors shall include key locks on the Station platform side to prevent unauthorized access. The opening of any auxiliary egress door shall result in the facility door detection and response requirements specified in Part 2B, Section 11.3.9.1.7.

In accordance with Section 10.2, Platform Edge Protection of ASCE 21, for any condition where passengers can extend limbs or digits through windows or other openings of the Vehicle, the means of platform edge protection shall be analyzed for any hazards in accordance with the Hazard Identification, Analysis and Resolution Process specified in Part 2A, Section 8.2.2.

11.3.12.1.1.3 Station Emergency Walkway Doors or Gates

There shall be doors or gates for safe egress from the Guideway emergency walkways. Any doors or gates shall be of stainless steel, designed, furnished and installed by the Developer. All emergency doors or gates provided by the Developer or others shall be locked by the access control subsystem (see Part 2B, Section 11.3.5.2.1.2) and have both local and remote alarms, but shall be openable from the Guideway side using panic hardware. All such doors or gates with access to the Guideway shall be monitored and alarmed by the Developer. Opening any Station emergency walkway door or gate shall result in an alarm being sent to Central Control. If any
emergency door or gate is unlocked and/or opened without CCO authorization, it shall be treated as an unscheduled door opening in accordance with the requirements of Part 2B, Section 11.3.9.1.7.

In addition, the Station emergency walkway doors shall remain locked under the air and wind pressures for which the APM Operating System is designed.

11.3.12.1.1.4 Emergency Guideway Power Shut-Off Switch

See Part 2B, Section 11.3.8.1.3.2 for blue light stations.

11.3.12.1.1.5 Door Alarms and Security Equipment

Doors between public and non-public areas of the Stations shall have locks in accordance with the requirements of Part 2B, Section 11.3.5.2.1. Intrusion alarm security equipment shall be provided as specified in Part 2B, Section 11.3.5.2.1.1 and Part 2B, Section 11.3.9.3.4.2. All exterior doors and normal public entrance gates shall have such locks and alarms. The Developer shall furnish and install all intrusion alarm security equipment. The Developer shall coordinate the design, location, and installation of these security components with LAWA.

11.3.12.1.1.6 Fire/Smoke Detectors and Alarms

Refer to Part 2B, Section 17 MEP and Fire Protection for non-ConRAC Stations; ConRAC Station fire protection shall be coordinated with the ConRAC design team.

11.3.12.1.1.7 Refuge Area

The Developer shall provide a refuge area under and along the platform edges for a person who is on the Guideway to use to get out of the path of a Train. The Guideway and Station equipment in the platform area shall permit easy access to this refuge area, and shall not obstruct its use. If such refuge area is not feasible, Developer shall provide appropriate mitigation including multiple blue light stations along the trainway to facilitate the return to safety of a person on the Guideway. Developer shall submit requirements as part of the DC/D and coordinate refuge area design and construction at the ConRAC Station with the ConRAC team.

These refuge areas shall allow unconstrained access from the Guideway to the Station platform level emergency doors. Such doors shall satisfy all of the requirements of Part 2B, Section 11.3.12.1.1.3.

11.3.12.1.2 Station Passenger Information

Platform Train arrival/departure and other audible and visual announcements shall be provided by the Developer as defined herein. These audible and visual announcement subsystems shall provide sufficient information to passengers to guide them in the correct and efficient use of the APM System.

11.3.12.1.2.1 Station Dynamic Signs

A system of dynamic Station signs shall be designed, furnished, and installed by the Developer. The dynamic element of the signs shall consist of LED backlit LCD displays or other media having equivalent readability (size in accordance with ADA/LAWA requirements) and reliability as accepted by LAWA. Display modes shall include, at a minimum: steady; flashing; and scrolling right, left, up and down. These signs shall be enclosed in a weather and vandal resistant housing.

The dynamic signs shall be suspended from the Station canopy or ceiling designs and installations of the APM Fixed Facilities or Related Projects or incorporated in the platform edge barrier walls over the Train boarding doors. The Developer shall propose locations for the dynamic signs as part of the Station Equipment Design Audit.
In addition to the dynamic signs within the Stations, one dynamic sign shall be installed near each entrance to each Station and at passenger decision points between each entrance and each platform. These signs shall be visible to entering passengers. These signs shall inform passengers of the status of that Station and provide any other important APM Operating System-related information. These signs shall be identical to the platform dynamic signs, except for being single sided.

In the APM Operating System, a dynamic sign shall be provided for each installed doorset. For the APM Operating System, the dynamic signs shall indicate which platform doors are active and which are inactive, and direct passengers to the active doorsets.

Each dynamic sign shall be individually controlled by the Automatic Train Control system, which shall automatically activate pre-recorded messages for each sign applicable to the APM Operating System’s operating mode, Station status, and Train routing. The dynamic sign system shall include the ability to change the pre-recorded messages from the CCC and to compose new messages at the CCC keyboard. The message memory capacity of the system shall be not less than three (3) times the requirement of the APM System in order to accommodate future APM Operating System requirements.

The dynamic sign system shall be capable of playing video content in one or more industry standard formats such as .mov, .mpeg, or .avi on all dynamic signs located in the station and on the vehicle. Video content shall be capable of repeating on a sequential rotation such as repeating continuously or repeating on a fixed time duration. All message types including video shall be capable of being assigned a message priority level. There shall be a minimum of five (5) priority levels such that higher priority messages override, pause, or stop lower priority messages. In order to accommodate future APM Operating System requirements, the message memory capacity of the system shall be not less than three (3) times the requirement of the APM System plus two (2) hours of 1080p resolution video content.

Messages displayed initially by the dynamic signs shall include all APM System operating modes and operating and Station status conditions.

A. The platform sign messages shall include, at a minimum:
1) The direction and major destination(s) served by each Train;
2) Time until the next Train arrival on a platform;
3) Inactive platform(s);
4) Train out of service or going out of service;
5) Clock time;
6) Special instructions; and
7) Warning messages indicating the imminent commencement of door closing.

B. The dynamic sign system shall include the following equipment:
1) Complete sign units, consisting of LED backlit LCD displays or other elements as accepted by LAWA arranged in 4-inch minimum height;
2) All necessary electronic interfaces;
3) Sign housings and mountings as accepted by LAWA, including any associated static messages;
4) Any necessary devices such that the view is not impaired by glare;
5) All control and power wiring necessary for their operation; and
6) Dynamic sign system design, software, fabrication, installation, test, check-out and demonstration.

The design of these signs and their messages shall be included in the Station Dynamic and Static Signage Plan submitted to LAWA for acceptance in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

11.3.12.1.2.2 Station Static Signage

Refer to Part 2B, Section 2 APM Stations for non-ConRAC Stations; ConRAC Station static signage shall be coordinated with the ConRAC design team.

11.3.12.1.2.3 Station Arrival/Departure Announcements

The Developer shall supply and install, on each Station platform, automatic audible and visual warnings that signal the arrival and departure of Trains. The arrival warning shall be made ten seconds before the Train enters the Station. The departure warning shall be made approximately four seconds before doors begin to close and shall be communicated to passengers both in the Trains and on the platform. APM Operating System routes having Trains operating over more than one destination from the same platform shall also audibly and visually announce the Train’s route and/or destination. Such visual announcements may be made by dynamic Station signs on the platform or by the Vehicle dynamic signs, provided that the message is also posted on the exterior of the Train and can be read by passengers on the platform. Voice announcements shall be in the languages specified in Part 2B, Section 11.3.1.4. Each platform side shall have a unique message to differentiate it from the opposite side and indicate the direction and destinations of the Train arriving or departing.

11.3.12.1.3 Public Address System

The Developer shall design, furnish, and install the public address subsystem of Part 2B, Section 11.3.10.1.1 and Part 2B Section 17.8. The public address subsystem speakers shall be attached to and integrated within canopies, walls or finish installations of Related Projects or APM Fixed Facilities. The Developer shall coordinate connection and installation of the public address subsystem components with LAWA.

11.3.12.1.4 Video Surveillance System

The Developer shall design, furnish, and install the Video Surveillance equipment of Part 2B, Section 11.3.5.2.1.3 and Part 2B, Section 11.3.5.10.2. The Video Surveillance cameras shall be attached to and integrated within canopies, walls or finish installations of the Related Projects or APM Fixed Facilities. The Developer shall coordinate connection and installation of Video Surveillance components with LAWA.

The System-wide design for the Video Surveillance system components with concealed and exposed applications shall be developed by the Developer as part of the Communications System Design Audit.

11.3.12.1.5 Emergency Telephone System

The Developer shall design, furnish, and install the Station emergency telephones (ETELs) in accordance with Part 2B, Section 11.3.10.1.2.1.

Station platform ETELs shall be attached to and integrated with the platform edge barrier walls.

The Developer shall coordinate connection and installation of all such communications equipment at the ConRAC Station with LAWA.
11.3.12.1.6 Station UPS Equipment

The Developer shall design, furnish, and install the uninterruptible power supply (UPS) equipment and components of Part 2B, Section 11.3.8.2.1, the communication systems identified in Part 2B Section 17 in addition to any other loads required to ensure User safety, fire life safety and ADA compliance. The Developer shall coordinate connection and installation of ConRAC Station UPS equipment and components with ConRAC design team.

11.3.12.1.7 Passenger Counting System

The Developer shall provide and install an automatic passenger counting system (APCS) to count, record, and report the number of passengers boarding and deboarding at each Station berth. The APCS shall provide LAWA-specified reports as described below.

The APCS shall include all required counting equipment, electronic interfaces, wireless communication equipment and software, mountings, cabling and wiring. The APCS may be comprised of electronic sensors, passive infrared detectors, optical detectors, CCTV software and associated cameras, and other software and systems that will measure and record the number of passengers to the specified level of accuracy. The APCS shall confirm both the opening and closing of Station doors and Vehicle doors such that the boardings and deboardings at each individual Station stop can be distinguished and discretely reported. Passenger counting systems based on Station occupancy or changes in Vehicle weight (such as "load-weight" systems) shall not be used to determine passenger counts. Sensors and other equipment, whether located on Vehicles or located on Station platforms, shall be aesthetically integrated into the platform environments; shall satisfy the temperature and humidity, electronic compatibility, lighting, corrosion, solar, and contaminant environment requirements of Part 2B, Section 11.3.4; and shall be tamper proof and vandal resistant. The APCS shall be powered by the UPS.

The APCS data shall automatically record and report passenger boarding and deboarding information, flow patterns and Vehicle occupancies as specified by LAWA. The APCS shall provide LAWA-specified reports of passenger flow patterns for ranges of times such as hourly, daily, weekly, and monthly. The APCS shall sort historical count data by time of day, date and specific location, including Station berth. Data shall be available for exporting and selective display in both tabular and graphical format on a monitor in the CCF workstations and other locations specified by LAWA.

The APCS shall be designed and installed with redundant data storage such that a disruption of communication to, from or within the APCS of up to 24 hours shall not result in a loss of data. In the event of disruption to data transmission, the stored data shall be uploaded when data transmission is restored. The review and analysis of stored passenger data shall not require proprietary software and shall not interfere with any other APM functions.

All aspects of the APCS shall be submitted as part of the Station Equipment Design Audit.

During the design audit the Developer shall describe the Developer’s testing and calibration processes to demonstrate at least a 95% accuracy of the APCS under the worst-case lighting occurring at the Station platforms. An independent or manual method of measurement based on the expected passenger volumes shall be used during the validation process to compare counts between the automatic passenger counting system and the means of verification. At the design review, the Developer shall propose its verification process.

The 95% accuracy of the APCS shall be the absolute value of the difference between the count from the APCS and the count by an independent means, such as manual counting. The difference shall be less than 5% of the total number of observed passengers for both boarding and deboarding passengers at each berth.
The APCS functionality shall be demonstrated at all passenger counting equipment locations. The APCS accuracy shall be demonstrated at a minimum of 50% of passenger counting equipment locations.

As part of the design review, the Developer shall describe the following:

A. How the sensors detect passengers, how sensor data is collected and processed to estimate counts;
B. How counts are correlated to passenger direction (boarding or deboarding), Vehicle location, direction of travel, and time of day;
C. How non-passenger items are distinguished and not counted;
D. How data is redundantly stored to avoid loss;
E. How the opening and closing of doors are confirmed;
F. How data is transmitted from the Station equipment to a central storage and processing location;
G. How data is compiled, organized and analyzed, including a description of the software being used;
H. The type of reports that are generated, including visual representation of current and historical data;
I. How data is stored for long term storage;
J. System interfaces and capabilities to communicate to other systems;
K. Alarm reporting and fault reporting; and
L. Maintainability Requirements.

11.3.12.2 APM Operating System Equipment Room

An APM Operating System equipment room at the ConRAC Station to house the Developer's Automatic Train Control, public address, Video Surveillance, telephone, alarm system, UPS, Gun Shot Detection System and other APM Operating System equipment. The room is depicted schematically in Part 5, Contract Drawing/Engineering Data. The Developer shall be responsible to finish out these rooms.

The Developer shall coordinate the design of, use of, structural, environmental and spatial requirements for, and electrical and communications connections to these rooms with LAWA starting with the (D/CID) (see 11.3.17.1.9 for interface requirements), and as part of the related equipment Design Audits. The Developer shall define Station equipment locations at all Stations as part of the Station Equipment Design Audit.

Developer-supplied equipment surfaces and installations in rooms at all Stations housing UPS and battery equipment shall be acid-resistant.

The Developer shall provide standard safety equipment and ventilation consistent with the type of UPS equipment provided at all locations of UPS equipment.

The Developer shall provide any necessary supplemental fire protection and/or suppression system for their specific design. Intrusion protection per 11.3.5.2.1.2 shall be provided.

11.3.12.2.1 Electrical

Electrical service for APM Operating System Station equipment room housekeeping power (i.e. lights, convenience outlets, etc.) at the ConRAC Station to meet the Developer's APM equipment related heat loads will be provided by LAWA as part of the Related Projects. Electrical service
for the Developer’s UPS and HVAC to support essential APM Operating System equipment in the Station APM Operating System equipment rooms shall be provided by the Developer. The Developer shall describe specific requirements to LAWA through the APM Operating System Station Design Audit and the (D/CID). The Developer shall be responsible for all distribution and connection of power within the ConRAC APM equipment room.

11.3.12.2.2 HVAC
The Developer shall be responsible as part of the Developer’s finish-out work for coordination of the specific HVAC requirements at the ConRAC Station. Developer shall provide a separate redundant HVAC system for the Central Control, APM equipment rooms and other Station locations used to house Automatic Train Control, public address, Video Surveillance, telephone, alarm system, UPS and other APM Operating System equipment in the event of failure of the primary HVAC service.

11.3.12.2.3 Fire Protection
The requirements of Section 10.5, Fire Protection of ASCE 21 shall apply.

11.3.13 APM System Maintenance Facilities and Equipment
This section addresses Maintenance and Storage Facility (M&SF) requirements, general maintenance functions, and maintenance equipment requirements. The M&SF shall be located and generally configured as shown in the Part 5, Contract Drawings/Engineering Data. The division of responsibilities for the M&SF is delineated in this Part 2B, Section 11.3.13 and Part 1, Scope of Work.

The M&SF shall be the location of all scheduled repair and maintenance required by the Vehicles and other APM Operating System equipment. Provisions shall be made for all functions and areas required by this section.

All necessary maintenance equipment shall be provided by the Developer for all inventory control, maintenance scheduling, maintenance management information processing, servicing, cleaning, inspection, troubleshooting, and repair of all APM Operating System equipment. This shall include all maintenance computer systems, test equipment, equipment test fixtures, and standard and special tools. In addition, the Developer shall provide equipment for inventory storage and handling of all materials, spare parts and equipment, consumables, and expendables required for APM Operating System operations and maintenance.

All APM Operating System maintenance shall be carried out in accordance with the Developer's APM System Maintenance Plan and APM Operating System Maintenance Manuals.

The Developer’s detailed plan to use this facility, including, at a minimum, finish-out, furnishings, use of the immediately adjacent areas, access routes, and operations and maintenance activities, shall be submitted as part of the APM Operating System M&SF Equipment Design Audit.

All operational and informational signage and graphics in the M&SF shall be furnished by the Developer. These signs shall be included in the M&SF Signage/Graphics Plan submitted in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

All communications equipment within the M&SF, including telephones, public address subsystems, and maintenance radios (characteristics as specified herein) and their power connections, and mountings, shall be provided by the Developer.

11.3.13.1 Functional Requirements
The functions of the M&SF are associated with maintenance of the APM Operating System.
11.3.13.1.1 M&SF Operations

The Automatic Train Control system (see Part 2B, Section 11.3.9) shall be extended to encompass the M&SF such that all Train movements, except movements into and out of the maintenance bays (see Part 2B, Section 11.3.13.1.8), may be conducted under automatic control.

11.3.13.1.2 Passenger Operations

Prior to the beginning of daily operations, or when additional Vehicles are needed for operations, the Vehicles shall be taken from their storage location(s); connected together, as needed, into the required Train length(s); maneuvered into position if required for pre-operational testing, subjected to required pre-operational testing; placed into the proper location and control configuration for automatic operation; and then dispatched into the Guideway and placed in automatic operation. Space and equipment shall be provided for these operations, including hostling of Vehicles, maneuvering room, test equipment, control equipment, and all associated Guideway/track.

At the end of the operational day, or when Trains need to be removed from normal revenue service, the Trains shall be received from the mainline Guideways and stored.

11.3.13.1.3 Vehicle Storage

The M&SF shall be designed to accommodate the following:

A. Vehicle storage area shall be sized for the APM System fleet. Any future expansion is limited to the space requirements shown on the Part 5, Contract Drawings/Engineering Data. The Vehicle storage area shall be fully automated. Space and facilities shall be provided for Vehicle inspection, maintenance and interior cleaning if those functions are to be performed in the Vehicle storage area. Regardless of the level of Vehicle inspection, maintenance, and interior cleaning that will be performed, the position and arrangement of stored Vehicles shall protect personnel from hazards such as moving Vehicles and propulsion power as well as provide room for firefighting personnel.

B. Movement of powered Vehicles from the mainline Guideway to and from defined storage locations.

C. Movement by the maintenance and recovery Vehicle (MRV) of unpowered passenger Vehicles awaiting maintenance or repair and for storage of those Vehicles until such activities can begin.

D. Storage of all MRVs and any related Vehicles and trailers provided for use on the Guideways.

11.3.13.1.4 Vehicle Washing

Automatic washing of the Vehicle exteriors shall be accomplished at the Vehicle wash facility that is planned as a separate area within the M&SF to be designed and outfitted by the Developer. The Developer shall design, supply and install the Vehicle wash system in accordance with the following requirements:

A. Vehicles/Trains to be washed shall automatically be routed to the Vehicle wash facility at the direction of the CCO.

B. Vehicles/Trains to be washed shall automatically queue at the entrance to the Vehicle wash facility. When the facility is clear, the next Vehicle/Train in the queue shall automatically proceed into the wash bay.
C. Washing shall be performed with water mixed with detergent. A rotating brush system, designed specifically for the contours of the Vehicles, shall mechanically agitate all surfaces of all Vehicles in the Trains. Special means shall be devised to mechanically wash the exterior ends of Vehicles in Trains.

D. All washed surfaces of the Vehicles shall be rinsed with clear water.

E. Pressurized air shall be used to dry all exterior Vehicle surfaces.

F. At the conclusion of washing, the Vehicle/Train shall automatically proceed out of the Vehicle wash facility, and move to a designated parking location, awaiting further direction from the CCO.

G. Equipment to recapture and/or treat wash water, including Vehicle wash water recycling and other fluids, shall also be provided. The recycling and reclamation system shall be capable of re-using at least 80 percent of the wash water. All wash water to be discharged shall be pre-treated to separate and remove oil products from the water and store them in a container system to be provided by the Developer. The Developer shall dispose of separated products.

H. All wastewater from the wash process shall be properly disposed of by the Developer.

I. The Developer shall provide specific information regarding the quantity and composition of the proposed effluents from the washing and any other maintenance activities in the General Design/Construction Interface Document (D/CID), in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

J. Over spray during wash operations shall be contained. Entry of rain and storm water into the wash facility shall be precluded.

11.3.13.1.5 Train Receiving Track

A Train receiving track shall be provided to receive Trains removed from passenger service by the CCO. When the CCO issues a command at the CCC for a Train to be removed from passenger service, it shall automatically proceed out of service as specified in Part 2B, Section 11.3.9.3.3.2.M.2.

Upon approaching the Train receiving track area, a warning horn shall sound and a red flashing light shall illuminate for not less than fifteen (15) seconds, signaling the imminent arrival of a Train. The arriving Train shall proceed automatically to the last available receiving track position, stop, and await further commands from the CCO to route it further. Trains being removed from service shall proceed under Manual Operation from the receiving track to the designated storage track, or other position.

11.3.13.1.6 Train Ready Track

A Train ready track shall be provided for positioning Trains that are ready for dispatch into passenger service by the CCO as specified in Part 2B, Section 11.3.9.3.3.2.A. Trains shall proceed automatically to the Train ready track as commanded by the CCO. Thereafter, the CCO may issue a command for the Train to be dispatched from the Train ready track into passenger service. When this command is issued, a warning horn shall sound and a red flashing light shall illuminate at the Train ready track site for not less than fifteen (15) seconds after which the designated Train shall automatically proceed from the Train ready track into passenger service.
11.3.13.1.7 Vehicle Storage Tracks
Vehicle storage tracks shall be provided for parking Trains in the M&SF area. Movement of Trains into and out of the Vehicle storage tracks shall be accomplished automatically upon command of the CCO.

11.3.13.1.8 Maintenance Bays
Maintenance bays shall be provided for performing maintenance on Trains at the M&SF. Train movement into a maintenance bay shall be accomplished only by manual means.

An AED device shall be located in the maintenance bay area.

11.3.13.1.9 Departure Test
Periodically and prior to a Vehicle being returned to passenger service after maintenance, the Train shall be subjected to a departure test as required in Part 2B, Section 11.3.5.1.9. The Developer’s Maintenance Plan shall specify the periodicity of the departure test. Departure Test Procedures shall be included in the Maintenance Manuals, as required in Part 2C Section 3.3.

The M&SF shall contain the departure test equipment. A section of the Guideway in the M&SF shall be designed, constructed, and used as the departure test track.

11.3.13.1.10 Maintenance Functions
The maintenance functions performed on all APM Operating System equipment shall include the following:

A. **Service** - The periodic replacement of consumables and expendables and adjustment of parts to their nominal position, required tolerance, setting, output, etc.

B. **Cleaning** - Interior and exterior cleaning of accumulated trash, dirt, and grime, including graffiti.

C. **Inspection** - Periodic inspection of parts, appurtenances and subsystems subject to deterioration and failure.

D. **Repair** - The repair or replacement of a part that has been damaged, has failed, or is nearing the end of its service life.

E. **Departure Test** - In accordance with the requirements of Part 2B, Section 11.3.5.1.9.

F. **Maintenance Management Information and Scheduling** - The processing of maintenance information, work reports, failure reports, and APM Operating System performance data needed to manage the APM Operating System maintenance program effectively and efficiently. See Part 2B, Section 11.3.13.7.

11.3.13.1.11 Maintenance Activities and Facilities
The Developer shall provide any and all required standard and special tools, test equipment, hoists, cranes, furniture, other equipment/fixtures, work platforms/scaffolds, consumables and expendables, and facilities needed to perform all planned APM Operating System maintenance activities, including, at a minimum:

A. Automatic Vehicle exterior washing (see Part 2B, Section 11.3.13.1.4).

B. Vehicle interior cleaning.

C. Undercar inspection and maintenance, in maintenance bays equipped to accommodate under-vehicle access for inspection and maintenance and the
removal of under-vehicle equipment for maintenance elsewhere in the M&SF. The design, size, capacity, and configuration of these bays shall be determined by the Developer and provided to LAWA as design audit data. Floor areas shall provide safe, well-lit, and convenient work space for maintenance personnel. At least one maintenance bay shall be capable of use for maintenance and inspection of the MRV(s) and other APM System support Vehicles.

D. A Vehicle blow-down facility, with appropriate equipment and utilities, shall be provided for cleaning Vehicles and/or undercar equipment and components. When appropriate, Vehicles shall be prepared before maintenance using the blow-down facility. The blow-down facility shall include provisions for treating the cleaning effluents to a level acceptable for disposal (1) in the M&SF waste disposal system and/or (2) by the Developer via other means.

E. Work in an open floor area near or within the maintenance bays, with an appropriate number of work benches.

F. Component repair and replacement in appropriate separate shops and areas, for items provided by the Developer or procured from another source.

G. Tire/wheel repairs as applicable.

H. Electronic troubleshooting and repair in shops with appropriate HVAC, electronic and other noise insulation, and exclusion of harmful substances as appropriate.

I. Lubrication and the storage of lubricants and flammable materials in a properly ventilated room with at least a two-hour fire rating.

J. Welding, metalwork, and machining in associated shop areas.

K. Vehicle HVAC maintenance, repair, servicing, and cleaning.

L. An area shall be designated for touch-up painting of the passenger Vehicles and equipment in environmentally acceptable circumstances with an adjacent paint locker that meets all fire code requirements and shall include provisions for any toxic paints and/or dust consistent with the type of paints and finishes to be repaired and/or utilized.

M. Tool storage in conveniently located secured tool storage cabinets sufficient to accommodate all hand held tools.

N. Parts storage in secured parts storage rooms equipped with appropriate storage bins and racks.

O. Proper storage of batteries and other materials that could present special hazards. All such materials shall be identified by the Developer. Such storage rooms shall have appropriate fire suppression and ventilation devices.

P. Storage of supplies and equipment associated with custodial functions in a utility room with appropriate plumbing.

Q. Shipping, receiving, and inventory control in one or more area(s) convenient to the loading dock and storage and work areas.

R. In addition to the above, the Developer shall provide the following:

1) Security, restricted access, and safeguarding of all tools, equipment, parts, and other items in the M&SF.

2) Offices for maintenance management, supervisory, and administrative personnel, and for data processing functions associated with maintenance
activities. These offices shall be located and designed for ease of supervision and access. Two offices shall be provided and furnished for LAWA use. These rooms shall be reviewed and accepted by LAWA.

3) Employee locker rooms, toilet and shower facilities, break and lunch room(s), and conference/training room(s). Separate male and female locker, toilet, and shower rooms shall be provided. There shall be toilet facilities in separate M&SF functional areas and on each floor of a multi-floor facility.

4) All offices and other personnel rooms shall be appropriately finished and furnished to meet the acceptance of LAWA. All such offices and rooms shall be fully compliant with the accessibility requirements specified in Part 2B, Section 11.3.4.

5) The Developer shall provide a shop exhaust system and any other special equipment that is necessary for the maintenance of the MRV within the Maintenance and Storage Facility.

6) A room to house LAWA IT equipment.

11.3.13.2 Location, Design, and Finishing

The location of the M&SF is shown in the Part 5, Contract Drawings/Engineering Data. The Developer shall provide the facility including all furnishings, utility provisions, and equipment for this facility as well as all equipment and other items required for the functions to be performed therein.

The Developer's detailed plan to use this facility, including, at a minimum, finish-out, furnishings, use of any immediately adjacent area, access routes, and operating and maintenance activities, shall be submitted as part of the M&SF Design Audit. Information sufficient for M&SF interface with Related Projects and utility provisions shall be provided in the Developer's General D/CID in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

Operational and informational signage and graphics in the M&SF shall be furnished by the Developer. These signs shall be shown in the M&SF Signage/Graphics Plan submitted to LAWA in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

An AED device shall be located in the office area of the M&SF.

11.3.13.3 M&SF Guideway and Related Equipment

The Developer shall provide all Guideway for passenger Vehicle movement into, out of, and within the M&SF. Any switches, cranes or hoists necessary to move and service Vehicles within the M&SF and between it and the passenger service Guideways shall also be provided by the Developer. Guideway for the following activities shall be powered and separated into zones as required for safe and efficient operations:

A. Pre-operational Vehicle checkout and departure testing of Part 2B, Sections 11.3.5.1.9 and 11.3.13.1.9.

B. Train make-up and Vehicle coupling and uncoupling.

C. Vehicle storage.

D. Vehicle exterior cleaning.

E. Vehicle movement among A, B, C, and D, above, the maintenance shops and the mainline Guideway.
Guideway for the following purposes shall not be powered:

AA. Within Vehicle heavy maintenance bays and pit areas;

BB. Maintenance areas not requiring powered Vehicle movement; and

CC. Areas where maintenance personnel cross the Guideway in the normal performance of tasks not associated with powered Vehicle movement.

The Developer shall provide Vehicle umbilical power cables and connectors as needed for Vehicle maintenance and/or movement within the Vehicle maintenance building of the M&SF. These cables and connectors, and the Power Distribution System feeding them, shall be of sufficient size and number so that all Vehicle electrical loads, including propulsion (if applicable) at AW0 loading, can be operated through these connections. The umbilical connectors shall be protected against short circuits caused by contact with metal surfaces or objects while not connected to the Vehicle.

Cables shall be of sufficient length and supported so that they permit required Vehicle movement without interference from any part of the Vehicle. At least two (2) labeled flashing red lights shall automatically be activated for each umbilical cable whenever it is energized and in use.

Where the Guideways pass through the M&SF building doors, there shall be door interlocks meeting the switch interlocking protection requirements of Part 2B, Section 11.3.9.1.12 to prevent Vehicle-door collisions. The door status shall be indicated on the CCC. The Developer shall provide and install local manual operation controls for these doors.

11.3.13.4 Maintenance Tools and Equipment

The Developer shall provide all tools, equipment, special Guideway-based Vehicles, and off-Guideway Vehicles required for pre-operations checkout, servicing, inspections, troubleshooting, maintenance and repair of APM Operating System equipment. If the supply of tools and equipment is found to be insufficient to perform the aforementioned functions during the APM Operating System operations and maintenance period, the Developer shall provide the necessary tools and equipment at no cost to LAWA. The tools and equipment shall provide for, at a minimum, the following:

A. Vehicle maintenance.
B. Automatic Train Control and communication systems maintenance.
C. Power Distribution System maintenance.
D. Guideway equipment maintenance.
E. Station equipment maintenance.
F. APM Operating System equipment cleaning.
G. System facility cleaning.
H. Guideway inspection Vehicles and/or other maintenance Vehicles.
I. Raised trackwork and equipment to lift Vehicles for maintenance.
J. An overhead crane to move major equipment components, if required.
K. Air compressors of sufficient power and capacity, including associated tanks, air driers, and piping.
L. Electronic and mechanical equipment required for diagnosis, troubleshooting, maintenance, and repair.
M. Support equipment maintenance.
N. Fuel dispensing (if applicable) and storage equipment.
O. Computer system hardware, software, and peripherals.
P. All diagnostic equipment required to perform the APM Operating System maintenance functions.
Q. Heating equipment (if applicable).
R. Emergency equipment, such as auxiliary lighting and rail shorting bars.
S. Mileage recording equipment as described in Part 2B, Section 11.3.7.9.5.

Equipment for jacking Vehicles derailed or similarly immovable on the Guideway shall be provided by the Developer. This equipment shall fit under the immovable Vehicle and allow it to be lifted and transported to the M&SF by the MRV. This equipment shall connect to the Guideway and distribute its load and that of the Vehicle(s) being recovered so that the Guideway structures are not overstressed or damaged in any way and all Vehicles are adequately supported.

A complete list of tools and equipment shall be submitted to LAWA in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

11.3.13.5 Spare Parts, Expendables, and Consumables

Spare parts and equipment are those items that are rotated into the fleet to allow worn and failed equipment to be removed and repaired or rebuilt, e.g., electric motors, compressors and body panels. Expendables and consumables are those items that are used or consumed in service and are not repaired, but are replaced with new items, e.g., belts, brake shoes, collector brushes, and lubricants.

The Developer shall plan, procure, and provide required stocking levels for an inventory of spare parts and equipment, expendables, and consumables to meet all of the APM OS Availability requirements of Part 2B, Section 11.3.6 and other requirements of these Part 2B, Design & Construction Technical Requirements necessary to carry out all maintenance in accordance with Developer’s Maintenance Plan and as specified in the Developer’s Maintenance Manuals, including first overhauls scheduled within the first three (3) years after the start of passenger service. The Developer shall establish stocking levels, procurement and supply procedures, and meet all related requirements of this section.

The following requirements shall apply to the inventory of spare parts, expendables and consumables:

A. A sufficient stock of spare parts and equipment shall be provided to assure that, as worn or malfunctioning equipment is removed from the APM Operating System, replaced with the spare items, and then repaired or reconditioned; the APM OS Availability requirements are met. The Developer shall determine the specific inventory considering cost, availability, supply process, and replacement/procurement lead times. In no case shall the inventory be less than that required for operations and maintenance to meet all requirements of these Part 2B, Design & Construction Technical Requirements for less than twelve (12) months for a mature APM Operating System where consumption rates of these materials have reached steady state.

B. All material, spare parts, spare equipment, and special tools needed for the first overhauls of any APM Operating System equipment shall be identified in APM Operating System Maintenance Plan and Maintenance Manuals.

C. The inventory shall include sufficient expendables and consumables to operate the APM Operating System for a 12-month period meeting all operating, APM OS
Availability, and maintenance requirements of these Part 2B, Design & Construction Technical Requirements.

D. The spare parts and equipment, expendables, and consumables inventory shall be stocked to the above levels at the issuance of the PSA. Any items used during acceptance activities, APM Operating System Demonstration, and operation and maintenance that occur prior to the issuance of the PSA shall be replaced by the Developer at no additional cost to LAWA. An insufficiency of spare parts, equipment, expendables, and consumables shall not be an exclusion for any aspect of APM OS Availability calculations of Part 2B, Section 11.3.6.

E. A formal review of these levels and processes shall be undertaken by the Developer prior to and as a condition for LAWA to issue the CFC. Should it be found during the APM Operating System operations and maintenance period that the inventory provided by the Developer is not sufficient to meet the APM OS Availability requirements of Part 2B, Section 11.3.6, the required additional inventory shall be provided at no additional cost to LAWA.

F. The Developer shall provide to LAWA a complete list of all inventory items, categorized by subsystem or component, and listing the product or part name, Developer's part number and supplier's part number, special storage requirements, three (3) (if available) source/manufacturer names and addresses, and current prices. This list shall be arranged by assemblies and subassemblies coordinated with the expanded assembly, pictorials, and assembly instructions of the Maintenance Manuals. This list shall be part of the computerized MMIS of Part 2B, Section 11.3.13.7. Detailed specifications for all such parts and supplies, adequate to provide these items independently of the Developer, shall be provided at no extra charge and within one month after being requested by LAWA.

G. For a period of not less than twenty (20) years after the issuance of the CFC, the Developer shall make available to LAWA renewed, repaired, and replacement parts at fair and reasonable prices based on prices for similar or equivalent items to other customers prevailing at the time of the purchase of said items. Parts shall be interchangeable with the original equipment and be manufactured in accordance with the quality assurance provisions of the Contract Documents. Normal scheduled-delivery orders of spare parts and equipment shall be delivered to LAWA within a maximum of thirty (30) days of date agreed upon.

H. Where the parts ordered by LAWA are not received within thirty (30) days of the agreed upon delivery date, the Developer shall provide to LAWA, within seven days of LAWA's verbal or written request, the design and manufacturing documentation for those parts manufactured by the Developer for all of the specified parts not received by LAWA. Developer's design and manufacturing documentation provided to LAWA shall be for LAWA's sole use in regard to the APM Operating System procured under the Contract Documents and for no other purpose.

11.3.13.6 APM Operating System Support Vehicles

11.3.13.6.1 On-Guideway Maintenance and Recovery Vehicle

The Developer shall provide at least one Guideway-based service Vehicle.

The Guideway-based service Vehicle shall:
A. Be bidirectional with equal performance in both directions and be operable by its own energy source, except that gasoline power shall not be permitted and diesel power shall have air pollution control equipment, meeting the same emission requirements as road-based Vehicles.

B. Carry replacement parts for maintaining and repairing Guideway and/or wayside equipment.

C. Carry jacking and/or re-railing equipment for Vehicle/Train recovery.

D. Have the means, such as a permanent or detachable crane or winch, to place/remove tracks, wayside equipment, jacking, and re-railing equipment on/from the Guideway.

E. Generate compressed air and 120 and 240 volt ac auxiliary power.

F. Have onboard storage for selected maintenance equipment and parts.

G. Be able to operate on all sections of APM Operating System Guideway under all environmental conditions of Part 2B, Section 11.3.4.

H. Be retained on the Guideway in a manner that satisfies the requirements of Part 2B, Section 11.3.7.9. It shall have any necessary additional stabilizing devices to prevent tipping and/or derailment while performing any Guideway maintenance and/or Train recovery functions.

I. Be detectable (including any trailers) by the ATP system, but shall not be required to be subject to all ATP restrictions. For any operation on the passenger carrying Guideways during periods where the APM Operating System is in passenger service its speed shall be limited to 10 mph or less subject to the Developer’s Hazards Analysis and ATP Design. Higher operating speeds for the MRV may be permitted subject to acceptance by LAWA.

J. Have onboard radio communications satisfying the requirements of Part 2B, Section 11.3.10.1.5.

K. Have an environmentally controlled cab.

L. Have light sources mounted on the MRV to assist O&M activities.

Any Guideway-based service Vehicle, by itself or with trailers, when fully loaded for any of its functions shall not exceed the load limits established for the Guideway structure or of any Guideway equipment, including guidance and running surfaces. Guideway-related structural analyses submitted by the Developer to LAWA shall include this Vehicle loading condition.

If Developer’s operation requires the use of one or more maintenance and recovery Vehicles (MRVs) to: (1) inspect and maintain the Guideways and Guideway equipment; (2) retrieve failed Trains anywhere on the Guideway; and (3) move Vehicles and Trains in the M&SF, the Developer shall provide them. The Developer shall determine the number and type of MRVs needed and submit supporting information, including the MRV design, capabilities, and related equipment to LAWA as part of the Maintenance Equipment Design Audit.

The MRV(s) shall:

AA. Be bidirectional with equal performance in both directions and be operable by its own energy source, except that gasoline power shall not be permitted and diesel power shall have air pollution control equipment.

BB. Couple with any maximum length Train loaded at AW0, then push, pull, and stop the Train over the entire Guideway length for an indefinite period of time in all
environmental conditions of Part 2B, Section 11.3.4. While the MRV shall have such push-pull capability, it shall not normally be used for failure management. See Part 2B, Section 11.3.3.1 for the normal failure management procedures.

CC. Carry replacement parts for maintaining and repairing Guideway and/or wayside equipment.

DD. Carry jacking and/or re-railing equipment for Vehicle/Train recovery.

EE. Have the means, such as a permanent or detachable crane or winch, to place/remove tracks, wayside equipment, jacking, and re-railing equipment on/from the Guideway.

FF. Generate compressed air and 120 and 240 volt ac auxiliary power.

GG. Have onboard storage for selected maintenance equipment and parts.

HH. Provide lift or ladder access to reach wayside equipment, if applicable.

II. Be able to operate on all sections of APM Operating System Guideway under all environmental conditions of Part 2B, Section 11.3.4.

JJ. Be retained on the Guideway in a manner that satisfies the requirements of Part 2B, Section 11.3.7.9. It shall have any necessary additional stabilizing devices to prevent tipping and/or derailment while performing any Guideway maintenance and/or Train recovery functions.

KK. Be detectable (including any trailers) by the ATP system, but shall not be required to be subject to all ATP restrictions. For any operation on the passenger carrying Guideways during periods where the APM Operating System is in passenger service its speed shall be automatically limited to 10 mph or less subject to the Developer’s Hazards Analysis and ATP Design. Higher operating speeds for the MRV may be permitted subject to acceptance by LAWA.

LL. Have onboard radio communications satisfying the requirements of Part 2B, Section 11.3.10.1.5.

MM. Have an environmentally controlled cab.

NN. Have light sources mounted on the MRV to assist O&M activities.

Where different types of MRVs are provided for different purposes, all MRVs shall, at a minimum, have the features required by Paragraphs AA., FF., GG., HH., II., JJ., KK., LL. and MM. above.

Any MRV, by itself or with trailers, when fully loaded for any of its functions shall not exceed the load limits established for the Guideway structure or of any Guideway equipment, including guidance and running surfaces. Guideway-related structural analyses submitted by the Developer to LAWA shall include this Vehicle loading condition.

11.3.13.6.2 Other Operations and Maintenance Vehicles

The Developer shall provide a sufficient number of commercial road-based vehicles to conduct all operations and maintenance tasks, including, at a minimum:

A. Rapid access of O&M personnel to any APM System location to respond to failures and malfunctions.

B. Pick-up and delivery of O&M equipment, parts, consumables, and expendables.

These vehicles shall be of heavy-duty construction and suited to and equipped for the purposes intended by the Developer. All such vehicles shall meet US and State motor vehicle requirements, and shall be licensed in the State of California. All shall have an appropriate color scheme,
markings, logos, and similar features to identify them as a Developer vehicle. They shall have flashing amber lights mounted for visibility by other motorists. All shall have on board mobile radios, or integral mounts for hand-held portable radios, to give full coverage wherever they are driven in the course of their duties, and access to the O&M radio communications subsystem in accordance with Part 2B, Section 11.3.10.1.5.

11.3.13.7 Maintenance Management Information System

A computer-based maintenance management information system (MMIS) shall be provided with at least the following capabilities:

A. **Human Resources Management** - Management and scheduling of human resources including staff and contract labor.

B. **Work Order Processing** - Recording a comprehensive description of each repair action as well as tracking the status of open and unassigned work orders.

C. **Status Tracking** - Documenting subsystems and component assets and repair histories.

D. **Preventive Maintenance Scheduling** - Projecting inspection dates and supporting the planned allocation of labor and materials resources.

E. **Failure Monitoring** - Documenting component failures for each subsystem, supporting quality control efforts, and projecting labor and materials needs.

F. **Maintenance Resource Planning** - Providing information from the above items to support on-going maintenance management decisions.

G. **Asset Management** - Shall include purchasing, fixed assets control, inventory control including parts and supply sourcing, and bar coding.

LAWA or its designee shall have complete access to all data of the MMIS at all times. The Developer shall provide the MMIS hardware, software, and peripherals. All forms, such as work orders, inventory slips, work scheduling sheets, and data input sheets shall be supplied by the Developer. All such attributes of the MMIS shall be submitted to LAW A as part of the Maintenance Provisions Design Audit. The Developer shall use this MMIS during APM Operating System testing, demonstration, and operations and maintenance. Training of LAWA's employees required by Part 2C, Section 3.1.3 shall include instruction in the use of the MMIS.

11.3.13.8 Architectural and Engineering Requirements

Refer to Part 2A, Sections 3 and 6.

11.3.13.8.1 Electrical

Electrical power shall be distributed by the Developer in all voltages and types needed for all functions in the M&SF. Power shall include voltages and capacities needed to operate electric motored equipment, battery chargers, welding equipment, HVAC equipment, and all other maintenance equipment.

All electrical equipment, devices, and installations required for the movement, maintenance, and testing of Vehicles and other APM Operating System equipment shall include necessary manual and automatic controls, protective shielding, and automatic power cut-offs to assure personnel safety.

M&SF Guideway power, including umbilical cords to the Vehicles, and power for APM Operating System equipment shall be provided by the Developer, along with power for all other uses in the M&SF, including shops, offices, and general housekeeping. Developer shall be responsible for interfacing with power stub-ins and shall distribute the power as part of the M&SF Work.
11.3.13.9  Safety
The M&SF Work of the Vehicle storage area, Guideway, and maintenance shops, shall be
designed and equipment procured and installed in accordance with the relevant NFPA, NEMA,
NESC, and ANSI standards, Part 4 and requirements of the AHJ.

See Part 2B, Section 11.3.5.1 for additional safety requirements and Part 2B, Section 11.3.5.2 for
other security requirements.

11.3.13.9.1  Overhead Hoist
Any required hoists and cranes shall be provided by the Developer and shall meet the
requirements of ANSI B30.16, Safety Standards for Overhead Hoists.

11.3.13.9.2  Signage
Warning signs shall be posted by the Developer in areas containing electrical voltage sources in
excess of 120 volts and near sources of steam, pneumatic, and hydraulic pressures.

11.3.13.10  Emergency Systems
11.3.13.10.1  M&SF Fire Protection System
See Part 2B, Section 3 MSF and Part 2B, Section 21 Fire/Life Safety.

11.3.13.10.2  Emergency Power
Emergency and backup power shall be provided in accordance with Part 2B, Section 11.3.8.2
requirements.

11.3.13.11  Central Control Facility
The Central Control Facility (CCF) shall be located within the M&SF. The Developer shall be
responsible to build and finish out the CCF, including all walls, ceilings and floors. The Developer
shall completely outfit the CCF and shall install all equipment and furnishings. The Developer
shall coordinate all phases of CCF design with LAWA. The Developer shall be responsible for all
communications interfaces and/or integration within the APM Operating System and with outside
communication systems, such as those provided by the local telephone company. The General
D/CID shall provide detailed information regarding these interfaces and/or integration. CCF
equipment, features, and functions are specified in other sections.

11.3.13.12  Administrative Offices
The administrative offices for the APM System, at the Developer discretion, can be located within
the M&SF. Administrative offices not at the M&SF shall be within 3 miles of the M&SF.

11.3.13.13  APM Operating System Simulator
An APM Operating System simulator shall be provided, installed, and tested by the Developer
prior to the start of the APM Operating System Demonstration (see Part 2C, Attachment C;
Section C5) and soon enough so that it may be used to conduct CCO training in accordance with
the requirements of Part 3, Section 1.2. The simulator will be used for analysis of APM Operating
System operations, and for training of CCOs. The simulator shall consist of a separate, stand-
alone console, computers and displays, and shall be located in the training room of the M&SF.
The simulator shall provide at least the following features:

A.  Dynamic graphic displays showing Trains, Guideway, Guideway Automatic Train
    Control sections, switches, Stations, and propulsion power feed points.
B.  Displays showing simulated Train movements, Station dwell times, and other
    operational data in real time or adjustable fast time.
C. CCO control interfaces to establish initial numbers and locations of Trains and Vehicles and Station dwell times.

D. Control interfaces to simulate the full set of CCO overrides and mode selections available in the actual ATS subsystem to use the simulator as a training tool.

E. Control interfaces to set, monitor, and evaluate selectable scenarios of operating schedules, all normal and failure operating modes and malfunction/failure management recoveries.

F. Time-based selectable printouts of performance snapshots.

G. Electronic records of the activities of trainees while using the simulator.

Simulated Train performance shall replicate actual Train performance, over the actual alignment, and in accordance with the operating conditions/modes being simulated.

The ATS subsystem installed in the simulator shall be a full functional equivalent of the actual ATS subsystem. The simulator shall be updated to maintain consistency with any updates made to the Operating System configuration.

11.3.14 Corrosion Control and Grounding

11.3.14.1 Purpose and Scope

Corrosion control systems shall prevent premature corrosion failures, minimize stray current effects, and be economical to install, operate, and maintain. Grounding systems shall prevent electrical shock hazards to the public, APM System employees and Developer personnel from lightning, APM Operating System power and other adjacent power sources, and shall protect equipment from damaging voltages and currents.

The Developer shall conduct a Predesign Corrosion Control Survey that investigates stray currents, soil resistivity, soil pH, soil sulfites, data from local utilities, or other factors affecting the level of corrosion that the Project may experience if such conditions are not mitigated. Testing shall be performed in accordance with NACE-SP0169.

The survey shall provide information on equipment, piping and other APM Fixed Facility data gathered from local utilities including any corrosion mitigation techniques currently installed by those entities, as well as any special requirements of those utilities concerning equipment types and installation requirements.

11.3.14.1.1 Interfaces

The Developer shall coordinate corrosion control and grounding with all utilities, and with the mechanical, civil, structural, electrical, trackwork, propulsion power, environmental, geotechnical, architectural, Automatic Train Control and communications subsystems. Corrosion control and grounding shall be coordinated throughout the design, installation, and start-up processes of any separate segment as well as the entire APM System.

Corrosion control, substation and APM System grounding designs, bonding design, and lightning protection requirements shall be coordinated and their designs shall be compatible with relevant safety requirements.

The Developer shall coordinate its designs with corrosion control measures provided by others for structures owned by others to resolve design conflicts and minimize adverse impacts and interference.
11.3.14.2 Soil and Water Corrosion Prevention

This section provides criteria for designs to prevent corrosion of Developer-provided structures from soil and water conditions. The designs shall be based on the design life requirements of Part 2B, Section 11.3.1.5. Where failure would affect safety or interrupt continuity of operation, corrosion control provisions shall be required for all facilities regardless of location or type of construction material.

Protection of metal structures shall include corrosion control techniques such as coating, electrical isolation, electrical continuity, and cathodic protection. Where necessary for the preservation of concrete structures, the Developer shall use cement types in accordance with ASTM C150 and as recommended by the American Concrete Institute. For severe environments, which shall be identified by the Developer, supplemental coatings shall be applied.

11.3.14.3 Stray Current Corrosion Prevention

This section provides design criteria to minimize the corrosion impact of stray currents from DC propulsion power systems on the Guideway and associated structures and on adjacent structures owned by others. Corrosion control measures shall be in accordance with Section 9.1.2, Corrosion Control of ASCE 21 and the requirements of this Part 2B, Section 11.3.14.3. The structures that could be affected by stray currents shall be identified, and designs shall be provided to minimize the impact of these stray currents.

A DC propulsion power distribution system shall operate without direct electrical connections between the power system return and ground, except that at each substation a single point earth ground connection shall be provided. The propulsion power system and the trackwork/Guideway shall be designed such that during normal operations the maximum stray direct current measured in the substation single point ground connection to the negative return buss does not exceed 0.1 milliampere per each 1,000 feet of single lane Guideway served by that substation.

11.3.14.3.1 Stray Current Corrosion Prevention Systems

The design of stray current corrosion prevention systems shall be based on studies that predict the magnitude of anticipated stray currents and consider the following requirements:

A. **Propulsion Power Substations** - The propulsion power distribution system shall be separated into appropriate electrically-isolated sections including at least: the mainline, yards, and shops. Substations shall be spaced at intervals that preclude the exposure of personnel to shock hazards and stray currents. The voltages to ground shall be limited to 25 volts. Substations shall include stray current monitoring access.

B. **Direct Current Distribution System** - The distribution circuit, consisting primarily of the distribution/contact system, shall have a minimum effective in-service resistance to earth of at least 1,000,000 ohms per 1,000 feet of single lane Guideway. The mainline running and guidance surfaces, including special equipment, negative return conductors, and all ancillary connections shall be designed to limit stray current in accordance with Part 2B, Section 11.3.14.3. These criteria shall be attained by using insulators and/or insulating devices such as insulated tie plates, rail clips, direct fixation fasteners, or other equipment devices. The negative return rail(s) shall have a minimum in-service resistance to earth of at least 1,000,000 ohms per 1,000 feet of single lane Guideway. These resistances shall be maintainable during the anticipated life of the APM System.

C. **Yard Trackage** - Yard and mainline propulsion power segregation points shall be located so that all Guideway on the mainline side of the segregation point are
normally electrically insulated and meet the criteria of Part 2B, Section 11.3.14.3.1.B.

D. **Maintenance Shops** - Shop propulsion power shall be provided by a separate dedicated power supply that is electrically segregated from yard propulsion power system circuits:

1) Shop tracks/Guideway propulsion shall be electrically grounded to the shop building and shop grounding system.

2) Shop tracks/Guideway shall be electrically insulated from yard tracks/Guideway by rail insulating joints or similar installations. Insulators shall be placed such that parked Vehicles cannot electrically short the shop-to-yard circuits longer than the time required to move a Vehicle into or out of the shop. Vehicle wash facilities shall operate on shop power if located in or adjacent to the shops.

E. **Water Drainage and Infiltration** - Below-grade structures shall prevent water from dripping or running onto the conductors, running surfaces, and Guideway equipment and shall prevent the accumulation of freestanding water. Mainline and yard water drainage systems shall minimize the possibility of water contacting electrical conductors and equipment. Shop drainage systems shall prevent water accumulation around the rail insulating joints immediately off the shop apron.

11.3.14.3.2 **Electrical Bonding**

A. **Structures** - Reinforcing steel in structures shall have electrical continuity.

B. **Utility Structures** – APM Operating System and utility structures, such as buried metallic pipe and conduits, shall be provided with electrical continuity. Pressure piping that penetrates exterior walls shall be electrically insulated from the outside piping to which it connects and from watertight wall sleeves. Electrical insulation of interior piping from outside piping shall be made on the interior of the wall penetrated.

Replaced, relocated, and maintained-in-place utility structures owned by others shall be provided with corrosion control measures as required by AHJs.

11.3.14.3.3 **Drainage Facilities**

The corrosion control design shall provide for stray current drainage facilities, including conduits, manholes, junction boxes, drainage buses, cables, drainage panels, and other associated equipment. Each substation shall have such equipment.

11.3.14.3.4 **Test Facilities**

Test facilities shall be provided on all electrically bonded APM System structures to measure and monitor stray currents. Corrosion control shall include test facilities for individual protected structures.

11.3.14.3.5 **Special Design Provisions**

The Developer shall identify special design cases, such as existing building foundations, parallel tower lines, and unusual soil conditions and recommend special design measures for acceptance by LAWA.

11.3.14.4 **Atmospheric Corrosion Prevention**

This section provides criteria for atmospheric corrosion control to reduce maintenance costs and preserve the appearance of facilities and fixed equipment.
A. The following criteria shall be met:

1) **Materials Selection** - Materials shall have established performance records for the service application.
2) **Sealants** - Sealants shall be used in crevices to prevent the accumulation of moisture.
3) **Protective Coatings** - Barrier or sacrificial coatings shall be used on steel.
4) **Design** - The use of dissimilar metals and recesses that trap moisture shall be avoided.

B. Developer shall identify equipment that requires atmospheric corrosion protection and incorporate necessary protection.

### 11.3.14.4.1 Atmospheric Corrosion Prevention Systems

#### 11.3.14.4.1.1 Materials

Metals that could be exposed to the atmosphere shall be selected and provided as follows:

A. **Steel and Ferrous Alloys** - Carbon steel and cast iron exposed to the atmosphere shall have a coating applied to all external surfaces. Rail and rail fasteners, such as spring clips, spikes, or rail plates do not require coatings:
   
   1) High-strength, low-alloy steels shall be protected in a similar manner to carbon steel and cast iron. Complete drainage of all surfaces, coating of metal-to-metal contact surfaces, and sealing of crevices is required. The potential staining of adjacent structures shall be considered.
   
   2) Type 316 and 317 stainless steels and high nickel-chromium steels shall be provided for use in exposed conditions. Stainless steel surfaces shall be cleaned and passivated after fabrication.

B. **Aluminum Alloys** - An anodized finish shall be used to provide a weather-resistant surface.

C. **Copper Alloys** - Copper and its alloys may be exposed without additional protection.

D. **Magnesium Alloys** - Where long-term appearance is critical, magnesium alloys shall have a barrier coating applied. Bi-metallic couples shall be avoided.

E. **Zinc Alloys** - Zinc alloys may be used without additional protection. Bi-metallic couples shall be avoided.

#### 11.3.14.4.1.2 Coatings

Coatings shall have an established performance record for the intended service and be compatible with the base metal to which they are applied. Coatings shall demonstrate satisfactory gloss retention, color retention, and resistance to chalking over their life spans. The minimum life expectancy of coatings before major maintenance or recoating shall be as defined below.

A. **Acceptable Metallic Coatings** - metallic coatings for carbon and alloy steels include zinc (hot dip galvanizing), aluminum, or a combination of aluminum and zinc. The minimum in-service life of hot dip galvanized coating materials shall be 25 years and the minimum coating thickness shall be based on recommendation of the American Galvanizers Association. Other metallic coatings shall have a minimum life expectancy of at least eight (8) years.
B. Organic Coatings. Organic coating systems shall consist of a wash primer if required by the condition of the substrate, a primer, intermediate coat(s), and a finish coat. Acceptable organic coatings are:

1) Aliphatic polyurethanes;
2) Vinyl copolymers;
3) Epoxy, as a primer where exposed in the atmosphere or as the complete system where sheltered from sunlight;
4) Acrylics, where not exposed to direct sunlight; and
5) Alkyds, where not exposed to direct sunlight.

11.3.14.5 Grounding

Grounding systems, including that required for APM Fixed Facilities, shall be provided in accordance with Section 9.1.4, Grounding of ASCE 21 and the requirements of this Part 2B, Section 11.3.14.5.

The grounding subsystem shall consist of grounding electrodes and/or conducting mats embedded in the earth, and located at the power substations, Guideway structure foundations, Stations, and other locations throughout the APM System in accordance with the Developer’s requirements. The Developer shall coordinate such requirements with LAWA and shall include requirements as part of the General D/CID. These grounding electrodes and conducting mats, including a means for the Developer to connect to them, shall be provided by Developer.

The Developer shall be responsible for assuring that the complete grounding system provides a ground resistance of not more than 5 ohms at all locations, including all points throughout the APM System. Measurements shall be in accordance with IEEE Standard 142, Grounding of Industrial and Commercial Power Systems. The Developer shall add grounding provisions as necessary to assure that all grounding for the APM System meets the requirements of IEEE Standard 142 and IEEE 80, Guide for Substation Safety in AC Substation Grounding.

Grounding and corrosion control requirements shall not conflict. Complementary grounding and corrosion control systems shall include proper location of insulation points and timely operation of grounding mechanisms.

Grounding protection systems shall be concealed where possible and shall:

A. Protect passengers and APM Operating System maintenance and Developer personnel from hazardous APM Operating System voltages.
B. Provide a ground path for lightning surges and fault currents.
C. Assure integrity of corrosion control systems.
D. Meet the most stringent grounding code requirements applicable to the APM Operating System.

All ground connections that will remain accessible throughout the life of the APM System shall be bolted. All connections that will become inaccessible shall be made using an exothermic weld (i.e. CADWELD) process. The Developer shall add ground rods as necessary to assure that the substation design meets the requirement of IEEE 80.

All metal enclosures and movable mechanical parts of the APM System shall be solidly earth grounded. All ground straps shall be connected at points free from contaminants or insulating finishes. Ground connections shall prevent hazardous potential differences or burnout under short circuit conditions and provide sufficient mechanical strength to withstand vibration.
General propulsion power grounding requirements are given in Part 2B, Section 11.3.8.1.5; more specific requirements are listed below.

11.3.14.5.1 Power Substations

Grounding for power substations shall consist of a ground bus connected to ground rods and conductors interconnected to form a low-resistance grid mat. To provide safe touch-and-step potentials, the mat shall meet IEEE 80. All risers to the ground bus shall be capable of carrying the anticipated range of short-circuit currents without damage. The equipment in the power substations shall have provisions for grounding. The negative return current of a DC voltage propulsion system shall be single point grounded at each substation per the requirements of Part 2B, Section 11.3.14.3.

The ground mat component materials, overvoltage device settings, and stray current drainage circuit quantities shall be coordinated to provide compatible power substation grounding and corrosion control systems.

11.3.14.5.2 Passenger Stations and Other APM Fixed Facilities

Grounding for APM Fixed Facilities will consist of a ground mat under each facility composed of a buried grid-and-rod system. Interconnection with steel piling and steel reinforcement shall be provided as necessary to reduce touch potentials. Grounded equipment, metal enclosures, motors, and similar equipment shall be located to preclude contact by passengers.

Grounding connections shall not be made on mechanical and utility pipes outside the dielectric coupling used to provide an electrical termination point for corrosion control systems.

Underground interconnections shall not be made between ground mats and water piping or other utility structures.

Additional grounding requirements for facilities and equipment are detailed in other sections and related standards.

To provide compatible passenger Station/facility grounding systems and corrosion control systems, ground mat component materials, platform insulation details, and pipe ground connection locations shall be coordinated.

11.3.14.5.3 Aerial Structures

Each grounding point for aerial structures shall consist of a ground electrode with rods and conductors at each end of the structure. If required, intermediate grounding points shall be provided. Ground electrode resistance to earth shall not exceed 5 ohms.

Aerial structures such as handrails, cable trough components, and other metal components, shall be made electrically continuous with the structure’s reinforcing steel. At each end of the structure, insulated cables shall be installed between the reinforcing steel and the ground electrode via an appropriately sized and conveniently located weatherproof junction box or manhole.

To provide compatible aerial grounding and corrosion control systems, ground electrode component materials, ground electrode locations, aerial component electrical continuity details, and pier support/insulation details shall be coordinated.

11.3.15 Guideway Alignment and Structural Requirements

This section addresses the requirements for the fixed Guideway alignment geometry, and the requirements for the structural design of the Guideway structure. The requirements of this section shall be used in conjunction with the requirements of the other sections; for instance: emergency walkway requirements are discussed in Part 2B, Section 11.3.11, passenger Station requirements
are discussed in Part 2B, Section 11.3.12 and Maintenance and Storage Facility (M&SF) requirements are discussed in Part 2B, Section 11.3.13.

11.3.15.1 Scope and General Requirements

The Part 5, Contract Drawings/Engineering Data provide an envelope for the Guideway and contain information on other APM Fixed Facilities (Stations, Maintenance and Storage Facility, etc.) that are required for the APM System. The Developer will develop the Guideway alignment and other related APM Fixed Facilities designs, based on the envelope and other information contained in the Part 5, Contract Drawings/Engineering Data. All Developer designs shall adhere to these requirements. The alignment and APM Fixed Facility designs are to be developed from the information in the Part 5, Contract Drawings/Engineering Data and these specifications and Developer shall coordinate its APM Operating System Work and its APM Fixed Facilities Work to fully integrate its designs and Work to provide an APM System that operates in conformance with the Contract Documents.

The structural system and elements shall be configured to minimize visual disruptions and shall be aesthetically integrated into the surrounding environment, whether existing or planned.

11.3.15.2 Guideway Alignment

The Guideway alignment shall be in conformance with Section 11.8, Guideway Alignment of ASCE 21, except as modified below.

A. The Vehicle ride quality criteria shall be as specified in Part 2B, Section 11.3.7.6.3.

B. Maximum superelevation at any section of the Guideway shall be limited to 6 percent.

C. Vertical grades shall not exceed 4 percent.

D. Guideway segments at Stations shall be flat. No vertical grade or super elevation shall be permitted at Stations.

E. Curved Guideway is prohibited in Stations. Guideway shall become tangent at least one Car length or 40 feet, whichever is greater, from the platform edge.

The conceptual Guideway envelope is shown in the Part 5, Contract Drawings/Engineering Data. Adjustments to the envelope may be considered if timely requested to optimize the Developer’s alignment to meet the specific APM Operating System requirements and to optimize the APM Operating System performance. All the Developer designs shall adhere to the envelope that is shown in the Part 5, Contract Drawings/Engineering Data. When considering adjustments to the envelope, primary consideration will be given to safety, passenger comfort, aesthetics, and functional design.

11.3.15.2.1 Horizontal Alignment

Horizontal alignment shall consist of tangents joined to circular curves by spiral transition curves. Spiral transitions shall be used at the entrances and exits of mainline circular curves and to transition between compound circular curves. Spiral length shall limit lateral jerk to the maximum value specified in Part 2B, Section 11.3.7.6.3. Minimum spiral length shall in no case be less than 40 feet. Spiral transitions length shall also consider the rate of change of super elevation for curves with super elevation together with the Vehicle racking limitations.

Clearances to adjacent structures shall be maintained in accordance to Part 2B, Section 11.3.15.2.3.
11.3.15.2.2 Vertical Alignment

Vertical alignment shall consist of tangents joined by parabolic curves having a constant rate of change of grade.

Clearance to adjacent structures shall be maintained in accordance to Part 2B, Section 11.3.15.2.3.

11.3.15.2.3 Clearance Requirements

The Guideway shall be designed and installed so that all non-APM System equipment and structures remains outside the Vehicle dynamic envelope at all times. The worst-case conditions include, as a minimum, suspension failures, wheel wear, flat tires (if applicable), construction and maintenance tolerances (including for guiding surfaces), Vehicle overhang on curves and super elevations, or combinations thereof. In addition, the clearance distance to adjacent structure or appurtenance, construction tolerances from designed position, and the effects of chord construction techniques relative to a curved alignment shall be considered. The clearance distance used for design shall include the capability of adjusting actual super elevation from the design value. A range of adjustment shall be investigated from the maximum super elevation of 4 percent to level track. Minimum clearances to the Vehicle dynamic envelope shall be as identified in Part 2B, Section 11.3.7.1.2 and as described below:

A. The minimum horizontal clearance between the dynamic envelope and any adjacent fixed or other structure that is not part of the Guideway structure shall be (established with sufficient clearance to provide maintenance access, emergency access and shall prevent interference between structures) as indicated on the Part 5, Contract Drawings/Engineering Data. The horizontal clearance at the Station platforms is specifically excluded from this requirement and shall be as identified in Part 2B, Section 11.3.7.10.4.

B. The minimum vertical clearance between the Guideway structure soffit and any adjacent fixed structure shall be established with sufficient clearance to provide maintenance access, emergency access and shall prevent interference between structures. A minimum vertical clearance from the top of the Vehicle dynamic envelope to any obstruction over the tracks shall be established with sufficient clearance to provide maintenance access, emergency access and shall prevent interference between structures.

C. The developer shall provide vertical clearance in accordance with Sections 1.3.1.G, 4.3.1.L and 7.3.2.D unless specifically identified otherwise on the Part 5, Contract Drawings/Engineering Data.

D. Clearance requirements between Vehicles and walkways are discussed in Part 2B, Section 11.3.11.8.1.

The Developer shall submit the proposed Vehicle dynamic envelope with its Vehicle Design Audit. In addition, appropriate clearance shall be provided between the Vehicle and other APM System equipment and structures, including power rails and undercar equipment, to ensure proper and safe operation.

11.3.15.3 Utilities/Services

The Developer shall coordinate with existing and planned utilities (power, communications, water, sewer, fuel lines, etc.), roadways and drainage channels or waterways as part of the Work. Interference with these shall be avoided. If existing utilities, roadways, curbs, pedestrian walks, signage structures, irrigation systems, landscaping, etc. must be relocated due to the Developer's Work, these shall be done by the Developer at no cost to LAWA and in a manner acceptable to
LAWA. At no time during the Work shall any utilities, roadways, etc. be disrupted or removed from service without the express consent of LAWA. All costs associated with providing temporary utilities (to avoid disruption of service) or maintenance of traffic roadways or systems shall be borne by the Developer.

11.3.15.4 Structural Criteria

The Guideway structure and any structure that supports the APM Operating System shall support, guide and restrain the Vehicles (up to the maximum length Train), running/guidance equipment and other related equipment. The Guideway shall also perform all other required tasks such as providing emergency access and egress capability, maintenance and operations access, support of wayside power distribution services, and housing of Automatic Train Control equipment.

The loads that shall be considered include, as a minimum, the loads defined in Section 11.9.1 of ASCE 21 with the following modifications:

A. The dynamic load allowance (I) or Impact Factor of thirty (30) percent shall be the larger of that required by Section 11.9.1 of ASCE 21 or the AASHTO LRFD Bridge Design.

B. The live load on the emergency walkways shall be 100 psf.

C. Guideway and maintenance platform structures shall support the end of line buffer. Developer shall design the support structure at this location to resist the loads defined in Part 2B, Sections 11.3.11.3 and 11.3.7.4.5.2.

D. Wind loads, including the design wind speeds, shall be computed based on the requirements of the local building code, or the requirements of Section 11.9.1 of ASCE 21, whichever is more stringent. Wind loads shall be applied in all directions on the surfaces of the APM Fixed Facilities as well as the Vehicle/Trains. If Trains will be stored inside a closed facility, the maximum wind loads on the Vehicle/Trains shall be based on the wind speed at which the Vehicle/Trains would be moved and stored inside.

E. The Fixed Facility structures shall be analyzed and designed for the effect of wind loads on the exposed surfaces of the structure as well as the loads from the exposed surfaces of the Vehicles/Trains and other equipment as appropriate.

F. Load effects imposed by the Developer’s APM Operating System shall not exceed the load effects used in the design of the APM Fixed Facilities; loads considered in the ongoing APM Fixed Facilities design development are indicated in the Part 5, Contract Drawings/Engineering Data.

The structural design (and construction) of the Guideway structure (and any structure that may support the moving Vehicle loads) shall conform to the seismic criteria in Part 2B, Section 11.3.4.11.

11.3.16 Electrical Materials and Workmanship

This section specifies the requirements for electrical materials and workmanship that the Developer and its subcontractors and/or suppliers must meet. The scope of this section includes all Work undertaken by the Developer and its subcontractors and/or suppliers except for the Vehicles. The Vehicle wiring requirements are specified in Part 2B, Section 11.3.7.8.5.

Unless otherwise specified, the Developer shall provide all equipment, software, cabling, cords, materials and appurtenances required to make the APM Operating System and associated subsystems fully operational for the specified design lives (see Part 2B, Section 11.3.1.5).
Refer to Part 2B Section 17 for additional cable and cable tray requirements for equipment that services LAWA’s network.

11.3.16.1 Compliance

Unless otherwise specified by the Contract Documents, all Developer and subcontractor designs, equipment, software, cables/wires, materials, appurtenances, terminology, abbreviations, and symbology shall:

A. Comply with applicable standards referenced in Part 2B, Section 11.2 and Part 4.
B. Be listed or labeled by Underwriter's Laboratories (UL) or an accredited testing agency.
C. Be installed in accordance with the manufacturer's recommendations, or if none, in accordance with best trade and engineering practices.

11.3.16.2 Working Environment

All equipment, cables/wires and materials shall (1) be designed and constructed for the intended working environment; and (2) operate within the intended working environment for the specified design life for the item.

11.3.16.3 Submittals

The Developer shall provide documentation to explicitly specify and illustrate the installation methods to be applied to all electrical equipment, cables/wires, materials and appurtenances, as part of associated Design Audits, and/or Design/Construction Interface Documentation. Further, the Developer shall identify all local construction permits required, and show evidence of applicable code research and compliance.

11.3.16.4 Interface Coordination

The Developer shall coordinate interfaces and/or integration requirements, in accordance with Part 2B, Section 11.3.17; Part 2A, Section 12; and as required elsewhere in the Contract Documents.

11.3.16.5 Pre-Installation Activities

All equipment, software, cables and materials shall be factory tested in accordance with the manufacturer's recommended quality control procedures. All equipment, software, cables, materials and appurtenances shall be packaged to prevent damage during transit and storage on-Site prior to use. The packaging shall have permanent label(s) affixed to it to identify the enclosed contents. Packaging and delivery requirements, as specified in applicable standards (e.g. EIA -383-A, EIA-583, EIA-541) shall be met.

11.3.16.6 Hardware and Installation Requirements

The Developer shall submit hardware and installation requirements that provide examples of typical equipment installations for Guideway, Station and M&SF locations to illustrate the type, number, appearance, and space requirements for installed equipment as part of the Guideway Equipment, Station Equipment and M&SF Equipment Design Submittal.

11.3.16.6.1 General

If the Developer penetrates existing or new walls, partitions or barriers, then all penetrations shall be fire-proofed in a manner that meets the requirements of applicable fire/safety codes. Such fire-proofing materials shall be specifically manufactured for this purpose.
Equipment, cables/wires, materials and appurtenances shall be installed in accordance with all applicable standards, including specifically: NFPA 70, NEC, NFPA 130, EIA/TIA-568, EIA/TIA-569, EIA/TIA 570, and EIA/TIA-606.

### 11.3.16.6.2 Damage

Equipment, cables/wires, materials and appurtenances that are damaged during implementation shall be replaced by the Developer prior to the APM Operating System Demonstration at no additional cost to LAWA.

### 11.3.16.6.3 Grounding and Bonding

Equipment and materials shall be grounded and bonded in accordance with these Part 2B, Design & Construction Technical Requirements, the manufacturer’s recommendations and all applicable standards.

### 11.3.16.6.4 APM Fixed Facility Installations

APM Operating System equipment, cables/wires and materials shall facilitate access for maintenance and operational purposes and allow operation/maintenance personnel to undertake activities without restricting APM Operating System operations or exposing themselves to hazards.

### 11.3.16.6.5 Equipment Mounting

Wayside enclosures, equipment, raceway and cable trays shall be mounted so as to prevent the ingress of water and foreign matter.

### 11.3.16.6.6 Cabinets and Consoles

All cabinet and console construction shall include provisions for forced or natural ventilation to prevent overheating of the internal equipment, components and cables/wires. The cabinets and consoles shall be capable of sustaining the intended dynamic and static loads. Sufficient clearances shall be incorporated into cabinet and console layouts to facilitate access to the enclosed equipment/components. The layout of equipment/components and cables/wires within the cabinet and/or console shall be such that future developments can be easily implemented.

Cabinet and console construction shall meet the requirements of all applicable standards, including EIA/TIA-310-D.

### 11.3.16.6.7 Raceway, Conduits, Ducts, Cable Tray Systems and Boxes

#### A. Hardware Requirements

1) **Raceway, Conduits and Ducts:** Unless otherwise accepted by LAWA, minimum conduit diameter shall be ½ inch for exposed Work, and 1 inch for embedded Work. Fittings shall be compatible with the conduit, and maintain a constant inside diameter. Conduit/tubing shall meet the following requirements:

   a) Flexible conduit shall be aluminum or steel alloy tubing with watertight compression fittings or LAWA- accepted equivalent. Both inside and outside surfaces shall be protected against corrosion.

   b) Unless otherwise accepted by LAWA, electrical metallic tubing (EMT) shall not be used. All electrical conduits shall be galvanized rigid steel (GRS).

   c) The Developer shall submit its raceway, duct and conduit provisions during the Design Audit process.
2) **Cable Tray Systems:** The Developer shall provide and install cable tray systems as required to complete the APM Operating System installation. The Developer shall provide all fittings, accessories, materials and appurtenances associated with the Developer-furnished cable tray systems. Cable tray systems shall adhere to all NEC requirements for grounding and bonding. The cover on the cable tray system shall be positively retained to remain with the tray. Cable tray system construction shall include a means to ventilate the enclosed cables, so the heat generated by the cables can be safely dissipated.

3) **Outlet, Junction and Pull Boxes:**
   a) Exposed exterior boxes shall protect enclosed equipment, cables and/or wires against water, water seepage, including water from rainfall or Vehicle operations and cleaning.
   b) Electrical boxes for control and communications applications shall conform to NEMA 4. NEMA 4X shall be provided for outdoor applications.
   c) Screws, associated with the box mountings and covers, shall not be smaller than No. 10-24. Box covers shall be (1) the same thickness as the boxes and (2) removable.

**B. Installation Requirements:**

1) LAWA is specifically concerned about visual appearance of installed equipment. Conduits, cabletrays, equipment boxes, track switches, switch cabinets, poles, antennas and the like shall be installed in an orderly, workmanlike manner. The Developer shall submit working drawings and BIM visualization models depicting representative equipment layout, conduit runs, and location of cable trays for the APM System Stations and representative sections of the Guideway including traction power supply. These shall be submitted to LAWA for aesthetic review and acceptance as appropriate in the Guideway Equipment, Station Equipment or M&SF Equipment Design Audit.

2) Conduits shall be installed so that moisture collecting in the conduit will be drained to the nearest box.

3) Conduits for emergency loads (e.g. emergency lighting, fire detection system, etc.) shall be run separately from non-emergency load conduits and protected from physical damage and fires. The Developer shall submit separation details to LAWA for review during the Design Audit process.

4) High and low voltage cables shall be installed in separate cable tray systems, in accordance with NEC and the cable tray system manufacturer’s recommendations.

5) Except for cases accepted in advance by LAWA, no conduit, duct, raceway or cable tray system shall contain more cables/wires than will result in more than a 40 percent fill.

6) Use of open or ladder-type cable tray systems shall be limited to APM System equipment rooms and Central Control. These locations shall, at least, (1) be a dedicated utility room with a minimum fire rating of one hour
and (2) include automatic sprinklers. All cables used within these cable tray systems shall be UL listed and identified as tray cable rated at a minimum.

11.3.16.6.8 **Cables, Wires, Fiber Strands and Cords**

A. **Hardware Requirements** - Unless otherwise recommended by the manufacturer and accepted by LAWA, metallic cables/wires shall be copper or tinned copper. Unless otherwise recommended by the manufacturer, all power (less than 600 volts), communication, control and signaling cables shall be suitable for use at any voltage up to and including 600 volts.

For control and signaling circuits, a minimum of ten percent spare conductors shall be provided.

All proposed cable, wire or fiber optic types and designs shall be submitted as part of the Design Audit process.

B. **Installation Requirements** - Where lubricants are used in the placement/installation of cables/wires, always adhere to manufacturer’s recommendations. Under no circumstances shall liquid detergent be acceptable. Pulling compound, if used, shall be nonconductive, non-hygroscopic, non-odorous, and shall not attract insects or rodents.

The Developer shall provide service loops at each cable end and at all hand/manholes. The length of the service loop shall be at least three (3) feet, or the manufacturer’s recommended length, whichever is greater.

Installation of cables/wires/fiber strands within ducts, raceway, conduit, cable tray systems, equipment cabinets and enclosures shall physically segregate and separate power, signal, control and communications cables/wires in accordance with manufacturer’s recommendations.

Cables/wires/fiber strands shall not be bundled within a conduit, duct or raceway. Each cables/wire/fiber strand shall be removable for replacement without disturbing other cables/wires/fiber strands in the enclosure. Where cables/wires/fiber strands are in open areas, bundling shall be permitted if this cable/wire/fiber strand removal criterion is met.

Exposed cables/wires shall be insulated, cleated, tied or secured by suitable means.

The following requirements shall apply to cable/wire/fiber strand harness ties and tape:

1) Tie wrap/tape spacing for all harnesses shall be uniform and shall not exceed six inches.

2) Ties and tape shall be installed before each breakout from the harness.

11.3.16.6.9 **Terminations**

A. **Hardware Requirements** - Termination hardware shall be constructed for the intended cable, wire and/or fiber strand size. Terminals used on AWG 10 or smaller conductors shall be of the insulating type and designed to grip and hold the insulation on the conductor securely.

B. **Installation Requirements** - Wire wrap termination methods and fast-on type terminals shall not be used.

With the exception of printed circuit boards, solder connections shall not be used.
No bare conductor or fiber strand shall be visible after the cable/wire/fiber strand has been terminated.

11.3.16.6.10 Pull Wires

Pull wires shall be installed in all Developer-provided cable systems.

11.3.16.6.11 Identification

All equipment, enclosures, cabinets, metallic cables/wires and fiber optic cables/strands and termination points shall employ a uniform system of identification throughout the APM Operating System. The Developer shall provide and install all materials and appurtenances required for the identification system. The Developer’s identification system shall be submitted for review by LAWA as part the Design Audit process. All electrical diagrams and schematics shall be keyed to the applicable identification system.

11.3.16.6.11.1 Color Coding

Color coding of cables/wires/fiber strands shall comply with the following requirements:

A. Power cable conductors shall be color coded as specified in the National Electric Code (NEC);

B. Fiber optic cable color coding shall unambiguously identify each fiber strand and meet all standards and manufacturer recommendations (e.g., EIA/TIA-598); and

C. Telephone and data multiple twisted pair cables shall unambiguously identify each twisted pair and meet all applicable guidelines, standards.

11.3.16.6.11.2 Labels/Tags

A permanent, corrosion-resistant label/tag shall be (1) affixed to or (2) located adjacent to, each piece of equipment, control and display, enclosure and cabinet. Each APM Operating System cable shall have at least one permanent corrosion-resistant label/tag per cable end. The identification of wiring and fiber strands shall include both color and alphanumeric coding. Each wire/fiber strand shall have at least one permanent corrosion-resistant label/tag per wire/fiber strand end. Spare equipment and cables/wires/fiber strands that are installed shall be clearly identified as such.

Where labels and/or tags are used, the following requirements shall apply:

A. Handwritten labels or tabs are not acceptable;

B. The materials that constitute the labels/tags shall be chosen so as to ensure they retain their integrity and information throughout the installation lifetime;

C. All labels/tags shall be in English, and located so as to be visible when the installation is completed; and

D. Adhesives shall not be used for securing labels/tags.

11.3.16.7 Spare Provisions

Except as otherwise specified, all control, signal and communications installations shall include at least twenty (20) percent spare wires and/or fiber strands. All spare equipment and cable/wire/fiber strand infrastructure shall be tested, as if they were operational.

11.3.16.8 Locks

The Developer shall provide padlocks and cabinet locks for all APM Operating System equipment as necessary for electrical safety in accordance with Part 2B, Section 11.3.5.1.4, and as
necessary to prevent acts of crime, vandalism, or sabotage in accordance with Part 2B, Section 11.3.5.2.

11.3.17 APM Operating System Integration and Interfaces

In addition to the provisions included in Part 2A, Section 12, the Developer shall address the following interfaces and integration provisions specifically for the APM Operating System. The Developer shall assure that all interface obligations identified in Exhibit 10 of the Agreement are coordinated with the appropriate AHJ for each of the five (5) areas of Related Projects. The Developer shall provide one (1) Design/Construction Interface Document, in accordance with the Summary of Submittals list in Part 2A, Section 6.7 and the requirements of this section, that address the integration of the APM System; with the right-of-way and any infrastructure contained therein; any adjoining facilities; and any facility not provided by Developer that is used or impacted by the Developer. This document shall identify and specify each interface with Related Projects and key integration activities within the Developer's Work. The Developer shall also provide the procedure by which each interface will be finalized. Interfaces shall be managed and controlled in accordance with the configuration management requirements of Part 2A, Section 12 and Interface obligations of Exhibit 10. Further details regarding the Design/Construction Interface Document are provided throughout these Design & Construction Technical Requirements. The timely preparation of the D/CID and their timely coordination is of critical importance.

11.3.17.1 APM Operating System Interfaces and Coordination

This section addresses the coordination of Work and integration and interfaces between APM Operating System elements Work provided by the Developer and other work, provided by LAWA and others associated with the Project (Related Projects). This section is not intended to provide the Developer with a detailed description of all such interfaces; rather, it provides broad descriptions focused on general interface areas and responsibilities.

The Developer shall prepare the D/CID Submittal in Chapters or Sections that address each interface separately. Some of LAWA's responsibilities involve participation in the Project by other parties, design professionals, and construction contractors who will not be under subcontract to the Developer.

The Part 5, Contract Drawings/Engineering Data depict site specific alignment envelope to which the Developer shall design and adapt its APM System such that the completed APM System is fully and properly integrated and operates in conformance with the Contract Documents. The Developer shall coordinate its Work in a timely manner on a regular basis such that the designs are fully integrated; interface information in the Part 5, Contract Drawings/Engineering Data is subject to further design development and Developer shall coordinate all interfaces.

11.3.17.1.1 Related Projects

The Developer shall review the design drawings and procurement documents, as applicable, for all aspects of Related Projects and provide comments related to the integration and interfaces with the Developer's Work and Related Projects. The Developer shall be responsible to coordinate with others who provide, as Related Projects, any equipment or work that interfaces with the APM System. The Developer is responsible for inspecting the Related Projects to identify and successfully meet all integration and interface requirements.

The Developer shall identify, coordinate and incorporate the interfaces between the APM Operating System and APM Fixed Facilities and Related Projects.

The Developer shall submit conduit requirements in accordance with the requirements of this section, so that conduits required to be installed in Related Projects may be embedded or hidden
from view. All conduits in public areas shall be embedded, or hidden in walls chases, Guideway structure, or Station structure.

The Developer shall provide and install all fasteners, dowels, etc. as may be necessary for the proper installation of its Work onto work provided by others. For example, dowels, whether embedded or drilled and epoxy fastened, for attaching the running surface to Guideway structure provided by others as Related Projects shall be provided and installed by the Developer.

The Developer shall provide all APM System power and control/communications wiring, unless otherwise noted in these Part 2B, Design & Construction Technical Requirements. All APM System power wiring shall be installed in conduits, duct banks, raceways, or wire ways separated from low voltage control and communication wiring. Power and control/communications wiring or cable not in conduit and under raised floors, above ceilings, or in plenums shall meet the fire and smoke requirements of NFPA 70. Additional conduit requirements are provided throughout these Contract Documents.

11.3.17.1.2 Reserved

11.3.17.1.3 Design/Construction Interface Document

The Developer shall provide one (1) Design/Construction Interface Document (D/CID) in accordance with the Summary of Submittals list in Part 2A, Section 6.7 as specified in this section. The DCID shall be organized into Chapters or Sections that correspond to the areas included in Exhibit 10. For areas where the Developer’s Work is required to be installed by Developer on structure provided by others the DCID shall address integration requirements applicable to the APM System relevant to the specific area of interface. The following sections provide guidance on the contents of the D/CID and are supplemental to the requirements of Exhibit 10. Updates of these documents shall be provided by the Developer when significant schedule or Project changes are made. The Developer shall participate in coordination meetings with LAWA and other Project stakeholders to develop and finalize all designs and interfaces as stated in Exhibit 10.

As part of the D/CID, the following typical information shall be prepared for each interface and/or integration item along with appropriate drawings illustrating interface details and requirements:

A. Type of interface and/or integration activity.
B. Description of the interface and/or integration activity.
C. Interface and/or integration identification code.
D. Location of associated equipment or components.
E. Design, performance and operational constraints.
F. Responsibility for interface and/or integration design and implementation.
G. Related drawing numbers and issues.

11.3.17.1.3.1 Guideways and Guideway Equipment

The Guideway topics to be addressed by the Developer as a separate chapter in the D/CID shall include:

A. Clearance, space, and structural loading requirements for the Guideway structure to accommodate Developer’s Trains and Guideway equipment. Confirm and identify any requirements that exceed the requirements identified by LAWA/others for Related Projects.
B. Emergency evacuation features (for Vehicle/emergency walkway compatibility and passenger suitability throughout the APM System.
C. Interfaces and/or integration with all Guideway equipment, including loads, dimensional requirements, mounting requirements and special features.

D. Provisions required in the Guideway structure to accommodate electrical conductors and grounding.

E. Geometric criteria of Guideway structure to ensure ride quality requirements are met.

F. Drainage requirements of Guideway structure and equipment.

G. Aesthetics (recommendations).

H. Interfaces and/or integration with existing and pending infrastructure elements.

I. Maintainability considerations and requirements.

J. Construction tolerances for proper ride and interface and/or integration with Guideway equipment.

K. Structural and spatial requirements for switches if Developer proposes to locate switches on ConRAC structure (see Part 2B, Sections 11.3.1.3.1 and 11.3.1.3.6).

L. Accessibility requirements.

M. Conduit, raceway, cable tray systems, etc. provisions and their associated mountings.

N. Cable routing and segregation.

O. Stairway and ladder requirements.

P. Isolation gap, expansion joint and seismic joint provisions.

Q. Location of Developer-provided equipment enclosures, materials, etc.

R. Spare provisions (see Part 2B, Section 11.3.13.5).

S. Emergency walkway lighting, power rail protection, and static signage interface and/or integration requirements.

T. Service and distribution requirements for infrastructure provided by LAWA.

U. Security requirements.

V. Ancillary structure requirements.

W. Dead load, live load and wind load requirements; including dynamic interactions and effects.

X. Dynamic load requirements.

Y. Summary of interfaces and/or integration between APM System and Related Projects.

The Guideway topics to be addressed by the Developer in the D/CID shall include key integration elements related to any dynamic envelope conflicts, key tolerances, and elements with significant visual impact.

11.3.17.1.3.2 Alignment Geometry and Clearance Envelope

Guideway alignment geometry is depicted in the Part 5, Contract Drawings/Engineering Data. This alignment, subject to modifications and refinements to accommodate specific requirements of the Developer’s APM Operating System as part of the ongoing design process, will serve as the basis for the final Guideway design drawings, subject to any proposed adjustments and
recommendations provided by the Developer. The Developer shall provide complete alignment information for any Developer-proposed changes to the horizontal and vertical alignments.

As part of the APM Operating System Guideway Design Audit effort, the Developer shall verify existing conditions, including the dimensional accuracy of the as-constructed Guideway structure, and shall promptly correct any discrepancies. The Developer shall document in its APM System Guideway Design Audit any design adjustments required to accommodate the APM Operating System.

The space available for Trains in the Stations and along Guideway sections is defined in the Part 5, Contract Drawings/Engineering Data. The ConRAC Station interfaces shall be subject to design coordination with the ConRAC Party as noted in Exhibit 10B. Extension of the platform edge to provide an appropriate gap between the Vehicle and the platform shall be the responsibility of the Developer.

The Developer shall fit all applicable equipment, including any secondary Guideway structures, within this available space. Clearances within this available space shall be in accordance with Part 2B, Section 11.3.7.1.

11.3.17.1.4 Stations

The Station topics to be addressed by the Developer in the D/CID shall include:

A. Station space requirements, clearances, loads and design features to accommodate the Developer-provided Station equipment, materials and cables. Identify the location and nature of all interfaces between the Developer-provided equipment, materials and cables and LAWA-provided Station work (Related Project).

B. Vehicle/platform interface and/or integration and clearance requirements, including the locations of the platform doors within the “allowable platform door zone” as shown on the Part 5, Contract Drawings/Engineering Data. Additionally, address evacuation from the Vehicle for the entire length of the Station platform, including identification of break-away panels for passenger evacuation directly onto the Station platform for all misaligned Train conditions.

C. Guideway equipment as appropriate including end of track buffers at end of line Stations.

D. Interface with the primary utility services, including electric power.

E. Safety and security provisions, including fire and other alarms.

F. Station intrusion alarms (i.e., security requirements).

G. Emergency evacuation of passengers, including Station access to/from the Guideway.

H. Conduit, raceway, and cable tray system requirements.

I. APM Fixed Facility/Station subsystem requirements (e.g., lighting, HVAC, plumbing, etc.), including specific need for HVAC for equipment rooms. Any required HVAC including HVAC redundancy to maintain APM equipment room ambient conditions shall be provided by the Developer.

J. Grounding and lightning suppression requirements.

K. Fire protection requirements, including detection alarms, fire management panel if applicable, and fire suppression.

L. Drainage requirements.
M. Maintainability and accessibility requirements.
N. Platform edge barrier wall requirements.
O. Cable routing and segregation.
P. Location of Developer-provided equipment, enclosures, materials, etc.
Q. Spares provisions (see Part 2B, Section 11.3.13.5).
R. ADA provisions and requirements.
S. Interfaces and/or integration with all Developer-provided Station equipment, materials and cable, including loads, dimensional requirements, mounting requirements and special features.
T. Aesthetics of Developer-provided equipment and fit with Related Projects aesthetics.
U. Locations, ancillary facility provisions and requirements as required for miscellaneous items such as static signage, portable fire extinguishers, etc.
V. Locations that can be used for LAWA-provided equipment as described in Part 2B, Section 17 at the Developer provided stations. IT Room location will be by ConRAC Team at the ConRAC station.
W. Access.
X. Dead and live load requirements.
Y. Refuge area requirements and interfaces and/or integration with the Guideway equipment and power rails.
Z. Station/Vehicle interface and/or integration data, including, at a minimum:
   1) Static Vehicle/Station interfaces and/or integration showing plan, elevation and end views, with specific depiction of the Train stopping positions within the “allowable platform door zones” (see Part 2B, Section 11.3.1.3.9).
   2) Vehicle dynamic envelope within the Station (plan and end views) for the normal combined effects of yaw and roll.
   3) Vehicle dynamic envelope within the Station for the worst-case combination of probable failure conditions where probable failures shall include support wheel/tire failure(s) and failure of vertical and/or lateral suspension components.
   4) Vehicle/Station interface and/or integration during unlikely failure conditions; where this unlikely failure shall include the worst combination of failures of Vehicle support, suspension and guidance components.

The Station topics to be addressed by the Developer in the D/CID shall include any dynamic envelope conflicts and elements with significant visual impact.

11.3.17.1.5 APM Operating System Power Distribution System

Electrical Power Distribution System (PDS) equipment for APM Operating System propulsion, auxiliary Guideway power, and any Developer-supplied equipment shall be supplied and installed by the Developer as specified in Part 2B, Sections 11.3.8 and 11.3.14, and throughout these Part 2B, Design & Construction Technical Requirements.
The Developer shall coordinate all aspects of the PDS design and construction phasing with Los Angeles Department of Water and Power (LADWP) (also referred to as the Power Company) through LAWA. The PDS topics to be addressed by the Developer in the D/CID shall include:

A. Power Company services (LADWP), APM Operating System load requirements and connections.

B. General requirements for substation equipment in all PDS substations.

C. The interfaces between LADWP equipment and the Developer’s equipment, including:
   1) Location of service entry and metering equipment and associated clearance and space;
   2) Equipment connectivity and compatibility requirements;
   3) Scheduling requirements; and
   4) Testing requirements.

D. Blue light stations.

E. Intrusion alarms.

F. CCTV.

G. Requirements for any UPS equipment (e.g., ventilation, water and sewer hook-ups).

H. Accommodations required for Developer-provided electrical wiring, conduit, duct banks, and associated hardware through any Related Projects construction.

I. A complete APM Operating System electric power system load analysis.

J. Grounding and corrosion control requirements.

K. Equipment maintainability and accessibility.

L. APM Fixed Facility subsystem requirements (e.g., lighting, HVAC, housekeeping power (e.g., convenience outlets), etc.). Any air conditioning to maintain ambient conditions shall be provided by the Developer, including HVAC redundancy.

M. Supplemental fire protection provisions, if any.

N. Cable routing and segregation.

O. Drainage requirements.

P. Access.

Q. Ancillary facility provisions (e.g., static signage, portable fire extinguishers, etc.).

R. Spare provisions (refer to Part 2B, Sections 11.3.13.5).

S. Conduit, raceway and cable tray requirements for embedments in Related Projects.

T. Operating environment conditions (e.g., minimal ambient temperature).

U. Security and Safety Requirements.

11.3.17.1.6 Central Control Facility

The space for the CCF shall be located at the M&SF as specified in Part 2B, Section 11.3.13.11. CCF equipment features and functional requirements are specified throughout the Part 2B, Design & Construction Technical Requirements.
The CCF topics to be addressed by the Developer as a separate chapter in the D/CID shall include, at a minimum:

A. All communications interfaces with non-APM System communication systems.
B. Locations, space and associated clearances that can be used for LAWA-provided equipment as described in Section 17.
C. Locations, space and associated clearances that can be used for Developer-provided equipment for LAWA use.

11.3.17.1.7 Maintenance and Storage Facility

The M&SF will be provided by the Developer, as specified in Part 2B, Section 3, and as shown on the Part 5, Contract Drawings/Engineering Data. The D/CID shall provide detailed information defining the interface and/or integration requirements between LAWA and Developer-provided equipment and Work.

Fire Management Panels (FMP) shall be provided by the Developer at locations coordinated with LAWA.

The M&SF topics to be addressed by the Developer in the D/CID shall include locations, space and associated clearances that can be used for LAWA-provided equipment and Developer-Provided equipment for LAWA use.

11.3.17.1.8 Vehicle Wash Facility

The Vehicle wash facility shall be located at the MSF.

Vehicle wash facility interface and/or integration topics that shall be addressed by the Developer in the D/CID shall include:

A. Drainage requirements;
B. Code/standard requirements;
C. APM System environmental design requirements;
D. Waste collection/disposal requirements; and
E. Specific information regarding the quantity and composition of the proposed effluents from washing and any other maintenance activities.

11.3.17.1.9 Equipment Rooms

The conceptual APM Operating System equipment room and the LAWA IT equipment room locations at the ConRAC are shown on the Part 5, Contract Drawings/Engineering Data and subject to design coordination; other equipment locations are to be located, provided, and furnished by the Developer. These locations are for Developer-provided equipment as specified throughout these Part 2B, Design & Construction Technical Requirements.

The equipment room interface and/or integration topics that shall be addressed by the Developer in the D/CID shall include:

A. Nature of room use, space requirements and room layout to accommodate the Developer’s equipment.
B. Housekeeping electric power service requirements.
C. Ventilation and air conditioning capacity requirements. All HVAC (including primary HVAC) will be provided by the Developer as defined in the D/CID; all redundancy in the HVAC system to maintain equipment ambient conditions shall be identified and provided by the Developer.
D. Equipment delivery access.
E. Safety and security provisions, including fire protection.
F. Developer-supplied equipment loads (electrical and structural).
G. Equipment maintainability and accessibility requirements.
H. Requirements for conduit, raceway and cable tray provisions to be embedded in Related Projects.
I. Cable routing and segregation requirements.
J. Drainage requirements.
K. Grounding system requirements.
L. ADA provisions and requirements.
M. Spare provisions.
N. Ancillary facility provisions (e.g., static signage, portable fire extinguishers, personal safety equipment, including emergency eyewash and shower facilities).
O. Supplemental fire protection, if any.
P. Locations, space and clearances for LAWA-provided equipment.
Q. Locations space and clearance for Developer-provided equipment for LAWA use.

11.3.17.2 Infrastructure Interfaces

The Developer is responsible for coordinating, inspecting and accepting all interface requirements between the APM System and existing and planned infrastructure as defined in these Contract Documents.

The Developer shall comply with Airport operations, AOA and airspace requirements, and clearance requirements for power lines and shall identify right-of-way impacts if power lines or other facilities are proposed to be relocated, modified or redesigned.

The APM Developer shall coordinate with the AHJ and LA Metro interfaces of fire detection alarms between the APM Operating System and LA Metro’s fire detection system.

11.4 Summary of Submittals

As a minimum, the Developer shall provide submittals as indicated in Part 2A, Section 6.
12. UTILITIES

12.1 General

This section establishes requirements for the rearrangement of utilities affected by construction of the Project. Refer to Part 2A, Third Party Coordination and Utility Coordination, Section 24 and 25 respectively, for coordination requirements and information related to utility agreements. The Developer shall comply with all requirements of the AHJ.

12.1.1 Existing Utilities

The Developer shall verify horizontal and vertical location of all existing utilities that may have the potential to affect the Work.

A. The Developer shall pothole, or by other means, locate all utilities that may be impacted by the Work. When such exploratory excavations show a discrepancy with the utility location indicated on the composite utility map, the Developer shall notify LAWA and the Utility Owner of such discrepancy, including proposed mitigation and design. The number of exploratory excavations and extent of potholing and restoration required shall be sufficient to determine the alignment and grade of the utility as well as any potential conflicts with the Developer’s Work.

B. The Developer shall demonstrate to Utility Owner that all remaining utilities and appurtenances are not a part of an active system and are therefore authorized for removal, as necessary. Pending that evaluation, the Developer shall not commence removal of any active utility items and appurtenances until authorization by Utility Owner. If any active systems are encountered which cannot be taken out of service or cannot be removed and are in conflict with the proposed construction of the Project, the Developer shall notify the Utility Owner.

C. All utilities encountered along the line of the Work shall be maintained continuously in service during all operations during the Term, unless other arrangements satisfactory to the Utility Owner and LAWA are made. All valves, switches, vaults, and meters shall be maintained readily accessible for emergency shutoff.

D. All existing manhole access shall be kept in place and accessible before and after the construction. The Developer is responsible for adjusting all existing manholes or utility accesses to the finished grade. For utility manhole access exceeding 20 feet in depth, the design of any fixed ladder shall comply with CFR Title 29 Sec 1910.27 of OSHA safety and landing requirements.

E. Central Utility Plant (CUP) on Center Way shall be protected in place and remain in operation at all times during the construction. All ductbanks connecting to CUP shall be protected in place.

12.2 Standards and Specifications

The Developer shall comply with the requirements listed in Part 4, Standards and Specifications.
12.3 Performance Requirements

12.3.1 Utility Relocations

A. The Developer shall provide LAWA an estimated schedule for its respective utility work and notify LAWA of any significant changes to the schedule as soon as practical.

B. The Developer shall minimize interruption of utility services by scheduling interruption of all re-routed utility lines and conduct tie-in activities during off-peak service periods approved by the affected Utility Owner.

C. The Developer shall not conduct storm water piping relocation tie-ins during or within twenty-four (24) hours of any rain event;

D. The Developer shall utilize pumps and diverted flows to maintain full service capabilities of all relocations of wastewater piping.

E. Utility service (service lines) to abutting properties shall be maintained and, if temporarily relocated, shall be restored to their prior location upon completion of the Work. The Developer shall be responsible for coordinating all temporary outages with utility companies and other affected parties.

F. Utilities impacted by the Project shall be adjusted to the Project datum. Monuments used to establish the Project datum and utility elevations shall also be used and recorded with any utility survey.

G. Utilities shall not be placed within drainage culverts or in any manner or position that might cause damage to or impair the safety of the Project per requirements of the AHJ.

H. Utility company structures shall be designed and constructed in accordance with each company’s corrosion control practices and provisions.

I. No foundation construction shall be conducted within Southern California Gas Company’s (SCG) Excavation Area for the two existing 30” gas mains (# L2003 and # L3007) along Aviation Blvd. The SCG Excavation Area is defined as ten (10)-ft. horizontal clearance and three (3)-ft. vertical clearance from the said facilities above. Developer shall contact Southern California Gas Company for their final locations prior to design and construction.

J. Overhead telecommunication lines located on power poles that are relocated need to be coordinated with Utility Owner prior to relocation.

12.3.2 Trenching and Backfilling for Utilities

Excavating, trenching, and backfilling for utilities and related structures shall comply with the requirements of the AHJ and the Geotechnical Report prepared and submitted by the Developer.

12.3.3 Sanitary Sewers

All sewer construction maintenance, relocation, and restoration, shall be performed in accordance with the requirements of the AHJ.

Developer shall be responsible for providing CCTV inspection of all existing sanitary sewers, including the Central Outfall Sewer (COS), within the D&C Limits as required by the AHJ.

The CCTV shall be conducted at three (3) construction stages of the adjacent construction:

A. prior to start of construction,
B. after the completion of the pile foundations, and
C. at the end of the construction.

At each stage the DVD and record log shall be submitted for review and confirmation that no damage has occurred to the existing sewers and to obtain approval to continue with the next construction operation.

**12.3.3.2 Layout of Work Near the Central Outfall Sewer**

To secure proper protection of the Central Outfall Sewer within the D&C Limits, the Developer shall have a survey done of the Central Outfall Sewer and the 15-foot sanitary sewer easement by a professional land surveyor licensed in the State of California. Both of these limits shall be located in the field. The professional land surveyor shall also verify the existing Central Outfall Sewer centerline horizontal and vertical alignments. The survey shall also verify that the existing Central Outfall Sewer maintenance holes are not offset from the centerline of the sewer, thus misrepresenting the Central Outfall Sewer alignment. Survey shall also stakeout the exact location of all piles to be constructed near the Central Outfall Sewer easement as shown on the structural plans. The Developer shall notify the AHJ of any found discrepancy with the foundation plans and actual field conditions.

If shoring is necessary, the Developer shall have a professional land surveyor layout the alignment of the shoring within the City’s Right of Way and sanitary sewer easements.

**12.3.3.3 Sewer Maintenance Hole Requirements**

All sewer maintenance holes shall be cleared of any vertical obstructions in order to allow for proper sewer maintenance.

**12.3.3.4 Placing, Spreading and Compacting Fill Material**

Special precautions and protection shall be considered, when working in the immediate area over and around existing Central Outfall Sewer and sanitary sewer easement. No backfill and recompaction in that area shall be done without the approval of the AHJ. No heavy machinery, spike rollers or heavy compactors shall be used for backfill and compaction operations over the 15 feet minimum sanitary sewer easements (7.5 feet each side of the centerline of Central Outfall Sewer). Heavy equipment can be permitted over the sewer only if the conduit is excavated, exposed and encased in concrete.

**12.3.4 Water (Domestic, Fire, Irrigation)**

The Developer shall design, furnish, and install water supply lines and connections at all Stations, The Maintenance and Storage Facility (M&SF) and Traction Power Substation (TPSS) sites for domestic water use as well as water for fire services, fire hydrants and sprinklers per the requirements of the AHJ.

- **A.** Domestic water shall be used for Vehicle washing. Developer shall provide storage for water and treatment facility to allow re-use. See Section 11.3.13.1.4.
- **B.** The Developer shall design, furnish and install irrigation water supply lines and connections at M&SF site and TPSS sites, the ITF West and along roadways in accordance with the requirements of the AHJ.

**12.3.5 Power Supply and Distribution**

The Developer shall design, furnish, and install all power supply lines and connections required for the scope of Work of the contract in accordance with the requirements of the AHJ and the FEIR.
12.3.6 Temporary Power Supply Distribution

Application for new temporary electrical services shall be in accordance with the requirements of the AHJ.

12.3.7 Permanent Power Supply and Distribution

LAWA has been working with LADWP to initiate the design for bringing two power feeds to each of the TPSS sites identified in the Contract Drawings and also to the M&SF site. If the Developer chooses not to use these sites or requires different dates for required service than those provided in Table 12.3.7.1-1 below, all costs to route the power and ductbank to those Developer determined locations and changes in the service required dates shall be the responsibility of the Developer. The Developer shall also be responsible for negotiating any changes with LADWP.

12.3.7.1 Electrical Service Planning Information

Table 12.3.7.1-1 below identifies the locations and date of requested service as indicated on the LADWP Service Request along with the estimated loads at each location. The Developer shall coordinate the service request dates with their actual requirements with LADWP.

<table>
<thead>
<tr>
<th>Address</th>
<th>Description</th>
<th>Service Date Requested</th>
<th>Estimated Loads</th>
</tr>
</thead>
<tbody>
<tr>
<td>51 World Way</td>
<td>LAWA APM TPSS #1</td>
<td>10/20/2020</td>
<td>5718kVA</td>
</tr>
<tr>
<td>5929 W. 96th Street #2</td>
<td>LAWA APM TPSS #2</td>
<td>6/12/2020</td>
<td>6041 kVA</td>
</tr>
<tr>
<td>9952 Aviation Blvd</td>
<td>LAWA APM TPSS #3</td>
<td>1/15/2021</td>
<td>3641kVA</td>
</tr>
<tr>
<td>5382 W Arbor Vitae St</td>
<td>LAWA APM M&amp;SF</td>
<td>6/24/2020</td>
<td>3581 kVA</td>
</tr>
</tbody>
</table>

In addition to running the ductbanks from the Points of Handoff to the locations identified in Table 12.3.7.1-1 Power Planning Information, the Developer shall install a vault in the vicinity of the area adjacent to the LADWP connection point at each site for future connection of new power feeders by others.

12.3.8 Points of Handoff

The Points of Handoff, as shown in Table 12.3.8-1 below, are defined as the location that the Developer will construct and connect its ductbank to a ductbank installed by others. LADWP will design the underground ductbanks, and utilize the duct banks to provide the power connections to the Developer for TPSS sites and additional ductbanks to other locations as indicated in Table 12.3.8-1.

<table>
<thead>
<tr>
<th>Point of Handoff</th>
<th>Developer Ductbank To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arbor Vitae and D Street within 100 feet</td>
<td>South down D-Street with feeds to the APM M&amp;SF site.</td>
</tr>
<tr>
<td>Arbor Vitae and D Street within 100 feet</td>
<td>South down D-Street with feeds to Neutrogena, and continue down D-Street and east on 96th Street to Bellanca.</td>
</tr>
<tr>
<td>Arbor Vitae and Aviation within 100 feet</td>
<td>South down Aviation from Arbor Vitae with feeds to the APM TPSS #3 site.</td>
</tr>
<tr>
<td>Arbor Vitae and Aviation within 100 feet</td>
<td>South down Aviation to future ITF East Garage site where the Developer shall stub up and provide a vault for future connection.</td>
</tr>
</tbody>
</table>
### 12.3.9 Availability of Power Feeders

Power feeders to the TPSS sites will be provided to the Developer in phases as follows:

A. LULEP will construct vaults at each point of handoff described in Table 12.3.8-1 as identified in Part 2A Section 21. These vaults will be available for Developer to connect its underground ductbanks; from each TPSS site;

B. Phase 1: The Developer shall coordinate with LADWP to provide power feeders as identified in Part 2A Section 21, from overhead lines through the Developer provided ductbanks to each TPSS site;

C. Phase 2: LADWP will provide power feeders as identified in Part 2A Section 21, from RS-N, through underground feeders to each of the Developers TPSS sites. When Phase 2 is ready, the Developer shall coordinate with LADWP to cut over to the new feeders.

Points of handoff for these vaults will be within the 100 feet identified in Table 12.3.8-1 with LADWP doing the design of ductbanks and vaults and pulling the power feeders after AHJ acceptance of the Developer constructed ductbank.

### 12.4 Summary of Submittals

At a minimum, the Developer shall provide submittals as indicated in Part 2A, Section 6.
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13. **STREETSCAPE, LANDSCAPE AND PUBLIC REALM**

13.1 **General**

This section describes the required Streetscaping, Landscaping and improvements within the public realm for the Work. The Developer shall incorporate the following requirements in accordance with the LAX Design Guidelines, Chapter 3:

A. Planting Palette;
B. Landscape Buffers;
C. Street Furnishings;
D. Structure Visibility;
E. Storm Water Management;
F. Lighting; and
G. Pedestrian, Multi-use path and Bicycle integration in compliance with AHJ bicycle and pedestrian route plans.

13.2 **General Streetscape guidelines**

The Developer shall incorporate the following into the Work:

A. Roadways, except CTA roadways, shall be lined with street trees, where feasible, near the curb, shading the sidewalks and creating an attractive and distinctive aesthetic appearance;
B. Sidewalks shall be wide, ranging from 13’ on collector streets to 18’ on boulevards, when feasible and within the public right-of-way;
C. Adequate and distinctive lighting shall be provided throughout the CTA. Street lights would be AHJ approved LED lighting;
D. Improvements along Century Boulevard shall comply with the City of Los Angeles’s (City) Century Corridor Streetscape Plan, once adopted, including wide sidewalk/parkway areas with a double row of street trees, where feasible, and a landscaped multi-use pathway on the south side. Pedestrian lighting shall be introduced on both sides of the street complementing the existing light columns:
E. Clear, easy to navigate and attractive pedestrian and bicycle connections from adjacent developments to the Stations outside of the CTA;
F. Landscaped medians and pedestrian refuge areas, where feasible, to reduce roadway crossing distances;
G. Streetscape areas incorporating storm water management and drought-tolerant landscaping;
H. Wayfinding signage for vehicles, pedestrians and bicyclists integrated into the streetscape;
13.3 Streetscape for Individual Streets

The Developer shall incorporate the following additional guidance and vision for specific streets included in the Work:

A. Century Boulevard – Within the D&C Limits, The Developer shall comply with the requirements of the Century Corridor Streetscape Plan, including,
   1) Regularly-spaced pedestrian-oriented lighting compatible with the existing light columns;
   2) Benches, trash cans, and other street furniture placed along the corridor and at transit stops; and
   3) Maintenance of pedestrian access to the CTA across Sepulveda Boulevard.

B. Aviation Boulevard, within the D&C Limits, including:
   1) Multi-use pathway on the west side of Aviation Boulevard from Arbor Vitae Street to 98th Street, transitioning to the east side or Aviation at the 98th Street intersection;
   2) Pedestrian-scaled lighting required to illuminate the multi-use pathway; and
   3) Raised median with turn lanes at signalized intersections.

13.4 Site Access and Circulation

The Developer shall ensure access to any given site within or adjacent to the D&C Limits is clearly organized and designed to minimize potential conflicts between all users, including pedestrians and bicyclists.

The Developer shall:

A. Prioritize pedestrian connections for site access to minimize conflicts and increase safety. The pedestrian access routes shall be clearly marked and shall use techniques such as raised crosswalks, crosswalks with lights, signage, lighting, distinctive street trees and/or distinct paving materials to show the pedestrian route;

B. Design automobile and bus pick-up/drop-off locations (as applicable) to be easily accessible and to minimize pedestrian conflicts; and

C. Ensure bus staging areas allow for safe pedestrian connections and minimize the visual impact of the large expanses of paved areas through the use of high quality paving materials, finishes and patterns.

13.5 Pedestrian and Bicycle Network

The Developer shall provide pedestrian and bicycle facilities along streets within the D&C Limits to enable passengers and employees to walk or bicycle to and from the Stations and the ITFs. Pedestrian circulation shall also connect buildings, streets, and parking areas. Notwithstanding specific streets as may be designated by the AHJ for bike lanes or multi-use paths, the Developer shall provide bike facilities in accordance with the following:

A. Facilities shall be clearly identified and easy for cyclists to use;

B. Bicycle network shall connect to the major destinations in the area and connect
seamlessly to other modes of transportation, including bicycle hubs / bicycle parking at the ITF West and Metro AMC stations will be installed by others.;

C. Facilities shall connect to existing and future bike lanes.

D. Where designated by the AHJ, the Developer shall incorporate within the D&C Limits bike lanes or multi-use paths.

13.6 Street Lighting

The Developer shall comply with the requirements of the AHJ with respect to illumination of streets constructed or modified.

13.6.1 Roadway Street Lighting

The Developer shall comply with the requirements of the AHJ for street lighting of different scales and designs to provide well-lit streets and sidewalks for the following streets:

A. “New A Street”; and

B. 96th Street between New A Street and Airport Boulevard.

13.6.2 Pedestrian Lighting

The Developer shall incorporate pedestrian lighting to illuminate sidewalks, curb ramps, barriers and informational signage for pedestrians, bicyclists and transit users. Pedestrian lighting shall be placed between new and existing street lighting fixtures to provide a uniform distribution of light. Such lighting:

A. Shall comply with FAA Guidance for downward facing lighting;

B. Shall utilize LED or solar-powered fixtures with integral photovoltaics;

C. Shall complement the site furniture; and

D. Shall relate to the quality and character of the surrounding architecture.

13.7 Landscape Zones

Within the D&C Limits, the Developer shall address three distinct Landscape Zones:

A. Streetscape Zone – areas within the public right-of-way for streets adjacent to LAWA properties and other properties;

B. LAWA Facilities Zone – sites of existing and future LAWA facilities, including the ITF West, ITF East, the Terminals, parking structures, surface parking lots, the Guideway and the Stations; and

C. Landscape Support Sub-area – LAWA-owned properties anticipated for future development, including retail, hotel, restaurant and other similar uses.

In addition, within the LAWA Facilities Zone and the Landscape Support Sub-area, The Developer shall utilize available open space for landscape buffers (to screen large structures) and bio-swales (for stormwater management).

13.8 Plant Palette

The Developer shall utilize plant palettes approved by the AHJ for plant material to be incorporated into each of the Landscape Zones noted above as well as within available open space and bio-swales adjacent to new facilities. Plant palettes include:
A. Trees;
B. Small trees & large shrubs;
C. Shrubs; and,
D. Groundcover and vines.

13.9 Streetscape Zone Landscape Elements
Landscape elements within the streetscape zone shall consist of street trees, tree wells, parkways and bio-swale areas, understory planting areas, and irrigation.

13.9.1 Street Trees
The Developer shall:
A. Select trees that create a visual distinction between streets that serve primarily as vehicular approaches to LAX and streets that are pedestrian focused.
B. Select trees that complement street lighting, street furniture and other amenities that create a distinct design for individual streets.
C. Coordinate tree selection, placement, and maintenance requirements with the placement and design characteristics of street light fixtures to avoid conflicts between tree canopies and street lighting.
D. Take into consideration sub-surface utilities in the selection of all street trees to avoid potential conflicts.

13.9.2 Tree Wells
The Developer shall provide tree wells for street trees to ensure sufficient space for intake of water, air and nutrients. Tree wells shall be sized to provide adequate space for growth of the tree to maturity.

13.9.3 Parkways and Bio-Swale Areas
The Developer shall provide infiltration planters and flow-through planters to address best management practices (BMPs) for stormwater infiltration and water quality improvements.

13.9.4 Understory Planting Areas
Where utilized, The Developer shall limit the height of understory plants to a maximum of 2'0" within 5'0" of driveways or curb cuts and 3'0" in other locations. Additionally:
A. The Developer shall select plants that are draught tolerant, and tolerant of radiant heat from adjacent hardscape surfaces, and typical urban air pollution; and,
B. The Developer shall utilize low water-use groundcover in lieu of turf.

13.9.5 Irrigation
The Developer shall install supplemental irrigation systems.

13.10 Site Furnishings
The Developer shall provide site furnishings in areas with high pedestrian activity, such as pedestrian walkways, entry plazas, building entrances, seating areas and transit stops. Site furnishings shall:
A. Complement the design of the surrounding architecture; and
B. Utilize a single, unified family of site furnishings;

Site seating shall correspond to the location of other site elements such as trash receptacles, pedestrian lighting and canopy trees for shade. Site seating shall be permanently attached to walkways.

13.11 Summary of Submittals

The Developer shall provide submittals as indicated in Part 2A, Section 6.
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14. **GEOTECHNICAL**

14.1 **General**

This section provides requirements for geotechnical investigations, analysis, design, and construction. The Developer shall be responsible for all geotechnical engineering analyses, recommendations, design and reporting. The Developer’s lead geotechnical engineer shall be a Professional Engineer registered in the State of California. The Developer shall be responsible for providing all geotechnical design and construction recommendations for all elements of the Work.

The Project specifications provided in this section shall be considered as the minimum acceptable specifications and are not considered to include all possible conditions that may be encountered in the final design by the Developer. The Developer’s Geotechnical Engineer shall be responsible for determining if more stringent criteria are appropriate and/or required by applicable codes, manuals, or other references to be addressed as part of the final design.

14.2 **Standards and Specifications**

The Developer shall comply with the requirements listed in Part 4, Standards and Specifications.

14.3 **Performance Requirements**

14.3.1 **Geotechnical Planning Report**

The Developer’s Geotechnical Engineer shall oversee preparation of a Geotechnical Planning Report (GPR) prior to the start of any geotechnical work. The GPR defines the engineering and design approach that the designer will follow to develop foundations to support the APM Guideway and other facilities as well as the necessary geotechnical information for the Project in accordance with the requirements of these specifications. The GPR at a minimum shall address all aspects of the required geotechnical engineering effort, including, but not limited to:

A. Review of geotechnical data from previously investigations;
B. Additional subsurface investigations and field and laboratory tests;
C. Determination of geotechnical design parameters;
D. Determination of seismic design parameters;
E. Geotechnical design and construction issues;
F. Ground improvement or treatment of in-situ soils;
G. Selection, design and analysis of foundation systems;
H. Lateral and vertical earth pressures;
I. Instrumentation and monitoring programs; and
J. Schedule of Work.

14.3.2 **Subsurface Investigations and Laboratory Tests**

The Developer’s Geotechnical Engineer shall submit a detailed Subsurface Investigation Work Plan addressing how the planned field investigations meet the requirements of the GPR. The locations of these investigations shall be shown on a site plan. The Plan shall clearly state the types of equipment to be used, planned penetration depths, sampling types and intervals, any geophysical survey planned, and completion details. In addition, the Plan shall address management of investigation, spoil material, maintenance of traffic requirements, environmental
compliance requirement, and a time line for execution of the work, including permitting and utility clearances.

The minimum requirements for the subsurface investigation shall be as specified below:

A. Elevated Guideway and Pedestrian Walkway foundations: One (1) boring for each pier or foundation, where the longest plan dimension is less than 100 feet. Two (2) borings for each pier or foundation, where the longest plan dimension is 100 feet or greater. Borings shall extend to a minimum of twenty (20) feet below the anticipated foundation design tip elevation.

B. APM Stations: Three (3) borings per station. Each boring shall be extended to a depth fifty (50) feet, or twenty (20) feet below the anticipated foundation design tip elevation, whichever is deeper.

C. Retaining walls: One (1) boring for every 250 linear feet spacing and each boring shall be extended to a depth of fifty (50) feet.

D. Sound walls: One (1) boring for every 500 linear feet spacing and each boring shall be extended to a depth of fifty (50) feet.

E. Sign structure foundations: One (1) boring extending to a depth of fifty (50) feet per foundation location, or ten (10) feet below the anticipated foundation design tip elevation, whichever is deeper.

F. TPSS sites: One (1) boring extending to a depth of thirty (30) feet per TPSS site. In addition, the Developer shall perform in-situ resistivity testing in two perpendicular directions.

G. Embankment fills with height greater than ten (10) feet: Two (2) borings at 500 feet interval, with at least one (1) drilled at toe and crest. Each boring shall extend to a minimum of two (2) times the fill embankment height.

H. A minimum one in-situ shear wave velocity measurement (P-S logging) for every 3000 linear feet along the Guideway alignment. The Developer shall install sufficient number of groundwater monitoring wells to characterize purged or deep groundwater depths, in areas where prior data represent presence of groundwater within design depths of the foundations.

I. Subsurface investigations for buildings (such as parking garages) and other structures (such as M&SF) not governed by AASHTO guidelines shall be conducted in accordance with the California Building Code. Geotechnical borings shall be drilled, logged and characterized in accordance with the CALTRANS Soil and Rock Logging, Classification, and Presentation Manual.

J. Pavement for parking lot: One (1) boring every 25,000 square feet (i.e., 500 foot grid). Boring shall be extended to a minimum depth of five (5) feet below the bottom of the proposed grade plane or 5 feet below the existing ground surface, whichever is deeper.

K. Roadway pavement: Sufficient number of boring shall be drilled to determine the subsurface profile, design parameters, and soil type under all pavement surfaces. At a minimum, borings shall be drilled every 500 feet along the proposed alignment of new pavements. For pavement sections placed directly on existing ground, in a cut section or when fill heights are less than five (5) feet, borings shall be extended to a minimum depth of five (5) feet below the bottom of the proposed grading plane or five (5) feet below the existing ground surface, whichever is deeper. At each
boring, obtain bulk samples of cuttings in the upper four (4) feet below grading plane and drive samples at intervals not to exceed two and a half (2.5) feet from proposed grading plane. At a minimum, determine the California R-Value, particle size distribution, plasticity index, and expansion index.

If the Developer determines that it has sufficient geotechnical data, the Developer will not be bound to conducting the boring program described above; however, this does not relieve the Developer from its responsibility to obtain sufficient geotechnical data upon which to base its designs.

The Developer shall obtain all required exploration/excavation permits from AHJ prior to performing any exploration borehole, CPT, or in-situ test requiring excavation or drilling.

The Developer shall complete the subsurface investigations and laboratory testing before completion of the final design for each Project element.

14.3.3 Geotechnical Design

The Developer shall be responsible for all geotechnical design and for ensuring that all criteria for foundations, support of excavation, settlement (consolidation and seismic), and ground improvements are clearly defined and addressed in the design.

A. Foundations: The Developer shall design foundations for APM Guideway Structure and other structures such that all foundation deformations are within acceptable limits to meet the performance requirements over the Design Life of the structure. Type I shafts as defined by Caltrans SDC shall not be used.

B. Driven Pile Foundations: The Developer’s Geotechnical Engineer shall establish driving, testing, monitoring and construction criteria and confirm compliance of the constructed Works with these criteria.

C. The Developer shall be responsible for Installing Embedded Data Collectors (EDCs) in all test piles and providing clear and safe access as required by the AHJ.

D. If the Developer plans to utilize driven precast pre-stressed concrete or steel piles, the Developer shall prepare a vibration monitoring plan for Review and Acceptance.

E. Integrity Tests: The Developer shall perform integrity testing of all CIDH piles constructed with the wet method in accordance with CALTRANS test requirements.

F. Load Tests: For single large-diameter (10 to 14 feet) CIDH piles, or for piles with nominal capacity greater than 12,000 kips, the Developer shall perform at least one pile axial load test on a nonproduction pile per control zone (defined by Developer Geotechnical Engineer) to verify high axial capacity in accordance with CALTRANS requirements.

G. LAWA reserves the right to observe and perform independent verification and independent assurance testing on any piles during any phases of the foundation operation.

H. Groundwater Monitoring Wells: The Developer shall contact the AHJ immediately if any monitoring wells are encountered within the D&C Limits that have not been grouted in accordance with the proper procedures for abandonment of the wells. The Developer shall decommission abandoned wells in accordance with the Contract requirements.
14.3.4  Vibration Monitoring

Vibrations caused by foundation construction activities shall be monitored for buildings at 5755 West 96th Street and 9606 Bellanca Avenue, and at for the City of Los Angeles Bureau of Sanitation Central Outfall Sewer in accordance with the following requirements.

14.3.4.1  General

A. The Developer shall be responsible for the following:
   1) Furnish and install vibration monitoring instrumentation.
   2) Protect from damage and maintain instruments installed by the Developer and repair or replace damaged or inoperative instruments.
   3) Collect, interpret, and report data from instrumentation specified herein.
   4) Implement response actions.

14.3.4.2  Vibration Monitoring Personnel

A. The Developer’s vibration monitoring personnel shall include a qualified vibration instrumentation engineer who is a registered Professional Engineer in the State of California, and who has at least four years of experience in the installation and use of vibration monitoring instrumentation and in interpreting the measured data. The vibration instrumentation engineer shall:
   1) Be on site and supervise the initial installation of each vibration monitoring instrument.
   2) Supervise interpretations of vibration monitoring data.

14.3.4.3  Quality Assurance

A record of laboratory calibration shall be provided for all vibration-monitoring instruments to be used on site. Certification shall be provided to indicate that the instruments are calibrated and maintained in accordance with the equipment manufacturer’s calibration requirements and that calibrations are traceable to the U. S. National Institute of Standards and Technology (NIST).

14.3.4.4  Vibration Monitoring Plan

Prior to beginning foundation installation, the Developer shall submit to LAWA and the AHJ a written vibration monitoring plan, vibration monitoring equipment manufacturer’s product data, and the resumes of the vibration instrumentation engineer as well as any vibration monitoring technical support personnel.

The vibration monitoring equipment manufacturer’s data sheet shall describe in detail all vibration monitoring instruments.

The written vibration monitoring plan shall detail the procedures for vibration monitoring and recording the data. Such details shall include the following:

A. The name of the Firm providing the vibration monitoring services.
B. Description of the instrumentation and equipment to be used.
C. Measurement locations and methods for mounting the vibration sensors.
D. Procedures for data collection and analysis.
E. Sample data sheet(s) format that will be used to record vibration.
F. Means and methods of providing warning when the particle velocity equals or exceeds specified limits.
G. Generalized plans of action to be implemented in the event the particle velocity equals or exceeds specified limits. The generalized plans of action shall be positive measures by the Developer to control vibrations (e.g. using alternative construction methods).

H. Name of the "responsible person" designated by the Developer. The responsible person designated by the Developer shall have the authority to stop the work causing excessive vibration.

Within 5 days of receipt of each instrument at the site, the Developer shall submit to LAWA a copy of the instruction manual and the laboratory calibration and test equipment certification.

In addition, the Developer shall submit data and reports as specified in "Data Reduction, Processing, Plotting, and Reporting."

Preconstruction and post-construction condition surveys of buildings and residential structures shall be submitted to LAWA within 5 days of the survey.

14.3.4.5 Vibration Monitoring Equipment

The Developer shall provide portable seismographs for monitoring the velocities of ground vibrations resulting from pile driving activities.

The Developer's instrumentation personnel shall conduct regular maintenance of seismograph installations.

A record of laboratory calibration shall be provided for all vibration monitoring instruments to be used on site.

14.3.4.6 Vibration Monitoring and Recording

The Developer shall furnish all installation tools, materials, and miscellaneous instrumentation components for vibration monitoring. Vibration monitoring and recording shall be performed during foundation installation activities at buildings and residential structures within a 300-foot radius of foundation construction activities.

The Developer shall have the seismographs in place and functioning properly prior to any work within the distances as defined above. No foundation installation shall be conducted within the monitoring zone unless monitoring equipment is functioning properly.

The equipment shall be set up in a manner such that an immediate warning is given when particle velocity equal to or exceeding 0.2 inches per second is produced for buildings, and 0.1 inches per second is produced for the sewer. The warning emitted by the vibration monitoring equipment shall be instantaneously transmitted to the responsible person designated by the Developer by means of warning lights, audible sounds, or electronic transmission.

Monitoring equipment shall be stationed within 3 feet of the exterior of designated buildings and residential structures and within the easement for the sewer on the side facing the Developer's work site. At least two monitors shall be utilized at each location. If permission to access a private property is not granted, the monitoring will be conducted at the closest public access area to the structure, such as sidewalk.

When any reading on monitoring equipment equals or exceeds 0.2 inches per second, the Developer shall immediately stop construction activities causing the vibration. The Developer shall take reasonable actions if possible to reduce and maintain the monitoring equipment reading below a particle velocity of 0.2 inches per second next to the buildings and residential structures.

The seismograph vibration sensors shall be firmly mounted on the surface slab of concrete or asphalt, or firmly set in undisturbed soil with a sandbag on top.
14.3.4.7 Data Collection

Prior to foundation construction activities, the Developer shall collect data using seismograph to document background vibrations at each monitoring location. This monitoring shall consist of a continuous recording of the maximum single-component peak particle velocities for one-minute intervals. The background monitoring shall be performed for a minimum of two non-consecutive workdays, spanning the hours during which construction activities will take place.

The Developer shall monitor vibration during pile driving activities. This monitoring shall consist of a continuous recording of the maximum single-component peak particle velocities for one-minute intervals, which shall be stored in the instrument and then transferred to a computer for analysis. During the monitoring, the Developer shall document all events that are responsible for the measured vibration levels as specified in "Data Reduction, Processing, Plotting, and Reporting" section.

14.3.4.8 Data Reduction, Processing, Plotting, and Reporting

During foundation construction, the Developer shall maintain weekly, hard copy reports summarizing any vibration monitoring data collected at the specified vibration monitoring locations.

All reports shall be signed by the approved Vibration Instrumentation Engineer and shall include the following:

A. Location of the monitoring equipment.
B. Location of vibration sources (e.g. bent number, abutment number, pile number, etc.).
C. Summary tables indicating the date, time, as well as magnitude and frequency of maximum single-component peak particle velocity measured during each one-hour interval of the monitoring period.
D. Field data forms (construction vibration monitoring only).
E. An appendix including tabulated or graphed measured data for every minute for the monitoring periods.

14.3.5 Bureau of Sanitation Specific Requirements

14.3.5.1 Pile Requirements

The Developer shall be responsible for taking appropriate precautions and determining any protection necessary when working in the immediate area over and around the existing Central Outfall Sewer. The Developer shall contact the Los Angeles Department of Public Works, Bureau of Contract Administration to request inspection of the work done in the vicinity of the Central Outfall Sewer.

Any proposed pile foundations shall be 18 inches horizontally from the limits of the 15 foot sanitary sewer easement for the Central Outfall Sewer. Any proposed pile foundation shall not surcharge any load within the zone of influence of the sanitary sewer easement. The zone of influence is defined as 1:1 from the both edges of the sanitary sewer easement at a depth 20 feet below the horizontal center line of the sewer. No pile foundations shall be driven unless approved by the AHJ. The Developer shall submit proposed pile foundation plans to the AHJ for review and approval.

Pile design on all other sewers shall not surcharge the sewers or impose lateral loads. The piles shall be located 18 inches outside the sewer trench limits.
14.3.5.2 Vibration Monitoring
The Developer shall install two (2) vibration monitors for each pile within the sewer sanitary easement to monitor construction activities related to the installation of the foundation piles near any existing sewer. Prior to the start of construction of pile foundations, the Developer shall submit a vibration monitoring plan. The monitoring plan shall include proposed vibration monitoring instrumentation on a layout plan, the construction schedule of the pile foundation, and list of equipment to be utilized during the construction of pile foundations. Maximum vibration criteria shall be 0.2 PPV (in/sec) with an alert level of 0.10 PPV (in/sec). Upon reaching the maximum level, any excavation within 50 feet of the sewer shall halt.

14.3.5.3 Placing, Spreading and Compacting Fill Material
Special precautions and protection shall be considered, when working in the immediate area over and around existing Central Outfall Sewer and sanitary sewer easement. No backfill and recompaction in that area shall be done without the approval of the AHJ. No heavy machinery, spike rollers or heavy compactors shall be used for backfill and compaction operations over the 15 feet minimum sanitary sewer easements (7.5 feet each side of the centerline of Central Outfall Sewer). Heavy equipment can be permitted over the sewer only if the conduit is excavated, exposed and encased in concrete.

14.3.5.4 Shoring
If the Geotechnical Investigation Report requires shoring design within or in the near proximity of the sewer sanitary easements or public right of way, the contractor shall submit shoring plans and calculations to AHJ for review and approval. The shoring plans and calculations shall be prepared by a California registered Civil/Structural engineer. No construction activities shall be started without the approval of the submittal.

14.4 Summary of Submittals
At a minimum, the Developer shall provide submittals as indicated in Part 2A, Section 6.
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15. **SURVEY AND LAYOUT**

15.1 **General**

The purpose of this section is to define Project Requirements for the delivery of surveying services during the Term.

15.2 **Laws, Standards and Specifications**

The Developer shall comply with the requirements listed in Part 4, Standards and Specifications.

15.3 **Performance Requirements**

15.3.1 **General**

LAWA has established Survey Control Network for the purpose of aerial mapping and Mobile LiDAR scans. It includes Monument 961010. This point is included in the LAWA Survey Control Network in Part 5, Contract Drawings / Engineering Data.

Survey Control Network for LAMP was established on California State Plane Coordinate System Zone 5, with NAD83 and NAVD88, Epoch 2010.0, to comply with the current FAA requirements. LAWA has established a common reference point within the CTA area to be used by all projects, including the APM to coordinate work in the area.

As part of the program development for the Project, LAWA has completed Site Investigation for the purposes of planning and preliminary concept design. This information covers the following categories:

A. Survey control network description (See Part 5 Contract Drawings/Engineering Data);

B. Digital Aerial Orthophoto imagery in SiD file format at 0.25’ resolution;

C. Topographic map in DWG file format, extracted from Aerial Imagery;

D. Digital terrain model of existing ground surface in DWG and LandXML file formats; and

E. Point Clouds derived from Mobile LiDAR survey in RCP/RCS and LAS file formats.

15.4 **Permanent Survey Markers**

The Developer shall be responsible for preserving all survey monuments and bench marks. Where existing monuments are to be removed or impacted by the Developer, the Developer shall re-establish the existing monuments in accordance with the requirements of AHJ.

15.5 **Summary of Submittals**

At a minimum, the Developer shall provide submittals as indicated in Part 2A, Section 6
16. **BIM PROJECT REQUIREMENTS**

16.1 General

The Developer shall utilize Building Information Modeling (BIM) and its successor systems throughout the D&C and O&M periods of the Project over the Term. The Developer shall maintain maximum object intelligence and ensure easy integration with all components of LAMP as well with the facilities with which the Project will interface with or that are adjacent to the Project.

16.2 Standards and Specifications

The Developer shall comply with the requirements listed in Part 4, Standards and Specifications.

16.3 BIM Roles and Responsibilities

This section describes the BIM Roles and Responsibilities of the different Project team members. These individuals and their involvement, as it pertains to the information models, shall be as follows:

16.3.1 LAWA

All BIM Models shall be developed in accordance with the Project Execution Plan (PxP) developed by the Developer per the BIM PxP Template included in Part 5, Contract Drawings/Engineering Data. Models shall be compatible with the version of the Revit-based applications in use by LAWA. It is the intention of LAWA to work with the Developer to develop more detailed model requirements as part of their BIM efforts, which shall be incorporated into future iterations of the BIM Project Requirements and the BIM Project Execution Plan. LAWA has the following BIM roles and responsibilities:

A. Provide BIM/CAD Standards;
B. Provide BIM/CAD template files;
C. Prepare a BIM Standards Compliance Report describing the discipline-specific Models developed by the Developer;
D. Review BIM PxP produced by the Developer for compliance with LAWA BIM/CAD Standards and procedures;
E. Review the Developer’s BIM files for each design submittal; and
F. LAWA’s BIM/CAD Support Group shall be given access to the Project’s data storage for oversight.

16.3.2 The Developer

The Developer shall have the following BIM roles and responsibilities:

A. Develop the BIM PxP for the Project, which shall describe the BIM implementation plan to be followed by the Developer team during all phases of the Project;
B. Produce 3D design models of the key engineering Project elements to a Level of Detail (LOD) defined in the BIM PxP;
C. Combine the 3D design model elements into an integrated model;
D. Perform BIM activities as defined in the PxP during Preliminary Engineering / Design Development;
E. Generate formatted 2D plan sheets from the design model;
F. Use model to generate a construction sequence model (4D model); and
G. Deliver an Integrated design model to LAWA with each design submittal

16.3.3 BIM Manager
The Developer shall appoint a full time project-dedicated BIM Manager to manage the implementation of the project-level BIM program. The BIM Manager serves as the Project’s point-of-contact on matters including, but not limited to, compliance with BIM Project Execution Plan, data exchange, shared coordinates, and design coordination. The BIM Manager’s responsibilities shall include the following:

A. Ensure that models are geospatially located and are consistent with LAWA’s LAMP coordinate system;
B. Ensure that all the Developer design team members are delivering and updating the information models according to the accepted Project Schedule;
C. Ensure that the submitted information models comply with all of the requirements as defined in this document;
D. Review the Integrated BIM model for coordination purposes and perform clash detection;
E. Provide design coordination and constructability feedback to all disciplines regarding their uploaded information;
F. Facilitate design coordination meetings; and
G. Serve as point-of-contact for BIM coordination with LAWA.

16.4 BIM Project Execution Plan (BIM PxP)
The Developer shall prepare a BIM Project Execution Plan (BxP). The Developer shall include master information and data management and assignment of roles and responsibilities for model creation and data integration in the BIM PxP.

16.5 BIM Data Specifications

16.5.1 ASTM UNIFORMAT II Classification System
The Developer shall utilize the ASTM UNIFORMAT II Classification System and the Omni Class Construction Classification System (or OCCS).

16.6 Model Ownership
For Non-O&M facilities BIM model shall be turned over to LAWA within thirty (30) days after final acceptance. The APM System BIM model shall be turned over to LAWA within thirty (30) days after the end of Term.

16.7 Summary of Submittals
At a minimum, the Developer shall provide submittals as indicated in Part 2A, Section 6.
17. COMMUNICATIONS

This section describes the Developer requirements for providing infrastructure and systems to support certain APM and areas of the project outside of the O&M limits and includes:

- Requirements where the Developer is required to expand or interface with existing LAWA systems;
- Install systems and infrastructure that will not be part of the O&M but will be handed over to LAWA upon completion of installation and testing;

In addition, the Developer shall coordinate installation of dedicated cable trays, conduits and pull boxes along the guideway with required drops to Developer provided subsystems and equipment as required.

Specific requirements are contained in this section and additional details can be found in Part 4, Standards and Specifications including layouts, specific equipment requirements, part numbers, and design/installation requirements.

17.1 General

The Developer shall be responsible for all work necessary to complete the design and construction of all communications and life safety communication systems required to complete the Work for the following areas:

A. Garage vertical cores;
B. Public areas of stations and mezzanines;
C. Pedestrian walkways;
D. New parking garages;
E. Un-programmed space;
F. CCTV cameras beneath the guideway;
G. ITF sites;
H. UPS, backup generator and automatic transfer switches

17.2 Systems

The design, construction, installation, integration, and commissioning of all communications systems and components shall provide functionality, durability, ease of maintenance and inspection, energy efficiency, and safety. Subsystems shall include:

- Structured Cabling Systems (SCS);
- Public/LAWA Operational Wi-Fi;
- Access Control and Alarm Monitoring System (ACAMS);
- Public Address (PA) System;
- Automated External Defibrillator (AED) with Automatic Dial function to Police Dispatch, audible alarms, and CCTV auto-zoom;
- Digital Advertising; and...
• Digital Video Management System (DVMS) not included in Part 2B, Section 11 for new installations in garages and at-grade along the guideway.

The Developer shall extend systems as defined in these documents to achieve the required functionality. The extensions of these systems by the Developer shall be seamless to the end-user and shall function exactly as the existing systems functions. The Developer shall provide detailed information regarding the interfaces and integration with these systems in the D/CID.

17.3 Standards and Specifications

The Developer shall comply with the requirements listed in Part 4, Standards and Specifications.

17.4 Performance Requirements

The requirements in this section are project-specific minimum requirements that designs shall conform to in the course of meeting applicable Standards and Specifications listed in Part 4.

17.4.1 Structured Cabling Systems

The Developer shall be responsible for all Work necessary for the design and construction of a new Structured Cabling System (SCS) and supporting active network systems as described in Part 4, Standards and Specifications to support the subsystems identified in this section. The Developer shall provide all materials, equipment, hardware, software, and labor to install and make ready for use a SCS and a Local Area Network (LAN) utilizing IP based protocol where extension or expansion of existing LAWA systems are being provided including the requirements identified in Part 2B Section 28, Art Program, and Part 2A Section 30, Digital Advertising Program.

The provision of the SCS and the configuration of the required LAWA standard Multiprotocol Label Switching (MPLS) network is expected to be multifaceted and require experience with complex routing structures, redundancy, equipment specific security features, integration with network security software, network management integration, and highly available networks.

The Developer shall coordinate the requirements for all network connected systems identified in this Section 17 that are extensions or expansion of existing LAWA systems and subsystems with LAWA’s Information Management Technology Group (IMTG) Office of Infrastructure Technology. This information shall be utilized to assist in configuring the network. The design for the SCS shall be submitted in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

17.4.1.1 SCS – Topology

The Structured Cabling System shall consist of both copper Cat 6a and Singlemode fiber optic cabling as needed and determined by the design to support the systems as required and defined in Part 4, Standards and Specifications.

The SCS shall comply with ANSI/TIA-568-D. This standard defines a hierarchical cable system architecture, in which a main cross-connect (MCC) is connected via a star topology across backbone cabling to intermediate cross-connects (ICC) and horizontal cross-connects (HCC). Backbone cabling is also used to interconnect entrance facilities (such as telco demarcation points) to the main cross-connect.

The backbone fiber cabling between the MCC (LAWA IT rooms) and the ICCs and HCCs (IT/TR rooms) shall consist of two fully redundant fiber optic cable links that are routed using physically divergent pathways to prevent any single points of failure.

The Developer shall design the SCS to accommodate an additional 25% (minimum) added capacity to accommodate future needs at each station with a minimum of 96 fiber strands remaining available. However, in no instance shall a fiber optic cable fiber count be less than 96 fibers.
Communications cabling shall not share conduits or pathways with any power cabling.

**17.4.1.2 SCS – Support Areas**

Locations for the SCS include each APM Station, Pedestrian Walkways, TPSS, and the M&SF to support where required: LAWA PA; LAWA IT rooms; Wi-Fi; Cellular; ACAMS; Visual Messaging/Digital Signage/Paging; Digital Advertising; and locations where LAWA IT phones will be provided.

**17.4.1.3 Optical Fiber - General**

Optical fiber cables shall be Corning Optical Communications SMF-28 Ultra Single Mode Fiber Optic (SMFO) Cable. Fiber Optic Jumpers shall be Corning Optical Communications SMF-28 Ultra Single Mode fiber jumpers. The specific type of cable (indoor non-plenum, indoor plenum, or outdoor, etc., shall be appropriate to the application/location). The Developer shall provide and install the following dedicated number of fiber optic cables specific for LAWA use with the to – from locations provided in Table 17.4.1.3-1 below in accordance with the requirements of Part 2B Section 17.4.1.8 and the LAWA Design and Construction Handbook:

<table>
<thead>
<tr>
<th>Fiber Optic Cable</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>144 Strands</td>
<td>CTA West Station</td>
<td>M&amp;SF</td>
</tr>
<tr>
<td>144 Strands</td>
<td>CTA West Station</td>
<td>CTA Center Station</td>
</tr>
<tr>
<td>144 Strands</td>
<td>CTA Center Station</td>
<td>M&amp;SF</td>
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<tr>
<td>144 Strands</td>
<td>CTA Center Station</td>
<td>CTA East Station</td>
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<td>144 Strands</td>
<td>CTA Center Station</td>
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<td>144 Strands</td>
<td>CTA East Station</td>
<td>M&amp;SF</td>
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<tr>
<td>144 Strands</td>
<td>CTA East Station</td>
<td>Vicinity of Stationing 43+ and 46+</td>
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<tr>
<td>144 Strands</td>
<td>Vicinity of Stationing 43+ and 46+</td>
<td>M&amp;SF</td>
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<td>144 Strands</td>
<td>Vicinity of Stationing 43+ and 46+</td>
<td>ITF West Station</td>
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<td>144 Strands</td>
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<tr>
<td>144 Strands</td>
<td>ITF West Station</td>
<td>ITF West Garage</td>
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<tr>
<td>144 Strands</td>
<td>ITF East Station</td>
<td>ConRAC Station</td>
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<tr>
<td>288 Strands</td>
<td>ITF East Station</td>
<td>M&amp;SF</td>
</tr>
<tr>
<td>144 Strands</td>
<td>ITF East Station</td>
<td>Future ITF East Garage</td>
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<tr>
<td>96 Strands</td>
<td>ITF East Station</td>
<td>AMC Metro Station</td>
</tr>
<tr>
<td>288 Strands</td>
<td>ConRAC Station</td>
<td>M&amp;SF</td>
</tr>
<tr>
<td>144 Strands</td>
<td>M&amp;SF</td>
<td>Telecom Building</td>
</tr>
</tbody>
</table>

Fully redundant 144 core SMFO cable is required for backbone between each APM station, the M&SF, ITF West Garage, future ITF East Garage, ConRAC, and shall be terminated at Developer provided LAWA IT rooms. Additionally, a fully redundant 144 SMFO cable shall be provided in the vicinity of stationing 43+ and 46+, for future use and should be stubbed in a junction box with
a 300’ service loop and connected to a LAWA standard patch panel at that location. Drop points shall be as required for connectivity between stations and equipment, including beneath the guideway for the at-grade CCTV cameras and any requirements of Cellular and Wi-Fi systems. Conceptual design is provided as information in the Reference Drawings. Note that these fiber optic cables do not include the requirements of the Cellular Carriers identified in Part 2B Section 17.4.1.4.

Each LAWA IT room shall have ladder racks to support 300 feet of fiber optic cable slack loops. Conduit and innerduct requirements are detailed in Part 2B Section 17.4.1.8.

17.4.1.4 Fiber Optic Cable for LAWA/ Local Exchange Carrier Interfaces

The Developer shall work with the Local Exchange Carrier (LEC), in this case AT&T. AT&T will provide a 48 strand fiber optic cable from their nearest maintenance hole into each station’s LAWA IT room and terminate these fiber optic cable strands on patch panels in the LAWA IT room per LAWA standards. Drawings shall be provided by AT&T to LAWA documenting each station’s LEC fiber cabling infrastructure. The Developer shall install conduit from each station’s LAWA IT room underground to the nearest LEC maintenance hole to provide for the routing of the 48 strand fiber optic cable. This conduit bank may be shared with the Developer for its needs and is also required for the copper cable LEC interface in Section 17.4.1.8 below. The conduit bank shall have at least one spare conduit for future LAWA use, and shall comply with LAWA standards.

Design of the dedicated LAWA Fiber Optic design and installation shall be submitted in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

17.4.1.5 Category 6A (CAT 6A)

Unless otherwise specified, all copper data/phone cable shall be Cat 6A, and the length of Cat 6A cabling shall be limited to a total distance of 90 m (295 ft.) in order to ensure compliance with the loss requirements specified in TIA/EIA-568-C.1.

17.4.1.6 Network Equipment

The LAN shall be configured as highly available in a two-tier hierarchical network architecture. Backbone switches shall support forty (40) Gb/sec Ethernet transport rates and be configured with redundant power supplies and in redundant VSS clusters (requires two backbone routers/switches). Access switches shall support 40Gb/sec uplinks and 10Gb/sec ports (at minimum) and be wired in a physical star topology. Specific equipment requirements including switches, routers, and other network equipment are provided in Part 4, Standards and Specifications.

All network and Wi-Fi equipment, software, firmware and licenses shall be purchased from LAWA’s current Cisco equipment vendor and shall be registered in LAWA’s name at the time of purchase.

Network security shall be addressed by the deployment of paired firewall and cyber monitoring appliances. Design of the Network Equipment shall be submitted in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

17.4.1.7 Routers/Switches and Network Hardware/Software/Firmware

Networking hardware/software/firmware shall consist of the following and comply with the LAWA Design and Construction Handbook and with the specific part numbers called out below.

Access layer network switch operating with ports of 10Gb/sec and 40Gb/sec uplinks (Cisco Catalyst C9300-24XU-A and C1A1TCAT93001-5Y with dual power supplies with 40Gb/sec redundant uplinks or Cisco Catalyst C9407 with Cisco Advantage Licensing). Quantity: as many as needed to provide required connectivity with 25% spare capacity.
A. Backbone network router/switches 24x40Gb/sec ports and uplinks (Cisco Catalyst C9500-24Q-A and C1A1TCAT95001-5Y with Cisco Advantage Licensing) in a Stackwise Virtual configuration – requires a pair of 9500 units. There shall be at least one backbone router/switch pair per station.

B. LAWA Standard Network Firewall Cisco Firepower operating with a throughput of 20Gb/sec and licensed for virtual contexts: and

C. Cyber Security monitoring shall be performed in compliance with the standards in Part 4, Standards and Specifications.

Design of the Backbone Routers/Switches and the Access switches and all other hardware/software/firmware shall be submitted in accordance with the Summary of Submittals list in Part 2A, Section 6.7. LAWA shall configure the Backbone router/switches.

17.4.1.8 Copper Wire for LAWA Local Exchange Carrier Interfaces

The Developer shall work with the Local Exchange Carrier (LEC), in this case AT&T. AT&T will provide a 25 pair Cat 3 copper cable from their nearest maintenance hole into each station’s LAWA IT room and terminate these cable pairs per LAWA standards. Drawings shall be provided to LAWA by AT&T documenting each station’s LEC copper cabling infrastructure. The Developer shall install conduit from each station’s LAWA IT room underground to the nearest LEC maintenance hole to provide for the routing of the 25 pair copper cable. This conduit bank may be shared with the Developer for its needs. The conduit shall have at least one (1) spare conduit for future LAWA use, and shall comply with LAWA standards.

17.4.1.9 Cable Trays, Conduits, and Junction Boxes

The Developer shall provide a stainless-steel cable tray with fastened cover along the guideway for dedicated LAWA use sized to house the fiber optic cable requirements in Part 2B Section 17.4.1.3 and the copper wire requirements in Part 2B Section 17.4.1.8. Cellular copper and fiber optic cables can either share this cable tray or placed in separate four (4) inch conduits.

All conduit shall be hot-dipped galvanized rigid steel and embedded in columns or otherwise concealed etc. Unless otherwise specified, all conduit shall be one (1) inch or larger.

Liquidtight Flexible Metallic Conduit (LFMC) shall be used only for applications that require a high degree of flexibility or to accommodate moving or vibrating equipment. Use LFMC at maximum of six (6) feet in length.

All junction boxes, pull boxes, and equipment enclosures installed outdoors shall be NEMA 4X, stainless steel type 316. Junction boxes for beneath the guideway at grade CCTV installations shall be placed inconspicuously beneath the guideway deck. Conduits for this installation shall be embedded.

Design of the dedicated LAWA Cable Trays, Conduits, and Junction Boxes shall be submitted in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

17.5 Public/LAWA Operational Wi-Fi

LAWA will manage the Wi-Fi network for the APM and provide the network gear to route the Wi-Fi traffic from the existing LAWA Internet connection. The Developer shall provide and install all conduits and junction boxes and associated wiring/fiber/cabling as required and shall be responsible for O&M. The Wi-Fi APs shall be LAWA Standard Cisco 3802 APs with Hyper location antennas and virtual beacon modules installed. The Cisco Wi-Fi controller license needed for each AP shall also be purchased as part of the AP procurement. Two Cat 6a cables shall be pulled to each AP location.
LAWA is expecting the bandwidth to be greater than 100Mb/second in all accessible locations to provide a seamless uninterrupted connection. Accessible locations shall include station platforms, pedestrian walkways, mezzanines, and the APM vehicles. To accomplish this, the Developer can provide wayside access points along the guideway and within stations/mezzanines and pedestrian walkways and or the installation of equipment router in the 4-car trains that will point back to the LAWA network to provide a consistent passenger experience. Equipment requirements are provided in Part 4, Standards and Specifications.

Design of the Public/LAWA Operational Wi-Fi shall be submitted in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

17.6 Cellular Service Distributed Antennae System (DAS)

LAWA will be selecting a single vendor to coordinate cellular services from various carriers. The Developer shall work with this vendor to provide and install all conduits, junction boxes and wiring from the LAWA IT rooms to the station, mezzanine and pedestrian walkway areas to support 5G. The DAS will not be part of the O&M limits. During the O&M Term, the Developer shall coordinate access to the various cellular carriers for access to the DAS installations for maintenance, repairs, and additions and betterments.

17.7 Access Control and Alarm Monitoring System

The Developer shall provide an Access Control and Alarm System (ACAMS) to restrict non-authorized access to non-public areas. The following ACAMS requirements shall apply.

The existing Access Control and Alarm Monitoring System (ACAMS) at the airport shall be extended to support access control requirements as part of this Project. These IP access control modules shall be connected to the security network. The Developer shall provide additional network switches as required to accommodate the ACAMS. The modules shall then connect to edge-devices such as, but not limited to, keypad/card readers, door locks, supervisor contacts, tamper switches, key override switches, biometric equipment on all doors to prevent access to non-public areas of the APM. These include station access doors to the guideway, doors to the Developer equipment rooms, LAWA IT rooms, gates and access doors to M&SF, APM Central Control, gates and access doors to all traction power substations, gates for first responder access stairs to the guideway. In addition, there shall be motion detectors within LAWA IT rooms.

All equipment shall be suitable for the environment it is being installed in. All outdoor hardware shall be environmentally hardened. All equipment and controllers installed in outdoor cabinets shall be environmentally hardened or installed in environmentally controlled cabinets.

Provide environmentally hardened access card readers and annunciators to secured non-public areas identified in Part 2B, Section 11 and in Section 17.4.3.1.

Design of the ACAMS shall be submitted in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

17.7.1 Access Controlled Areas

Controlled areas are defined as Access Control of entry points as identified in Part 2B Section 11 in addition to other non-public spaces, including elevator machine rooms and LAWA IT rooms.

17.7.2 Access Control Field Hardware

The system shall allow the transport of digital signals for communications between field edge-devices (i.e. card readers, sensors, tamper devices) and ACAMS panels. The ACAMS panels shall communicate to the ACAMS servers. The Developer shall coordinate the LAN requirements,
port counts at each location, minimum required LAN speed, QoS, latency, and schedule with the Airport, and provide all equipment as necessary.

The Developer shall comply with DCH, Specification 28 13 00, for ACAMS requirements.

LAWA Information Management Technology Group (IMTG) is in the process of defining requirements to replace the Picture Perfect access control system, GE access control panels, and associated equipment. The following components shall be for ACAMS:

<table>
<thead>
<tr>
<th>Device type</th>
<th>Part no</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access Control Panel</td>
<td>GE M3000</td>
</tr>
<tr>
<td>Card Reader Interface Module</td>
<td>GE 8RP model 110100501</td>
</tr>
<tr>
<td>Output Interface module</td>
<td>GE DOR model 110078001 or 110071001</td>
</tr>
<tr>
<td>Input Interface module</td>
<td>GE DI model 110072003</td>
</tr>
<tr>
<td>Card Reader</td>
<td>HID R40 and RK40 (w/ keypad)</td>
</tr>
<tr>
<td>Wiegand Interface Unit</td>
<td>GE Model WIU-4</td>
</tr>
<tr>
<td>Power Supplies</td>
<td>24 VDC Power: Altronix AL1024ULACM, or approved equal</td>
</tr>
<tr>
<td></td>
<td>12VDC Power: Altronix AL1012ULACM, or approved equal</td>
</tr>
<tr>
<td>Door position switch (alarm contact)</td>
<td>Flush mount: GE 1078/1076 Series, or approved equal</td>
</tr>
<tr>
<td></td>
<td>Surface Mount: GE 2700 Series, or approved equal</td>
</tr>
<tr>
<td>Alarm Horns</td>
<td>Interior Alarm Horns: System Sensor MHW, or approved equal</td>
</tr>
<tr>
<td></td>
<td>Exterior Alarm Horns: System Sensor HRK, or approved equal</td>
</tr>
<tr>
<td>SJB cabinet</td>
<td>(mounted above each door) Hoffman A16N16ALP, or approved equal</td>
</tr>
<tr>
<td>Wire &amp; cable</td>
<td>2 CAT 6A from LAWA IT room to SJB above door</td>
</tr>
<tr>
<td></td>
<td>DI/DOR: 18/3 Alpha 2423C or equivalent</td>
</tr>
<tr>
<td></td>
<td>Lock power wiring: 16/3 Alpha 2433C or equivalent</td>
</tr>
</tbody>
</table>

17.7.3 **Access Control Panels and Cards**

The Access Control Panels (ACP) and cards shall comply with LAWA Standards defined in Part 4 Standards and Specifications.

17.7.4 **Access Control Door Hardware**

The ACAMS shall include the LAWA Standards for door shunt time to allow persons with disabilities additional time to access non-public locations and an extended shunt time to allow additional time to pass through the door before alarm and shall meet all of the requirements as set forth in the Americans with Disabilities Act. The Developer shall coordinate this work with the
door hardware designer for the provision of the appropriate door locks and closures for doors requiring access control.

### 17.7.5 Power Supplies

The Developer shall provide a minimum of two (2) hour stand-by battery and/or UPS run time at full power supply loading for all field panels, lock power supplies, and communication equipment including LAN switches. Note that this circuit shall be separate from any power that may be shut off during fire alarm activation.

### 17.8 Public Address System

The Developer shall provide three Public Address (PA) systems in all public areas as follows:

A. **System 1:** An extension of the airport PA system and connected to ARCC used to make airport announcements including emergency announcements such as evacuation voice announcements and be compliant with the requirements defined in Part 4 Standards and Specification and the LAWA Design and Construction Handbook.

B. **System 2:** The APM PA subsystem identified in Part 2B Section 11.3.10.1.1. Note that LAWA’s emergency announcements shall have priority over the APM PA subsystem announcements by muting the APM PA subsystem; and

C. **System 3:** As required by the AHJ and meet the requirements of NFPA 72, Fire Alarm Code. The PA system shall be used to generate emergency evacuation announcements.

D. The design of the extension of the LAWA PA System and Emergency PA System including visual paging of Section 17.4.5 shall be submitted in accordance with the Summary of Submittals list in Part 2A, Section 6.7. Refer to Part 2B Section 11.3.10.1.1 for submittal requirements for the APM PA System. Implementation and commissioning shall require approval from the AHJs and have the following minimum characteristics:

E. Have an ambient noise detection that automatically adjusts to amplifier output to maintain announcement volume levels at 10 dB above ambient levels up to a maximum of 85 dB and as required by the AHJ’s;

F. Speakers shall be UL1480 fire resistant or as required by the AHJs;

G. The Emergency PA system (System 3) shall meet the intelligibility requirements as specified in NFPA 72, National Fire Alarm Code; and

H. Audio communications shall further meet the requirements of NFPA 130 and shall interface with fire management panels as required by the AHJ’s.

### 17.8.1 Visual Paging System

The Visual Paging System shall interface to the PA paging system so as to announce visually any audio announcements to meet ADA requirements. Details including equipment requirements are provided in Part 4, Standards and Specifications. Design of the Visual Paging System shall be submitted in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

### 17.9 Digital Video Camera System

The Developer shall be responsible for all Work necessary for the design, construction, and installation of cameras in parking garages, elevator machine rooms, within the LAWA IT rooms,
and beneath the guideway at grade level. Conceptual design is provided as information in the Reference Drawings.

With the exception of the wireless CCTV cameras installed within the APM vehicles, all APM System CCTV cameras shall have two feeds such that one feed goes to the APM System CCF and the other feed goes to LAWA. Distribution of APM CCF camera video to LAWA shall be accomplished by configuring a second video stream on the camera to be provided to LAWA via multicast configuration. Developer shall coordinate with LAWA for multicast network configuration and network firewall parameters. For APM related DVMS design requirements, refer to Part 2B Section 11. CCTV data stored on-board the APM Vehicles shall be downloaded to LAWA each time the Vehicles are returned to the M&SF. Refer to Part 2B Section 11 for further details.

Work defined herein shall include a combination of fixed and PTZ cameras and power supplies required to form a fully functional and operational system. The system shall operate as an expansion of the existing system over a new digital IP/Ethernet network and connected to the existing IP/Ethernet network. The Developer shall provide additional network switches and network projecting as required to accommodate the camera video stream routing to LAWA's Video Management System.

17.9.1 Camera Locations

In addition to the CCTV requirements identified in Part 2B, Section 11, the Developer shall furnish and install the correct quantity, location, mounting system, enclosures, cameras and lens types to provide the required CCTV coverage described herein and are not part of the O&M period.

All cameras located in low light conditions where the required visibility cannot be achieved, shall have external Infrared (IR) Illuminators.

All cameras must be accessible for maintenance via ladder, walkway or thirty (30) foot bucket trucks. Camera locations shall be positioned first to address camera view then adjusted for vandalism and maintenance at the direction of LAWA.

Field of View (FOV) surveys shall be conducted for all proposed camera locations. The Developer shall submit a detailed FOV report for all proposed cameras, providing the information listed below in accordance with the Summary of Submittals list in Part 2A, Section 6.7. All camera locations shall be approved by LAWA. Surveys shall be performed using fixed or PTZ cameras of the same model proposed for installation. Daylight images and videos shall be provided for all locations. Low light areas shall have IR illuminators for CCTV camera coverage. The FOV survey shall provide the following:

A. Camera Location;
B. Camera Mounting Type;
C. Camera Mounting Height; and
D. Intended Use.

The Developer shall provide still photos for camera view of fixed cameras aimed at pedestrian walkways, perimeter areas, and cameras aimed at doors, gates and hatches.

The Developer shall also provide still photos and video (including PTZ demonstration) for camera view of all PTZ cameras.

All photos and videos shall be labelled with a corresponding CCTV location shown on an equipment location plan. Still photos shall be video image captures presented on an 8-1/2” x 11” PDF page. All still images and video captures shall be provided on Universal Serial Bus “memory sticks”. Developer to provide one video file for each camera, named with the corresponding camera name. Four memory sticks shall be provided, each containing all still images and video
17.9.2 CCTV Coverage Areas

The Developer shall provide complete CCTV video coverage of the following areas:

A. Garages. Fixed and PTZ cameras shall provide 100% coverage of all new garages from point of entry throughout every level and point of exit and also general surveillance of all areas where the general public have access such as garage entrances and exits, elevator lobbies and locations where AEDs will be provided. Cameras shall provide the ability to identify basic features, including color of skin and color of clothing of a pedestrian approaching from either direction and provide the quality required to support license plate reader technology.

B. Maintenance & Operations Spaces. Fixed cameras at entrances and exits to maintenance areas such as electrical power rooms, services buildings, service elevators, LAWA IT rooms, and associated entrances and exits shall provide the ability to identify facial features, color of skin and color of clothing of a pedestrian approaching from either direction.

C. Beneath the Guideway: PTZ cameras mounted at each column location for full at-grade coverage beneath the guideway from CTA West Station to the ConRAC Station. This includes continuous coverage beneath the guideway of roadways, vehicle lanes, shoulders, driveways, parking areas, and any other area where a vehicle may travel, stop or park in or around the guideway, its supports, its access points and station areas. PTZ cameras shall provide the ability to monitor all roadway traffic activity at a level of detail in which operators can identify movement as well as vehicle class and color. Additional PTZ cameras shall be provided for “situational awareness” which can be used to identify license plates, number of occupants in the front seats, if a door is open, and to identify an item, approximate size of one (1) cubic foot, that may have been left behind by a vehicle.

17.9.3 Video Cameras

All DVMS equipment, including but not limited to cameras, domes and PTZ controllers shall be fully compatible with the existing LAWA system and network. Camera painting and finishing’s shall only be provided by the OEM; cameras shall not be painted after installation. All cameras shall be hardwired. Wireless camera connections are not acceptable except for camera installations identified in Part 2B Section 11.

17.9.4 Video Camera Power Supplies

Developer shall utilize Power over Ethernet (PoE) to power IP cameras. Where required to meet IP camera manufacturer operational requirements, PoE power injectors or PoE mid-spans shall also be utilized to augment network appliance PoE electrical power. Cameras unable to be powered by PoE may utilize external 24VAC power supplies. The junction box requirements for the under guideway at grade level CCTV cameras shall contain a fiber optic patch panel, a fiber optic terminal and a 120 volt quad receptacle (if cameras are clustered in groups of five, a LAWA standard mini ruggedized network switch with fiber optic uplinks shall be used) and a 120-volt quad receptacle.

17.9.5 Video Camera Mounting Systems

The camera mounts shall be provided as required by the manufacturer for the locations identified Section 17.4.6.2.
17.9.6 Gunshot detection

The Developer shall provide a gunshot detection system in all public areas of the APM System including Pedestrian Walkways, Station platforms, and mezzanines. The detection system shall have the capability to pinpoint the location within the designated area that the gunshot occurred. Upon detection of the gunshot, the video system shall zoom to the gunshot location. The Developer shall implement a system which identifies gunfire with real-time data. The system shall include:

a. Hardware/software, installation, training and maintenance for a Gunshot Detection and Location system;

b. Interfaces with the Automatic Train Control system as a Priority I alarm per Part 2B Section 11.3.10.2.2; and

c. Link to the CCF as well as LAWA Police with auto CCTV call up.

The exact coverage area will be based upon the location of CCTV cameras and detailed in the Station Equipment and Communications Design Audits.

17.10 Automated External Defibrillator

The Developer shall provide Automated External Defibrillators (AED) at all stations, mezzanines, and pedestrian walkways at a distance not to exceed 3-minute walking distance. Locations shall be as coordinated with the AHJ. Design, Program, Maintenance and Training for the AED’s including related interfaces shall be submitted in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

17.10.1 AED Program

The Developer shall be responsible for the development of a plan by a State of California licensed physician as a Medical Director that will ensure compliance with California State AED Laws that include the requirements for training, notifications, and maintenance.

17.10.2 AED Training

The Developer shall be responsible for satisfying the training requirements as well as the number of employees trained as outlined in the California State AED Laws.

17.10.3 AED Maintenance Program

The Developer shall develop an AED maintenance program according to the manufacturers recommendations, the American Heart Association, the American Red Cross, and all state, local and federal regulations and include in the APM System Maintenance Plan identified in Part 2C.

17.10.4 AED Cabinet

All cabinets for the AEDs shall have following features:

- Alarms powered by a 12-volt lithium battery pack;
- Continuous self-monitoring circuitry with 9-volt battery
- A 120-decibel output alarm continuous for 3 seconds followed by an intermittent tone;
- High intensity strobe light alarm;
- Telephone interface connection with auto-dialer function to connect to LAWA Dispatch Communications Center when the door is opened;
- Theft deterrent system with all cabinets keyed alike;
17.11 Digital Advertising

As part of its design, the Developer will be required to provide infrastructure to support the possible inclusion of sound, digital media and light installations for digital advertising within each Station mezzanine and along the Pedestrian Walkways. Such infrastructure shall include an interface with the LAWA visual paging system; 120 volt, 20 amp dedicated circuits at 20 foot intervals to the nearest normal power panel(s); 2” conduit, fiber, empty 24 square j-box for possible fiber connection; consolidation points connected directly to the LAWA IT room equipment adjacent for the head-end data devices.

Additionally, the Developer is encouraged to identify potential locations for Digital Advertising as part of its design development.

17.12 LAWA IT Rooms

The Developer shall provide dedicated LAWA IT rooms to meet the requirements and in the locations identified in this Section. Conceptual design of the LAWA IT rooms is provided as information in the Reference Drawings. Complete details are provided in Part 4, Standards and Specifications.

17.12.1 Requirements

The minimum interior dimensions of the LAWA IT (MPOE / TR) rooms shall be as follows:

- M&SF: 11’ wide x 21’long x 108” high with the UPS not included in this space and it is preferable that the UPS not be included in the LAWA IT room, but just outside the LAWA IT room;
- Stations: M&SF: 11’ wide x 21’long x 108” high with the UPS not included in this space and it is preferable that the UPS not be included in the LAWA IT room, but just outside the LAWA IT room;

The LAWA Standard for UPS shall be the LAWA standard Liebert UPS units for LAWA IT rooms by Vertiv.

Each LAWA IT room shall have the following equipment and functions:

- Incoming kWh meter to record power consumption;
- Occupancy sensor light switch;
- ACAMS access controls;
- Dedicated IT electrical panels for house power and UPS;
- Wall phone and outlet connected to LAWA network;
- Convenience outlets every 6 feet;
- Entrance conduits;
- Vertical ladder racks;
- Horizontal ladder racks;
- Anti-static/Static dissipative vinyl tile with grounding attachment;
- Four equipment cabinets for the M&SF LAWA IT room measuring 34” wide x 36” deep x 84” high with eight 4” knockouts per cabinet;
- Five equipment cabinets for the APM Station LAWA IT rooms measuring 34” wide x 36”
deep x 84” high with eight 4” knockouts per cabinet;

- One to two UPS Cabinets (Developer may also use the APM UPS for this purpose);
- Six 48” LED fluorescent type light fixtures;
- Fire protection/suppression to be coordinated with the AHJ’s (Developer may utilize the same system with the APM Equipment Rooms);
- Telecommunications grounding busbar;
- #4 AWG stranded green insulated grounding wire in conduit to the electrical panel;
- 144 port wall-mount fiber optic patch panel (if insufficient rack space);
- Backbone distribution conduits as required;
- External cold air ducting if required;
- Horizontal conduits with CAT 6A Cables;
- Fire rated plywood backboard painted white;
- Liebert self-contained AC unit with condensate drain to maintain the interior temperature between 68° and 71°
- CCTV Security camera that covers the entrance and one or more cameras to cover the rest of the LAWA IT room space;
- Ladder racks on the back wall to support 300’ of fiber optic cable slack loops, one rack per cable;

The Developer shall coordinate with the Cellular Carriers to include any additional requirements. Design of the LAWA IT rooms shall be submitted in accordance with the Summary of Submittals list in Part 2A, Section 6.7.

17.13 Summary of Submittals

At a minimum, the Developer shall provide submittals as indicated in Part 2A, Section 6.
18. TRACTION POWER SUBSTATION INFRASTRUCTURE

18.1 General
The Developer shall construct the Traction Power Substations (TPSS) to provide power to the APM Operating System.

18.2 Standards and Specifications
The Developer shall comply with the requirements listed in Part 4, Standards and Specifications.

18.3 Performance Requirements
18.3.1 General
LAWA has identified three (3) site locations for the TPSSs. These locations are indicated on the drawings found in Part 5, Contract Drawings/Engineering Data. They are in the vicinity of the CTA East Station, the ITF West Station, and the ITF East and ConRAC Stations. The Developer is not bound to the locations described above or to the number of TPSS sites and may determine alternate locations. It is the responsibility of the Developer to coordinate with LAWA, all AHJs, utility companies and any agencies affected by the TPSS location. In addition, the Developer shall perform load calculations to verify TPSS sites. All permits and any ROW acquisition required for any alternative sites is the responsibility of the Developer. TPSS sites shall avoid conflicts with existing airport infrastructure and airport operations, and shall support the operations and power demands of the APM System. The Developer shall provide each TPSS with controlled access, security fencing, and various landscaping elements as reflected in the Contract Documents.

Each TPSS shall be sized as necessary to support the APM System requirements as described in Part 2B, Section 11, as well as providing access around the building to support maintenance.

Design specifics shall be as follows:

A. Landscaping: Landscaping shall provide a green buffer between TPSSs and the surrounding area and shall be in accordance with Contract Documents.

B. Safety and Security:
   1) The TPSS and related parking areas shall be fenced. Fencing shall be AOA type with a rating of K4. All gates shall be lockable and card activated for entrance;
   2) Access control systems intrusion alarms shall be provided at all gates and provide notification upon detection of intrusions in accordance with requirements of Part 2B, Section 17.
   3) The Developer shall provide CCTV coverage of the TPSS for safety and security purposes in accordance with the requirements of Part 2B, Section 17.

18.3.2 Building Components
The massing, architectural character, detailing and exterior finish materials of the TPSSs shall be visually sensitive architectural character of the TPSSs shall be complementary to design of the APM Stations.
A. Exterior appearance and materials: Visible TPSS structures and their exterior finishes shall conform to Contract Documents. The exterior materials, consistent with the facility’s industrial use, shall be durable, corrosion and damage resistant;

B. Minimum roof slope shall be as required by code and manufacturer’s specifications;

C. Keying shall comply with requirements in Part 2B, Section 11.3.5.2.1.2;

D. Floor surfaces shall have an anti-skid finish;

E. Cathodic Protection: Protect the facility piping from corrosion with a cathodic protection system if determined necessary by soil conditions and stray current;

F. Mechanical systems shall be designed to address ambient outdoor design conditions at the location of the facilities;

G. Lighting: Provide LED-type lighting fixtures; and

H. Emergency Lighting and Ventilation: Provide emergency lighting using the same type fixtures as normal lighting, powered from an emergency source to provide 90 minutes full output from the fixtures.

18.3.3 Inspection Requirements
Baseline inspections are required to be performed during the D&C Period as described in Part 3, Section 5.2.1.

18.4 Summary of Submittals
At a minimum, the Developer shall provide submittals as indicated in Part 2A.
19. ROADWAY BRIDGES

19.1 General
The Developer shall provide elevated roadway bridges within the CTA for access to the terminal departures level and parking garages.

19.2 Standards and Specifications
The Developer shall comply with the requirements listed in Part 4, Standards and Specifications.

19.3 Performance Requirements

19.3.1 General
The Developer shall:

A. Account for any non-composite dead load, such as leveling courses, and utilities, in the design.

B. Design visible portions of the roadway bridges with a consistent architectural theme and uniformity of appearance.

C. Provide a minimum vertical clearance over the lower level of West Way of 15'-3".

D. Seismic Design: Design the seismic performance of the roadway bridges per applicable portions of Part 2B, Section 1.3.1.2(I).

E. Wind Design: Aeroelastic force effects shall be taken into account in the design of bridges and structural components apt to be wind-sensitive. Bridges with a span to depth ratio, and structural components thereof with a length to width ratio, exceeding 30.0 shall be deemed to be wind-sensitive. As applicable, the vibration of cables due to the interaction of wind and rain shall also be considered.

F. Foundation Design: The Developer shall perform all site specific investigations and develop all supplemental information to provide a final geotechnical engineering report which shall identify recommended soil properties to be used in design, including densities, strengths, compressibility, environmental conditions and any other data necessary for the successful execution of the design to be performed by the Developer. Refer to Part 2B, Section 14 Geotechnical, for Foundation Design.

G. Stormwater: Direct any stormwater accumulating along the structure to inlets, then to drain pipes located within pier columns and bents and transmitted into the existing or new storm drainage system or natural surface-level water courses. Such drainage provisions shall not be visible to the public and shall not point discharge onto any streets or roadways. Refer to Part 2B, Section 8 Drainage for drainage requirements.

H. Existing Structures: Support existing structures as necessary to avoid loading and / or settlement as a result of the construction of the roadway bridge.

I. Provide the design loads and other information pertinent to the structural design on the Release for Construction Documents (RFCD) plans.

J. Prepare designs, plans and specifications under the direction of a registered Professional Engineer in the State of California.
K. Utility conduits, externally connected to the structure must not be visible to the public.

19.4 Summary of Submittals

At a minimum, the Developer shall provide submittals as indicated in Part 2A, Section 6.
20. **DEMOLITION**

20.1 **General**
This section defines Project Requirements for demolition.

20.2 **Standards and Specifications**
The Developer shall comply with the requirements listed in Part 4, Standards and Specifications.

20.3 **Structures and Roadways Removed Or Demolished**
In the course of constructing the APM Guideway and site preparation of right-of-way parcels, several structures or portions of structures will have to be removed or demolished. Refer to Part 1, Scope of Work for a description of demolition work. All demolition work shall be in accordance with the AHJ.

20.4 **Performance Requirements**

20.4.1 **General**
The Developer shall remove or demolish structures and protect or shore adjacent structures in place in accordance with the following:

A. Utilities: relocate, remove, cap or terminate utilities as necessary;

B. Environmental Remediation: Developer shall be responsible for environmental remediation prior to demolition of existing structures and for the proper storage and disposal of Hazardous Materials from such remediation. The Developer shall also be responsible for any and all Hazardous Waste mitigation of the land on which such structures stand;

C. Shoring and protection-in-place: shore and protect-in-place existing structures to remain;

D. Water Intrusion: protect and water proof existing structures to remain in order to prevent water intrusion;

E. Foundations: remove foundations of all demolished structures including slabs on grade to a depth of five feet below existing grade; back fill, compact and return grade to match existing conditions. Where surrounding grade is landscaped, introduce top soil sloped to drain and install landscaping to match existing conditions;

F. At the 6150 Century Complex, after demolition, the area shall be graded to drain and paved; and

G. Existing finishes: patch, finish and paint roadway parapets, garages and terminals to match existing conditions. Where structural parapet walls are required at parking garages, install infill parapet walls and secure them structurally to the abutting walls. At existing terminal structures, infill wall construction shall match adjacent construction; interior and exterior finishes shall, likewise, match existing.

20.4.2 **Demolition in the Vicinity of Central Outfall Sewer**
Extreme caution shall be exercised when performing proposed demolition of any structure, removal and installation of foundations so that the existing Central Outfall Sewer is not damaged. The construction operation shall be such that no heavy equipment shall be allowed to impose
excessive loads over the sewer. A proposed plan for the demolition of any structure within the zone of influence of the Central Outfall sewer as determined by the AHJ shall be submitted to the AHJ for review and approval, prior to any demolition. See also Part 2B, Section 14.3.4, Vibration Monitoring, and Part 2B, Section 14.3.5, Bureau of Sanitation Specific Requirements.

### 20.5 Summary of Submittals

At a minimum, the Developer shall provide submittals as indicated in Part 2A, Section 6.
21. FIRE LIFE SAFETY

21.1 General
The Developer shall develop fire protection requirements for Guideway and Guideway elements including Stations, ancillary Guideway facilities, TPSS and the M&SF. Guideway fire protection comprises the fire protection requirements for the Guideway itself.

Fire protection design shall take into account the following elements in order of precedence:

A. Avoidance;
B. Elimination;
C. Substitution;
D. Engineering Controls;
E. Warnings; and
F. Administrative Controls.

The Developer shall connect fire alarm devices to LAWA and the CCF in accordance with Part 2B, Section 17.

21.2 Standards and Specifications
The Developer shall comply with the requirements listed in Part 4, Standards and Specifications.

21.3 Performance Requirements

21.4 Classifications of Fire Protection Requirements

21.4.1 Avoidance
Avoidance is the ideal form of fire protection in that the Hazard cannot even exist. Examples of this are noncombustible construction and a complete lack of flammable materials and conditions.

21.4.2 Elimination
Elimination removes the Hazard condition. Examples of this are removal of flammable materials from the site.

21.4.3 Substitution
Substitution replaces flammable materials with nonflammable materials or ones that are lesser of a Hazard. Example of this are nonflammable liquids replacing flammable or combustible ones.

21.4.4 Engineering Controls
Engineering controls are elements added in to mitigate the Hazard. Common ones used are isolation, detection and suppression. Isolation uses barriers to confine the fire effects to the incident area. Detection identifies the existence and location of a fire incident and suppression reduces the power or heat release rate of the fire.
21.4.5 Warnings

Warnings are used to create a heightened awareness that a Hazard exists. Warnings require a person to be involved in the process and are thus considered less desirable than an automatic response to a fire product or condition.

21.4.6 Administrative Controls

Administrative controls are even further removed from warnings. These for example only allow those with specific training to enter a hazardous area.

21.4.7 Station Requirements

The primary purpose of a Station shall be for the use of the passengers who normally stay in a Station structure for a period of time no longer than that necessary to wait for and enter a departing passenger-carrying Vehicle or to exit the Station after arriving on an incoming passenger-carrying Vehicle.

21.4.7.1 Emergency Responder Access

Each Station having fire alarm initiating devices shall be provided with a fire alarm annunciator panel at a location coordinated with the AHJ and that is accessible to emergency response personnel in accordance with NFPA 72.

21.4.7.2 Noncombustible Construction

Building construction for all new stations shall be not less than Type IA, Type IB or Type IIA construction as defined in the California Building Code, for the station configuration or as determined by fire Hazard analysis of potential fire exposure Hazards to the structure.

All public areas shall be fire-separated from adjacent non-public areas.

21.4.7.3 Detection and Notification

Annunciator panels shall announce by audible alarm the activation of any fire alarm initiating device in the Station and visually display the location of the actuated device.

When activated, all indicator signals for fire alarms, smoke and heat detection shall be transmitted simultaneously to CUP Operations and.

Automatic fire detection shall be provided in all ancillary spaces by the installation of listed combination fixed-temperature and rate-of-rise heat detectors or listed smoke detectors.

21.4.7.4 Egress Requirements

For a Station, the design of the means of egress shall be based on an emergency condition requiring evacuation of the Vehicle(s) and Station occupants to a point of safety.

At least two (2) means of egress remote from each other shall be provided from each Station platform as follows:

A. A means of egress used as a public circulation route shall be permitted to provide more than fifty (50) percent of the required egress capacity from a Station Platform or other location.

B. Means of egress from separate Platforms shall be permitted to converge.

C. Where means of egress routes from separate Platforms converge, the subsequent capacity of the egress route shall be sufficient to maintain the required evacuation time from the incident Platform.
21.4.7.5 Standpipes

The following shall apply to standpipes:

A. Class I standpipes shall be installed in all Stations in accordance with NFPA 14 except as modified herein; and

B. Standpipe systems shall not be required to be enclosed in fire-rated construction provided the following conditions are met:
   1) The system is cross-connected or fed from two locations; and
   2) Isolation valves are installed not more than 245 m (800 ft.) apart.

In addition to the usual identification required on fire department connections for standpipes, there shall also be wording to identify the fire department connection as part of the Station system.

21.4.7.6 Sprinklers

If required, the installation of sprinkler systems shall comply with NFPA 13 or applicable local codes as required. A sprinkler waterflow alarm and supervisory signal service shall be installed and interfaced with the annunciator panels in Part 2A Section 21.4.7.3. Other fire suppression systems, if approved, shall be permitted to be substituted for automatic sprinkler systems.

21.4.8 Ancillary spaces

21.4.8.1 Emergency Responder Access

Each facility having fire alarm initiating devices shall be provided with a fire alarm annunciator panel at a location coordinated with the AHJ and that is accessible to emergency response personnel in accordance with NFPA 72.

21.4.8.2 Noncombustible Construction

Building construction for all new facilities shall be not less than Type IA, Type IB, or Type IIA, or combinations thereof, noncombustible construction in accordance with the requirements of California Building Code, for the facility configuration or as determined by fire Hazard analysis of potential fire exposure Hazards to the structure.

All public areas shall be fire-separated from adjacent non-public areas.

21.4.8.3 Detection and Notification

Annunciator panels shall announce by audible alarm the activation of any fire alarm initiating device at the facility and visually display the location of the actuated device.

When activated, all indicator signals for fire alarms, smoke and heat detection shall be transmitted simultaneously to CUP Operations and CCF.

Separate zones shall be established on local annunciator panels.

Automatic fire detection shall be provided in all ancillary spaces by the installation of listed combination fixed-temperature and rate-of-rise heat detectors or listed smoke.

Signals received from such devices shall be identifiable as to the origin of the signals.

21.4.8.4 Sprinklers

If required, the installation of sprinkler systems shall comply with NFPA 13 or applicable local codes as required.

A sprinkler system waterflow alarm and supervisory signal service shall be installed.
Other fire suppression systems, if approved, shall be permitted to be substituted for automatic sprinkler systems.

**21.4.9 M&SF and TPSSs**

**21.4.9.1 Emergency Responder Access**

Each facility having fire alarm initiating devices shall be provided with a fire alarm annunciator panel at a location coordinated with the AHJ that is accessible to emergency response personnel in accordance with NFPA 72.

**21.4.9.2 Detection and Notification**

Annunciator panels shall announce by audible alarm the activation of any fire alarm initiating device at the facility and visually display the location of the actuated device.

When activated, all indicator signals for fire alarms, smoke detection, valve switches, and waterflow shall be transmitted simultaneously to CUP Operations and CCF.

Separate zones shall be established on local annunciator panels to monitor waterflow on sprinkler systems and supervise main control valves.

Automatic fire detection shall be provided in all ancillary spaces by the installation of listed combination fixed-temperature and rate-of-rise heat detectors or listed smoke detectors except where protected by automatic sprinklers.

Heat and smoke detectors shall be installed at the TPSSs.

**21.4.9.3 Egress Requirements**

Egress requirements shall comply with local Building Codes.

**21.4.9.4 Smoke Control**

Smoke control requirements shall comply with local Building Codes.

**21.4.9.5 Sprinklers and Standpipes**

A. Sprinklers:

1) An automatic sprinkler protection system shall be provided in all areas of maintenance facilities;

2) Installation of sprinkler systems shall comply with NFPA 13 or applicable local codes as required;

3) A sprinkler system waterflow alarm and supervisory signal service shall be installed; and

4) Engineering plans shall define the Occupancy Hazard Classifications and boundaries of each.

B. Standpipes:

1) Class I standpipes shall be installed in accordance with NFPA 14 or applicable codes as required.

**21.4.10 Guideways**

**21.4.10.1 Emergency Responder Access**

Except as described herein, points of egress and exits from the Guideway shall serve as emergency access routes.
A. If security fences are used along the Guideway, access gates shall be provided in security fences, as deemed necessary by the AHJ.

B. Access gates shall be a minimum forty-four (44") wide and shall be of the hinged or sliding type.

C. Information that clearly identifies the route and location of each gate shall be provided on the gates or adjacent thereto.

D. Access to the elevated Guideway shall be from stations or by emergency stairs as shown on drawings in Part 5, Contract Drawings/Engineering Data.

21.4.10.2 Noncombustible Construction

Surface: Construction materials shall be not less than Type II (000) noncombustible material as defined in NFPA 220 and applicable codes, or as determined by a fire Hazard analysis of potential fire exposure hazards to the structure.

Elevated: All structures necessary for Guideway support and all structures and enclosures on or under guideways shall be of not less than Type I or Type II (000) or combinations of Type I or Type II noncombustible construction as defined in NFPA 220 and applicable codes, or as determined by a fire Hazard analysis of potential fire exposure hazards to the structure.

21.4.10.3 Egress Requirements

The APM System shall incorporate a walk surface or other approved means for passengers to evacuate a Vehicle at any point along the Guideway so that they can proceed to the nearest Station or other point of safety:

A. Walkway continuity shall be maintained at special track sections (e.g., crossovers and pocket tracks).

B. Walkway continuity shall be provided by crosswalks at track level.

C. The means of egress within the Guideway shall be provided with an unobstructed clear width of thirty (30) inches from the walking surface to a height of sixty-two (62) inches above the walking surface decreasing to seventeen (17) inches at eighty (80) inches above the walking surface.

D. Doors in egress routes serving guideways shall have a minimum clear width of thirty-two (32) inches.

21.5 Threat and Vulnerability Assessment

21.5.1 General

The Developer shall assess terrorist vulnerabilities and incorporate mitigation measures in the design and construction of the APM System as provided in this Section 21.5. The Developer’s assessment of terrorist vulnerabilities shall be based on the threat scenarios included in LAWA’s report entitled “LAWA APM Project Threat and Vulnerability Assessment Summary,” dated July 28, 2017, which is a Contract Document and will be made available by LAWA to the Developer prior to submittal of the Developer’s Technical Proposal. The Developer shall comply with the requirements of this Section 21.5 for all Threat and Vulnerability Assessment (TVA) activities performed by the Developer and any TVA information provided by LAWA.

21.5.2 Definition

The intent of TVA is to determine appropriate design of the key areas of concern for the APM System in order to increase the overall resistance to the following:
A. An attack on the APM Fixed Facilities that could lead to progressive structural collapse of key areas of concern.

B. An attack on the APM Operating System that could result in loss of train control, leading to collision with fixed facilities or other trains, fire, or other detrimental occurrence.

21.5.3 Scope

The Developer shall perform a TVA and prepare a TVA report prior to commencement of the final design phase to determine appropriate modifications to key areas of concern for the APM System to increase overall resistance to a potential terrorist attack. The evaluation shall focus on the following key areas of concern:

A. Structural vulnerability of the APM Stations: Structural elements shall be designed and constructed to withstand the blast load identified in the Contract Documents. Blast load analysis and design shall be a part of the APM Fixed Facility security requirements. The APM Fixed Facilities shall be designed to prevent disproportionate or progressive collapse resulting from any localized damage associated with intentional acts or attacks. All critical load-carrying elements in key elements of the structures shall be designed with sufficient strength and ductility to provide adequate resistance against attacks to prevent loss of function and/or shall incorporate means of ensuring standoff or access restriction measures such that the vulnerability of the element is substantially reduced.

B. Vehicular attacks: Station plaza areas at ground level shall be protected from vehicular attacks using crash-resistant perimeter barriers or bollards located around the perimeter of the plaza areas. Crash-resistant perimeter barrier shall, at a minimum, meet the Department of State (DoS) penetration rating designation of K4 (equivalent to M30-P1 in ASTM F 2656-07) for a 15,000-pound medium-duty truck traveling 30 mph. The protective perimeter can incorporate other at-grade APM Fixed Facilities, but the portion of the at-grade APM Fixed Facilities that supplements a protective barrier or bollard shall also meet the requirements for the barrier or bollard.

C. Blast-proof glass: Glass used in APM stations and vertical cores shall be blast-proof at ground level.

D. Cyber Attacks: The APM Operating System shall include protections from cyber-attacks that could lead to hacking or hostage taking of the following:

1) Automatic train control;
2) Wayside communications;
3) SCADA or other controls;
4) Developer network.

The Developer shall conduct a TVA workshop with representatives from LAWA, FAA, First Responders, and the Developer’s design team prior to submitting the TVA report. The Developer shall present their proposed threat mitigation measures at the workshop. Input from the workshop attendees shall be incorporated into the final TVA report.

The Developer shall submit the TVA Report detailing the threat scenarios analyzed and the recommended mitigation measures to LAWA for review and acceptance prior to final design of the APM System. The accepted TVA mitigation measures shall be incorporated into the final design.
21.5.4 Security Protocol

21.5.4.1 TVA Participant Qualifications

Each individual on the Developer team who will participate in producing or accessing TVA information shall meet the following qualifications:

A. Passes LAWA’s security clearance related to these reviews; and

B. Individually executes the Non-Disclosure Agreement – Threat and Vulnerability Assessment Information.

21.5.4.2 TVA Participant Nomination

The Developer shall nominate potential TVA participants and submit the participants’ names and related documentation to LAWA for review and approval. The proposed TVA participants shall physically report to LAWA’s offices to be fingerprinted and provide any other information needed in relation to the security clearance. LAWA will respond to the Developer regarding the proposed participants and shall have the right to reject or dismiss any participant based on the results of the security clearance process or for otherwise failing to meet the requirements set forth in this Section 21.5.7. The number of TVA participants from the Developer shall be limited to six. The Developer shall not change or substitute participants without LAWA’s prior written approval.

The Developer shall submit the following for each participant it nominates:

A. A completed LAX Security Badge Office Fingerprint Application (Part 2B, Appendix A, Form A);

B. A copy of the completed Los Angeles World Airports Non-Disclosure Agreement – Threat and Vulnerability Assessment Information (Part 2B, Appendix A, Form B) executed by the proposed participant.

21.5.4.3 TVA Handling

LAWA intends to seek official Sensitive Security Information (SSI) designation under 49 CFR 1520 for all work products resulting from the TVA, including the final TVA report. The Developer shall mark and store the TVA documents as SSI in accordance with 49 CFR 1520, and treat TVA information as confidential during the development of the TVA report. Once the TVA report has been officially designated as SSI by the Transportation Security Administration, the Developer will be required to comply with the requirements under 49 CFR 1520. The following are the minimum requirements for handling TVA and SSI information:

A. Electronic presentations shall be marked with the SSI header on all pages and the SSI footer on the first and last pages of the presentation.

B. Spreadsheets shall be marked with the SSI header on every page and the SSI footer on every page or at the end of the document.

C. Video and audio shall be marked with the SSI header and footer on the protective cover when able and the header and footer shall be shown and/or read at the beginning and end of the program.

D. CDs and DVDs shall be encrypted or password-protected and the header and footer shall be affixed to the CD or DVD.

E. Portable drives including “flash” or “thumb” drives shall not themselves be marked, but the drive itself shall be encrypted or all documents stored shall be password-protected.
F. When leaving the computer or desk, the TVA participant must lock up all TVA information and lock or turn off the computer.

G. TVA participants shall not take TVA or SSI home.

H. Discussing TVA or SSI over cellular telephones should be done carefully to prevent eavesdropping. Land lines in non-public locations are more secure than cellular telephones.

I. Email shall not contain TVA or SSI in the body of the email. TVA or SSI shall be emailed in a password-protected attachment. Passwords shall be sent separately with no subject line or shared either in person or via telephone.

J. Passwords for TVA or SSI documents shall contain at least eight characters, have at least one upper-case and one lower-case letter, contain at least one number, and not be a word in the dictionary.

K. Faxing of TVA or SSI shall be done by first verifying the fax number and that the intended recipient will be available to retrieve the SSI fax.

L. TVA or SSI shall be mailed by U.S. First Class mail or other traceable delivery service using an opaque envelope or wrapping, and the outside wrapping shall not be marked as TVA or SSI.

M. Interoffice mail shall be sent using an unmarked, opaque, sealed envelope so that the TVA or SSI cannot be read through the envelope.

N. TVA or SSI stored on network folders shall either require a password to open or the network shall limit access to the folder to only TVA participants.

O. Interim work products not intended for submission to LAWA shall be disposed of in a manner consistent with SSI material.

P. Destroying TVA or SSI shall be done using a cross-cut shredder which produces particles that are 1½ inch by ¾ inch or smaller.

The Developer shall:

AA. Establish appropriate points of contact for the Developer;

BB. Limit reproductions and account for electronic and paper documents;

CC. Release secure information only to those who have a need to know, and have obtained the proper security clearances, as determined by LAWA;

DD. Identify appropriate storage methods;

EE. Control transmitting and shipping information;

FF. Dispose of documents as necessary to control security information.

The Developer shall provide a TVA Information Protocol that determines what elements of the Work will be designated SSI material and addresses how the Developer will meet the requirements listed above such that the process of developing assessments and subsequent Work of the Project will result in Work that meets the SSI designation of 49 CFR 1520.

The Developer shall not disclose or release any TVA Information without express written authorization from LAWA.

The Developer shall promptly report to LAWA any security violation, including loss, theft, misuse, misplacement, or unauthorized disclosure of TVA information, whether or not the TVA participants...
or any other official, employee, consultant or subcontractor to the Developer is personally involved.

Once under Contract, the TVA Contract Documents shall continue to be made available to the Developer’s TVA participants defined Section 21.5.7 throughout the Term. LAWA’s TVA information shall be stored and handled in accordance with the requirements set forth herein.

All conditions and obligations imposed upon the Developer by this Section 21.5 shall apply during the Term and shall survive the termination, expiration or cancellation of the Agreement or any rights related thereto.

### 21.6 Summary of Submittals

At a minimum, the Developer shall provide submittals as indicated in Part 2A, Section 6.
22. MECHANICAL

22.1 General
This section describes the functional and design requirements for building environmental control system that provides control to air conditioning, heating and ventilation system for D&C Work. The Developer shall provide thermal and ventilation comfort following sustainable design criteria relative to heating, ventilation and air conditioning system.

22.2 Standards and Specifications
The Developer shall comply with the requirements of Standards and Specifications listed in Part 44.

22.3 Performance Requirements
The building environmental control system (BECS) shall control temperature, humidity, air flow, static pressure change, odor, dust and stop the spread of fire by means of mechanical devices and ventilation systems.

A. Air conditioning systems shall be provided at normally occupied offices, elevators and elevator machine rooms, CTA West Station un-programmed space and the Central Control Facility and administrative offices.

B. Ventilation systems shall be provided for TPSS buildings, electrical rooms, maintenance rooms, storage rooms, maintenance and repair rooms, toilets, garages, and custodial rooms in accordance with AHJ requirements.

C. HVAC for Station Platforms is not required.

D. The Developer shall provide an atrium smoke evacuation system to keep the bottom of the smoke layer out of the occupancy level at CTA West Station un-programmed space and at the M&SF. The Developer shall provide calculations and analysis to support the proposed design.

E. The Developer shall determine the appropriate HVAC requirements for all rooms associated with the APM System and shall provide climate control as required. Similarly, the Developer shall determine the appropriate requirements for HVAC for all facility maintenance rooms included in the Work. The developer shall not place fresh air intakes in areas accessible to the public. For additional requirement see Part 2B, Section 11.

F. In determining the appropriate HVAC requirements for the CTA West Station un-programmed space, the Developer shall provide an HVAC system to support a core and shell building with at least five (5) independent zones and metering capabilities (see Part 2B, Section 2.3.2). The developer shall not place fresh air intakes in areas accessible to public.

G. The Developer shall provide screening for roof mounted equipment in areas visible to the public.

22.3.1 CTA West Station Un-Programmed Space HVAC Systems
The Developer shall provide an appropriate and complete BECS for the CTA West Station un-programmed space located at the CTA West Station parking structure top floor and below the Station Platforms. The Developer shall coordinate with LAWA to select an HVAC system that is
appropriate for space and usage. The system shall take advantage of the local weather conditions, including temperature and humidity. CTA West Station Platforms are open and no conditioning required.

The selected system shall be installed in a manner that minimizes sound transmission to normally occupied spaces.

The selected system shall be screened so that roof mounted equipment is not visible by users of the un-programmed space or the CTA West Station.

Air distribution ductwork may be installed at the Developer’s discretion; however, any exposed ductwork shall be designed as a part of the overall building aesthetic subject to the design review process.

The Developer shall provide smoke control and exhaust in accordance with the applicable codes and standards noted and shall comply with all fire and life safety requirements of AHJ.

The Developer shall not place fresh air intakes in areas accessible to the public.

**22.3.2 Maintenance & Storage Facility HVAC System**

The Developer shall provide an appropriate and complete BECS for the Maintenance & Storage Facility (M&SF). The Developer shall provide evidence that the selected system, or individual system components is appropriate for each individual space of the facility and the anticipated use of such spaces. Specialty areas, including battery rooms, UPS system rooms, Central Control Facility, ATC, communication rooms and other such spaces, as may be programmed by the Developer, shall be provided with the appropriate HVAC systems, HVAC redundancies, monitoring systems, fire and life safety systems commensurate with the space utilization and occupancy.

The BECS for the M&SF shall be provided with N+1 redundancy as dictated by the requirements of the APM Operating System.

**22.3.3 HVAC Instrumentation and Building Management**

The Developer shall install an HVAC instrumentation and building management system that shall be capable of integrating with the existing LAX legacy BMS/Direct Digital Control (DDC) System for Non-O&M Facilities. The Developer shall confirm the capacity of the existing system with respect to the addition of additional control modules for connection of the new HVAC systems.

For APM System Fixed Facilities the Developer shall install a complete HVAC instrumentation and building management system. The developer shall not place fresh air intakes in areas accessible to the public.

**22.3.4 Plumbing and Natural Gas System**

This section describes the requirements for the plumbing and piping system for domestic water, natural gas, storm drain, sanitary waste and vent, and compressed air and oil system (if any) systems serving the APM. Plumbing and piping systems include sewage systems for conveying sanitary waste, storm drain system for conveying storm water, industrial waste system for conveying water and other fluid (condensate drainage, station wash down, irrigation water) run-off from stations and the M&SF to the site sewage system.

Plumbing system shall comply with the requirements of the AHJ.

**22.4 Summary of Submittals**

At a minimum, the Developer shall provide submittals as indicated in Part 2A, Section 6.
23. ELECTRICAL AND LIGHTING

23.1 General
The Developer shall provide normal and emergency electrical power for lighting and equipment. The design of the facilities electrical systems shall provide for its safe, reliable, and continuous operation. The Developer shall ensure that electrical spaces are properly located and sized to facilitate the installation and the maintenance of the equipment.

The Developer shall provide accessibility to allow for removal and replacement of major equipment.

The Developer shall provide a design which promotes uniformity of design and standardization of equipment throughout the facilities of the system.

23.2 Standards and Specifications
The Developer shall comply with the requirements listed in Part 4, Standards and Specifications.

23.3 Performance Requirements

23.4 Electrical

23.4.1 General Electrical Design Criteria
Calculations that ensure the safety and reliability of the APM System and set the ratings for the equipment are to be done and provided for future reference during the O&M Period. Also, the requirements of code NFPA 70E are applicable for all electrical facilities in this Project. Dry transformers shall be used for all power transformations.

23.4.1.1 Classification of Loads

A. Definitions:

1) "Nonessential": Includes all loads not classified essential or critical. Such loads shall be backed by an automatic primary transfer to an alternate independent source but may be disconnected if necessary during emergency conditions.

2) "Essential" loads are determined to affect life safety and loads which require a continuous power source. Such loads shall be backed by an automatic transfer to an alternate independent source and shall not be disconnected during emergency conditions.

3) "Critical": Loads which cannot tolerate any interruption longer than 1/4 HZ or which warrant extra back-up. Such loads shall be served by a battery or Uninterruptible Power Supply System (UPS).

B. Essential and Critical Loads:

1) Essential Loads:
   a) Emergency Lighting;
   b) Emergency ventilation fans and dampers;
   c) Station duplex sump pumps (only if part of Fire Life Safety System);
   d) Station Exhaust Fans (only if part of Fire Life Safety System).
2) Critical Loads:
   a) Station control functions;
   a) Communications;
   b) Security; and
   c) Fire control and alarms.

23.4.1.2 Safety Considerations

Ground fault protection shall be provided on branch circuits which have equipment or outlets for which personnel protection is required by either the NEC or engineering judgment. Ground fault tripping shall be at the UL Class A level (5ma).

Heavy duty safety switches shall be provided as a means to disconnect equipment from its feeder when equipment is not within the sight of feeder breaker or motor controller, or where advantageous to separate feeder from electrical loads to be supplied by others. In general, safety switches shall be of the non-fusible type. They shall have the means of being locked in the open position.

23.4.1.3 Utility Feed

The ancillary electric service shall be designed with high reliability. The Developer shall provide electrical redundancy with physically isolated equipment by having two independent and physically separate feeders connected to the utility network bus. Each feeder capacity shall be of equal rating and sufficient to carry the entire Station load.

The Developer shall provide fully redundant incoming service sections. Each shall be fed by a full capacity utility feeder network bus. All loads in the Station shall be connected such that they can receive power from either section. Each section shall be in a separate electrical room.

23.4.2 Electrical Devices and Materials

Convenience outlets shall be provided for receiving plug-in type Specification grade twenty (20) amperes, 120 volts NEMA 5-20R duplex equipment. Receptacles in the Station shall be lockable and tamper-proof type. Weatherproof covers shall be provided on all receptacles.

23.4.3 Grounding

The protection levels shall be as defined in IEEE Standard 80. Grounding requirements of traction power systems and equipment are described in Part 2B, Section 11.

23.5 Lighting

All lighting visible to drivers and pedestrians on the surface shall be Illuminating Engineering Society (IES) cut-off type.

Lighting shall emphasize directional signage indicating preferred circulation paths, and the informational signage which provides for quick recognition of danger and decision points.

The Developer shall provide fuses and fuse holders for outdoor lighting ballasts and light pole fixtures.

All emergency and egress lighting shall meet the requirements of the AHJ.

See Section 11.3.11.8.1 for emergency walkway lighting requirements.
23.5.1 Specific Lighting Requirements by Area

Station Areas:

A. Lighting shall emphasize Station system graphics, informational messages, as applicable;
B. Lighting shall direct the Users to the horizontal and vertical circulation elements; and
C. Lighting shall utilize LED-type lighting fixtures.

23.5.2 Illumination Levels

A. Average Maintained Lighting levels shall be within the ranges noted:

1) Artwork and Displays = 40-50FC.
2) General illumination = 15-20FC.
3) Escalators, Moving Walkways, and Stairways = 15-20FC.
4) Platform Queuing/Waiting = 20-30FC.
5) Platform Edge = 20-30FC.
6) Station Mezzanine areas: 15-20FC
7) Pedestrian Walkways: 15-20FC
8) Station Plazas at ITF West and ITF East: 5-10FC

B. Building Exteriors and Parking / Parking Garages:

1) Basic:
   a) Minimum Maintained Horizontal Illuminance (fc) = 1.0.
   b) Minimum Maintained Vertical Illuminance (fc) = 0.5.
   c) Average Maintained Illuminance (fc) = 5.0 min.

2) Ramps:
   a) Day: Minimum Maintained Horizontal Illuminance (fc) = 2.0, Minimum Maintained Vertical Illuminance (fc) = 1.0.
   b) Night: Minimum Maintained Horizontal Illuminance (fc) = 1.0, Minimum Maintained Vertical Illuminance (fc) = 0.5.
   c) Average Maintained Illuminance (fc) = 10.0 min. (day), 5.0 min. (night)

3) Entrance:
   a) Day: Minimum Maintained Horizontal Illuminance (fc) = 50.0, Minimum Maintained Vertical Illuminance (fc) = 25.
   b) Night: Minimum Maintained Horizontal Illuminance (fc) = 1.0, Minimum Maintained Vertical Illuminance (fc) = 0.5.
   c) Average Maintained Illuminance (fc) = 50.0 min. (day), 5.0 min. (night)
4) Stairs: Minimum Maintained Horizontal Illuminance (fc) = 2.0, Minimum Maintained Vertical Illuminance (fc) = 0.1.

All interior and exterior areas shall have a ratio of average/minimum maintained foot-candles value as specified by IES.

Top Level of parking garages open to the sky, to use Maintained Illuminance Values per IES.

All values are horizontal at a point thirty (30) inches above floor level (interior) or at grade (exterior).

23.6 Summary of Submittals

Electrical and lighting systems shall be part of pertinent design submittals.
24. ELEVATORS, ESCALATORS AND MOVING WALKWAYS

24.1 General

This section defines the functional and design requirements for passenger elevators, freight elevators, moving walkways, and escalators. These criteria cover the elevators, escalators, and moving walkways for the Project. The design of the elevators, escalators, moving walkways shall incorporate the design criteria for all related systems. The Developer's procurement documents for these conveyances shall include requirements for quality assurance, reliability, maintainability, and safety.

There are two vertical circulation groups:

A. Garage Vertical Cores: Installed by the Developer; operated and maintained by LAWA; and

B. Stations and M&SF: Provided, installed, operated and maintained by the Developer.

24.2 Standards and Specifications

The Developer shall comply with the requirements of the listed in Part 4, Standards and Specifications.

24.3 Performance Requirements

The number of escalators and elevators at each station platform shall meet the following minimum requirements:

A. Be provided in sufficient quantity to clear the platform within 120 seconds during peak train headways and passenger loads;

B. Convey peak passenger loads at level of service (LOS) A (based on TRB, Transit Capacity and Quality Service Manual, 3rd Edition) to and from the platform to meet the 95 MAP peak passenger loading calculated for each station;

C. In the event of failure management in which one of the CTA stations is inoperative, clear the platform within 120 seconds;

D. In the event of failure of primary or secondary power, the failure management requirements as defined in Part 2B Section 11.3.3.1.7 shall maintain 100% operation of all Station escalators and no less than 50% operation of all Station elevators as required by Part 2B Section 11.3.8.5; and

E. Be provided in sufficient quantity such that there is a redundancy of one additional vertical conveyance element (elevator and escalator) in addition to the minimum number required pursuant to Part 2B Section 24.3 A, B and C. In no case, shall the number of elevators and escalators be less than the numbers stipulated in Part 2B Section 24.3.3.

24.3.1 Elevators

A. Acceptable Manufacturers:

1) Garage Vertical Cores: Subject to compliance with Contract Documents requirements, provide products by one of the following:
a) Kone;
b) Otis;
c) Schindler;

2) Stations and M&SF are at the Developer’s discretion.

B. Elevator System General Requirements:
   1) All equipment provided shall be weatherproof;
   2) Elevators shall be electric, traction-type elevators; and
   3) Elevator cable mechanism and underside of cabs shall be hidden or clad.

C. Capacity Rating:
   1) Garage Vertical Cores: Rated capacity of each passenger elevator shall be based on patronage with a minimum capacity of 3,500 pounds.
   2) Stations: Rated capacity of each passenger elevator shall be based on patronage with a minimum capacity of 5,000 pounds.
   3) M&SF: Rated capacity of passenger and freight elevators shall be at the Developer’s discretion.

D. The minimum speed of passenger elevators shall be 200 fpm.

E. Passenger elevators shall provide vertical transportation between levels for passengers, including individuals who have disabilities, and maintenance equipment.

F. All exterior elevator entries shall be covered and protected from weather. Floor areas outside elevator doors and elevator shaft shall slope away from elevator. Provide floor drains outside elevator doors where entries are subject to weather. All fixtures shall be vandal proof.

G. Controls shall be designed and located to meet requirements of the Americans with Disabilities Act Accessibility Guidelines and local codes.

H. The final assembly of all components shall not pose hazardous conditions to the public or maintenance personnel. Surface irregularities, sharp edges, or protrusions in public or non-public areas shall not be permitted.

I. Metal surfaces exposed to public view shall be stainless steel. Other metal surfaces shall be hot-dipped galvanized, except nonferrous metals and stainless steel. Where hot dip galvanizing is not feasible, an alternative corrosion resistant treatment providing the equivalent protection shall be provided:
   1) Machined and operational areas shall be protected from corrosion by applying a rust preventative compound, oil or grease;
   2) All galvanized surfaces shall have a paint finish in accordance with the approved paint schedule; and
   3) No dissimilar metals shall contact each other.
J. Elevator Car and Entrance Criteria:
   1) Station elevator clear interior car width shall not be less than 6'0". All
elevators shall be the same size. Total elevator clear interior area shall be
a minimum of 334 sf at each Station.
   2) Floor materials shall match the Platform floor finish materials;
   3) All metal wall and ceiling cladding, railings, and trim shall be stainless steel.
   4) Elevator car ceiling heights shall be a minimum of 9'0"; and
   5) Provide energy-efficient light fixtures.

K. Signal Equipment Criteria:
   1) An emergency alarm bell shall be provided;
   2) A “Door open” bell shall be provided on the car;
   3) Car and landing shall be equipped with illuminated and tactile pushbuttons.
   Hall lanterns that are visible from the side and bells shall be provided at
each floor level centered above each elevator entrances;
   4) Call buttons and control devices shall be in NEMA 4 boxes in all locations;
   and
   5) Shaft wiring shall be waterproof.

L. Communication Equipment:
   1) A pushbutton-activated Emergency Telephone shall be provided in each
elevator car for use by the public and employees. The phone equipment
shall communicate with the appropriate parties. (See Part 2B, Section 17.);
   2) A public address speaker (PA) shall be provided for audio messaging from
   the public address and emergency signaling systems; and
   3) CCTV cameras shall connect to the appropriate party. (See Part 2B,
   Section 17.)

M. Remote Monitoring System:
   1) Provide signals to report failures or out of service conditions to the
   existing/new elevator remote monitoring system; and
   2) Signals are to be monitored by the appropriate parties. (See Part 2B,
   Section 17.)

N. Emergency Power/Standby Power:
   1) Provide emergency or standby power for elevator operation in event of
   normal power supply failure.

O. Car and Hoistway Ventilation:
   1) Where the hoistway may be subject to solar heat gain, provide ventilation
   as appropriate to keep equipment in operating range temperatures; and
   2) Provide ventilation as appropriate to keep car cool.
P. Machine Room:
   1) Machine and controller rooms and their access doors shall have adequate space for the installation and maintenance of the equipment. Only elevator related equipment shall be located in the rooms. Lighting, heating, ventilation, and/or air conditioning shall be provided to meet manufacturer’s recommendations, code requirements;
   2) Provide separate telephone service to the elevator machine rooms in order to permit remote monitoring of the equipment; and
   3) Provide keys for elevator access and control (within elevator) in the elevator machine room.

B. Elevator Pits: The hoistway entrance shall be designed to minimize the likelihood of water entering the pit; and including water from rainfall or maintenance activities.

C. Commissioning: All equipment shall be placed into operation through a formal commissioning procedure.

24.3.2 Escalators and Moving Walkways

A. Acceptable Manufacturers:
   1) Subject to Developer’s discretion.

B. Quality Assurance:
   1) In addition to the requirements listed below, escalators and moving walkway shall comply with APTA Heavy Duty Transportation System Escalator Design Guidelines; and
   2) Shall be capable of operating twenty-four hours per day, 7 days per week.

C. Escalator/Moving Walkway General Requirements:
   1) Escalators/moving walkways shall be designed and installed for outdoor use. Escalators shall have weather protection;
   2) Escalators/moving walkways shall be heavy duty escalator suitable for public transit. The escalator design shall incorporate finishes, material, and components to deter and resist vandalism, and reduce maintenance;
   3) Provisions shall be incorporated in the design to accommodate the drainage of rainwater. Escalators shall be provided with drains in pits to prevent accumulation of water; and
   4) Escalator/moving walkways shall include sleep mode function to reduce energy use and wear on equipment.

D. Performance Requirements:
   1) Direction of travel shall be both direction, up or down and reversible;
   2) Escalator Speed: 100 feet per minute plus or minus four (4) feet per minute speed variation under varying load conditions in either direction; and
   3) Moving walkway speed: 140 feet per minute plus or minus four (4) feet per minute speed variation under varying load conditions in either direction.
E. Escalator dimensional criteria:
1) Inclination: not to exceed thirty (30) degrees;
2) Nominal step width: forty (40) inches; and
3) Flat steps: Three (3) minimum for less than 32’10” rise; four (4) minimum for greater than 32’10” rise.

F. Moving walkway dimensional criteria:
1) Inclination: not to exceed ten (10) degrees; and
2) Nominal width: forty (40) inches.

G. Commissioning:
1) All equipment shall be placed into operation through a formal commissioning procedure.

B. Remote Monitoring System:
1) Provide signals to report failures or out of service conditions to the existing/new escalator remote monitoring system;
2) The escalator controller shall provide discrete normally open contacts for each of the safety devices within the escalator to interface with the remote monitoring system; and
3) Signals are to be monitored by the CCF.

24.3.3 Station Elevator and Escalator Quantities and Locations
At a minimum, the Developer shall provide the number of elevators and escalators as indicated in this table.

<table>
<thead>
<tr>
<th>Location</th>
<th>West Platform End</th>
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<th>Other</th>
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<tr>
<td>CTA West</td>
<td>4 4 4 4</td>
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<td></td>
<td></td>
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<tr>
<td>CTA Center</td>
<td>2 3 2 3</td>
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<tr>
<td>CTA East</td>
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<td></td>
</tr>
<tr>
<td>ITF West</td>
<td>2 3 2 3</td>
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<tr>
<td>ITF East</td>
<td>2 3 2 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper West Way drop off curb to un-programmed space level</td>
<td>2 elevator 2 escalators</td>
<td></td>
<td>Connects Upper West Way drop off curb to public concourse adjacent to un-programmed space level at CTA West Station. The elevators shall also connect to Level 1 and Level 2 of the CTA West Parking Garage.</td>
<td></td>
</tr>
</tbody>
</table>
24.3.4 Pedestrian Walkway Moving Walkways Quantities and Locations

At a minimum, the Developer shall provide moving walkway lengths as indicated in this table:

<table>
<thead>
<tr>
<th>Pedestrian Walkway Location</th>
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<th>Quantity</th>
<th>Comments</th>
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<tbody>
<tr>
<td>CTA EAST to VC-P1</td>
<td>150 ft.</td>
<td>2</td>
<td>1 moving walkway in each direction</td>
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<td>CTA EAST to VC-P7</td>
<td>200 ft.</td>
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<td>CTA CENTER to TVC 1.5</td>
<td>100 ft.</td>
<td>2</td>
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<td>CTA CENTER to TVC 2.5</td>
<td>100 ft.</td>
<td>2</td>
<td>1 moving walkway in each direction</td>
</tr>
<tr>
<td>CTA CENTER to TVC 5.5</td>
<td>238 ft.</td>
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<td>CTA WEST to TVC 3.0</td>
<td>165 ft.</td>
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<td>1 moving walkway in each direction</td>
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<tr>
<td>CTA WEST to TVC 4.5</td>
<td>270 ft.</td>
<td>2</td>
<td>1 moving walkway in each direction</td>
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24.4 Availability Requirements

The Availability requirements for elevators, escalators, and moving walkways shall be no less than the following:

A. Escalator systems shall be available 98% of the time when Stations are open;
B. Elevator systems shall be available 98% of the time when Stations are open; and
C. Pedestrian moving walkway systems shall be available 95% of the time when passenger bridges and Stations are open.

24.5 Summary of Submittals

Elevators, escalators and moving walkways shall be part of pertinent design submittals in Part 2A, Section 6.
25. **APM STRUCTURES AND GUIDEWAY STRUCTURE INSPECTION REQUIREMENTS**

25.1 **General**

The Developer shall develop an APM Structures and Guideway Structure Inspection Plan during the D&C Period.

25.2 **Standards and Specifications**

The Developer shall comply with the requirements listed in Part 4, Standards and Specifications.

25.3 **Performance Requirements**

25.3.1 **APM Structures and Guideway Structure Inspection Plan**

The Developer shall prepare an APM Structures and Guideway Structure Inspection Plan (Inspection Plan) and submit the plan to LAWA for review and comment six months prior to baseline inspections. The Inspection Plan shall follow bridge inspection requirements stated in the AASHTO Manual for Bridge Evaluation (MBE), with additions to cover all structures that are part of the APM System. The Inspection Plan shall cover the procedures the Developer will follow in carrying out inspections, the frequency of those inspections and the requirements for submitting inspection reports to LAWA. The Inspection Plan will address both visual and physical inspections. The Inspection Plan shall include field forms and data requirements to document both visual and physical inspections. All inspections shall be carried out by a registered Professional Engineer in the State of California. The Developer shall perform visual and physical inspections of the Guideway Structure, Pedestrian Walkways, and Station structures. The Developer shall implement the first inspection of the Guideway Structure, Pedestrian Walkways and Station structures within one month after completion of construction and before installation of Operating System elements. The Developer shall perform baseline inspections during the D&C Period. Subsequent inspections are described in Part 3, Section 5.4.

All other structures not addressed above (including but not limited to the TPSS structures M&SF structure, any retaining walls, small buildings, culverts, and associated foundations) shall be visually and physically inspected and documented on a cycle of no less than once each 48-months.

25.4 **Summary of Submittals**

At a minimum, the Developer shall provide submittals as indicated in Part 2A, Section 6.
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REQUEST FOR PROPOSALS
FOR THE
AUTOMATED PEOPLE MOVER
LANDSIDE ACCESS MODERNIZATION PROGRAM
AT
LOS ANGELES INTERNATIONAL AIRPORT

PART 2B

APPENDIX A
FORMS
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REQUEST FOR PROPOSALS
FOR THE
AUTOMATED PEOPLE MOVER
LANDSIDE ACCESS MODERNIZATION PROGRAM
AT
LOS ANGELES INTERNATIONAL AIRPORT

PART 2B
FORM A
LAX SECURITY BADGE OFFICE FINGERPRINT APPLICATION
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**APPLICATION INFORMATION - ENTIRE SECTION MUST BE COMPLETED BY THE APPLICANT AND VERIFIED BY THE AUTHORIZED SIGNER**

Attention Applicant - Please print your name as it appears on your valid government-issued picture identification that you will present at the time of badging.

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**AUTHORIZED SIGNER INFORMATION**

I certify that the employee named on this fingerprint application is a direct employee for the organization listed below. Further, I have reviewed the information and statements on this application and signed and dated the application ONLY AFTER ALL INFORMATION WAS COMPLETED AND VERIFIED.

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**X**

AUTHORIZED SIGNATURE

DATE

Application is valid for 14 calendar days from date of Authorized Signature

**WARNING:** This record contains Sensitive Security Information that is controlled under 49 CFR parts 15 and 1520. No part of this record may be disclosed to persons without a "need to know," as defined in 49 CFR parts 15 and 1520, except with the written permission of the Administrator of the Transportation Security Administration or the Secretary of Transportation. Unauthorized release may result in civil penalty or other action. For U.S. government agencies, public disclosure is governed by 5 U.S.C. 552 and 49 CFR parts 15 and 1520.

**SECURITY BADGE OFFICE USE ONLY**

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REQUEST FOR PROPOSALS
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PART 2B

FORM B
LAWA NON-DISCLOSURE AGREEMENT THREAT AND
VULNERABILITY ASSESSMENT
LOS ANGELES WORLD AIRPORTS
NON-DISCLOSURE AGREEMENT
Threat and Vulnerability Assessment

I, ____________________________, an official, employee, consultant or subcontractor to ____________________________, (“Developer”), which is the developer for the Automated People Mover Project (“Project”), hereby consent to the terms in this Agreement in consideration of Los Angeles World Airports (“LAWA”) granting me conditional authorization to (i) produce threat and vulnerability assessment information for the Project and (ii) receive, store and access any threat and vulnerability assessment information provided by LAWA (collectively, “TVA”). I understand and agree to abide by the following terms and conditions in conjunction with this authorization:

1. I will only disclose the TVA to Developer’s officials, employees, consultants or subcontractors who (i) are working directly on Developer’s design for the Project, (ii) have executed and delivered a copy of this Agreement to LAWA, and (iii) have been approved by LAWA to participate in this process in accordance with Part 2B, Section 21.5 (Threat and Vulnerability Assessment) of the Technical Provisions.

2. I will abide by the requirements set forth in Part 2B, Section 21.5 (Threat and Vulnerability Assessment) of the Technical Provisions related to the production, reception, storage and/or handling of TVA any additional protocol I, or the Developer, receive from LAWA or its representatives related to the TVA.

3. I will protect the TVA from unauthorized disclosure, in accordance with the terms of this Agreement, the Contract Documents and any applicable Law.

4. I attest that I understand my responsibilities and that I am familiar with and will comply with the standards for protecting the TVA that I may produce or otherwise have access to consistent with the terms of this Agreement. LAWA may conduct inspections, at any time or place, for the purpose of ensuring compliance with the conditions for access, dissemination, handling and safeguarding information under this Agreement.

5. Except as otherwise authorized by this Agreement, I will not disclose or release any TVA without express written authorization from LAWA to me personally or to the Developer. Should situations arise that warrant such a disclosure or release of information, I will do so only after receiving this written authorization.

6. I will not alter or remove markings that indicate a category of information or require specific handling instructions, from any TVA.

7. I shall promptly report to LAWA Deputy Executive Director of Security and Public Safety any security violation, including loss, theft, misuse, misplacement or unauthorized disclosure of TVA, whether or not I am personally involved.

8. If I or another representative of the Developer violates the terms and conditions of this Agreement, such violation may result in the cancellation of the conditional access to the TVA. This may also serve as a basis for LAWA denying access to other types of sensitive information.
9. This Agreement is made and intended for the benefit of LAWA and may be enforced by LAWA or the Developer. By granting me conditional authorization to produce, receive, store and/or access TVA, LAWA and the Developer may seek any remedy available to them to enforce this Agreement including, but not limited to, application for a court order prohibiting me or other individuals who obtain this information as described in this Agreement from disclosing TVA in breach of this Agreement. I understand that if I or any official, employee, consultant or subcontractor to Developer violate the terms and conditions of this Agreement, I and/or these individuals could be subjected to administrative, disciplinary, civil, or criminal action, as appropriate and neither I nor LAWA have waived any statutory or common law evidentiary privileges or protections that we may assert in any administrative or court proceeding to protect any sensitive information to which I or the Developer has been given conditional access under the terms of this Agreement.

10. Unless and until I am released in writing by the then acting City Attorney of the City of Los Angeles, I understand that all conditions and obligations imposed on me by this Agreement apply during the time that I am granted conditional access, and at all times thereafter.

11. Each provision of this Agreement is severable. If a court should find any provision of this Agreement to be unenforceable, all other provisions shall remain in full force and effect.

12. My execution of this Agreement shall not nullify or affect in any manner any other secrecy or non-disclosure agreement which I, the Developer or its officials, employees, consultants or subcontractors have executed or may execute with the City of Los Angeles.

13. These restrictions are consistent with and do not supersede, conflict with, or otherwise alter the obligations, rights, or liabilities created by otherwise applicable Executive Orders or state and federal Laws.

14. Signing this Agreement does not bar disclosures to Congress or to an authorized official of an executive agency or the Department of Justice that are essential to reporting a substantial violation of Law.

15. Capitalized terms not otherwise defined herein shall have the meaning given them in Exhibit A to the Design-Build-Finance-Operate-Maintain Agreement for the Project.

16. I have read this Agreement carefully and understand its terms and conditions.

<table>
<thead>
<tr>
<th>Typed/Printed Name (Position):</th>
<th>Business Address:</th>
<th>Telephone Number:</th>
</tr>
</thead>
</table>

I make this Agreement in good faith, without mental reservation or purpose of evasion.

Signature: