Electromagnetic background and radiation shall be in conformance with Sections 2.1.8 and 2.2.3 of this standard.

9.2.4 System Monitoring and Alarms

Indicating instruments shall be installed within each substation to display voltage, current, and power demands. Abnormal conditions shall be transmitted as an alarm to central control per Sections 5.3.2.2 and 5.3.3.3. As a minimum, the following conditions shall result in an alarm:

Overvoltage	Switchgear local mode (see Section 9.2.7)
Undervoltage	Overtemperature
Overcurrent	Loss of phase
Ground fault	Fire or smoke

All transformers and rectifiers shall be provided with overtemperature sensors that activate alarms at central control and cause automatic shutdown of the affected equipment at the preset temperature. Alarms shall be transmitted first at impending overtemperature, then with critical overtemperature accompanied by equipment shutdown.

9.2.5 Power Regeneration Equipment

Traction power regeneration may be specified. If specified, the system shall make efficient use of train regeneration capability. The system shall be designed to accommodate the worst-case overvoltage conditions associated with power regeneration at maximum vehicle speeds, loading, and train length. Provisions for regeneration shall prevent excessive voltage from being returned to the utility power source. If power regeneration is specified, the hazard of regenerating power into the deenergized power rail shall be analyzed in accordance with Section 3.1.2.1.

9.2.6 Remote Monitoring and Control

The traction power substation shall be remotely monitored and controlled through the automatic train supervision system (see Sections 5.3.2.2 and 5.3.3.2, item 11). Monitoring shall include data logging (see Section 5.3.3.4). All commands for power application and removal shall be logged, with a time stamp.

9.2.7 Local Control

The power distribution equipment shall include provisions for local control (open and close) of the switchgear in addition to the remote control provisions cited. Each separate switchgear element shall have a lockout switch allowing local control of the switchgear, locking out remote control when in local mode. Local mode shall be annunciated at central control.

9.2.8 Restoring Power

The power distribution equipment shall allow the main switchgear at the power substation to be closed, both from central control and locally at the traction power substation, to reenergize the substation. Restoration of power shall be done in accordance with operational procedures.

Automatic reclosing of power distribution equipment shall be permitted only after thorough hazard analysis in accordance with Section 3.1.2.1. If implemented, the design shall provide for reclosing only when line testing verifies that the short-circuit condition does not exist.

9.2.9 Substation Facilities

Substation facilities and the structure housing the power distribution equipment shall be provided in accordance with NFPA 70 (2005). Traction power substation equipment shall provide its own auxiliary and control power.

A fire protection system shall be provided to detect the presence of and contain fire. Traction power substation design may be considered in combination with station design to provide fire-rating compliance, as approved by local fire authorities. Traction power substations shall comply with the requirements of Section 5.2.3.2 of NFPA 130-2007 (2007), and of Section 5.3.3.3.2, Facility Fire and Intrusion Alarms of this standard.

9.3 WAYSIDE POWER COLLECTION

As the interface to onboard power collection equipment, wayside power collection equipment shall be provided in accordance with the following sections.

9.3.1 Guideway-Mounted Power Distribution

The system providing power to the vehicle shall use rigid power rails or other means. The power rail system consists of the power rails, fastening means, expansion joints, protective covers, and other hardware. Power rails shall be electrically insulated from each other and from adjacent structures, as determined by the operating voltage. The location and method of mounting the power rails shall include consideration of the operating dynamic envelope of the vehicles.

The power rail system shall be sized for its current and voltage drop requirements and to provide structural strength for appropriate support spacing.

The power rail system shall not be damaged by the electromagnetic forces developed during short-circuit conditions.

9.3.2 Power Zones

Where the power distribution system is sectionalized, the power feeding arrangements shall include sufficient flexibility to allow each section of the guideway to be powered even if power is removed from adjacent sections, so that degraded-mode operation can continue under failure conditions or maintenance outages. Power zones shall be coordinated with the blue light station design (see Section 9.1.1).

A single vehicle shall be able to bridge power gaps between zones to provide a continuous electrical supply at all times that the APM system is operational. An exception shall be made when two adjacent zones are electrically incompatible, in which case a nonbridgeable isolating gap shall be provided. A means shall be provided to prevent the accidental energizing of an unpowered section of guideway (e.g., during maintenance), which could be caused by bridging a power gap with a vehicle.

9.3.3 Splice Joint Requirements

The power rails and splice plates shall provide positive and rigid splice joints. The length, cross-sectional area, and profile of the splice plate or plates shall be designed to provide adequate heat dissipation surfaces to limit heat rise increases to no greater than 2 °C (3.5 °F) above the power rail temperature at its operating capacity.

9.3.4 Expansion Joints and Sections

Expansion joints and sections shall be provided to accommodate the thermal expansion and contraction of the power rails caused by changes in ambient temperature and heat rise of the conductor caused by electrical load, solar radiation effect, and guideway movement.

The expansion joint or section slider assembly shall be able to withstand electromagnetic forces encountered during short-circuit conditions. All jumpers providing electrical continuity shall have capacity equal to or greater than the power rail capacity.

9.3.5 Power Rail Transitions

If there are breaks in the guideway power rail, means shall be provided to facilitate smooth engagement and disengagement of current collector shoes at the train's rated speed.

9.3.6 Insulators

The surface of the insulating material shall be smooth, hard, UV-resistant, and rated either self-extinguishing or nonburning per ASTM D635-06 (2006a).

Power conductor rails shall be protected from inadvertent contact.

9.3.7 Mounting

Power rails, if used, shall be solidly supported to prevent lateral or vertical motion, while allowing longitudinal movement necessary for thermal expansion.

9.3.8 Power Rail to Earth Resistance

Each conducting power rail of the guideway power distribution system shall have a minimum in-service effective resistance to earth of 1 megohm per 300 m (1 megohm per 1,000 ft) under all conditions.

For DC supply systems, negative return elements shall be designed to have a minimum in-service effective rail resistance to earth of 500 ohm per 300 m (1,000 ft) for a single track.

9.3.9 Power and Ground Rail Heating

Power and ground rail heating, if required, shall be provided with sufficient heat for local anticipated icing conditions. The heating system shall be segmented, with each segment independently controlled.

9.4 PASSENGER STATION ELECTRICAL EQUIPMENT

Station equipment shall be designed so that housekeeping power and lighting distribution are provided from one location. Station communications and alarms, emergency lighting, and signage shall have backup power. Typical loads to be supplied by the facilities electrical substation include automatic train control (ATC), uninterruptible power supply (UPS), communications, and other station equipment. The facilities electrical substation shall be designed in accordance with NFPA 70 (2005).

9.5 UNINTERRUPTIBLE POWER SUPPLY

In the event that primary power is unavailable, equipment requiring power shall be supported by UPS

devices. Uninterruptible power shall be provided for at least the following functions:

- ATC (per Chapter 5),
- Communications (all audio and visual, per Chapter 6),
- Fire and other appropriate safety and security equipment, and
- Power distribution system control power at the substation.

UPS equipment shall be sized to provide for all of the aforementioned functions for a period determined in accordance with Section 3.1.2.1, Hazard Analyses.

Chapter 10
STATIONS

The areas of the station addressed by this chapter include automated people mover (APM) equipment spaces and passenger boarding and alighting platforms.

10.1 DISABLED PERSONS ACCESS REQUIREMENTS

This section presents disabled access requirements for the APM interface between the vehicle floor edge and the station platform edge. The specific requirements presented in this section focus on those areas applicable to the vehicle–platform gap and detectable warnings and do not address those considered architectural concerns.

NOTE: Disabled access in the United States is subject to the Americans with Disabilities Act of 1990, and applicable federal regulations should be consulted.

10.1.1 Vehicle–Platform Gap

The vertical and horizontal vehicle–platform gap requirements are presented in Section 7.3.

10.1.2 Detectable Warning Strip

The platform edge between the guideway and station, if not protected by platform edge barriers, shall have a detectable warning. Such detectable warnings shall be 0.6 m (2 ft) wide and run the full length of the unprotected platform.

NOTE: In accord with the aforementioned requirement, platform edges protected per items 1 or 2 of Section 10.2 do not require detectable warning strips. For item 3 of Section 10.2, detectable warning strips are required only at openings in the platform. For item 4 of Section 10.2, detectable warning strips are required to run the full length of the platform edge.

Detectable warning strips shall consist of raised truncated domes with a nominal diameter of 23 mm (0.9 in.), a nominal height of 5 mm (0.2 in.), and a nominal center-to-center spacing of 60 mm (2.35 in.) and shall contrast visually with adjoining surfaces, either light on dark or dark on light.

The material used to provide contrast shall be an integral part of the walking surface. Detectable warnings used on interior surfaces shall differ from adjoining walking surfaces in resiliency or sound-on-cane contact.

10.2 PLATFORM EDGE PROTECTION

A means of platform edge protection shall be provided to protect people from the potential hazard of being struck by a moving train or moving elements within the guideway, falling from the platform, shock, or electrocution.

Acceptable means of platform edge protection include the following:

1. *Intrusion prevention* through full-height solid barriers and automatic horizontal sliding doors (see Section 10.2.1).
2. *Intrusion control* through barriers with a minimum height of 1.1 m (42 in.) and automatic horizontal sliding doors or gates (see Section 10.2.2).
3. *Intrusion detection* in association with platform edge barriers (minimum height 1.1 m [42 in.]), with openings located at the doors of stopped vehicles. The openings shall be provided with an intrusion detection device that monitors the opening in the railings (see Section 10.2.3).
4. *Intrusion detection* using a system located in the guideway or along the platform edge for the entire station length of the platform (see Section 10.2.3).
5. Any other method that provides acceptable protection as approved by the authority having jurisdiction over the system and as demonstrated by a hazard analysis per Section 3.1.2.1.

For conditions in which a fall of more than 1.5 m (5 ft) from the station platform is possible, either intrusion prevention per item 1 or intrusion control per item 2 shall be required (see also Sections 10.2.1 and 10.2.2).

For conditions in which passengers can extend limbs from vehicles through windows or other openings (see Section 7.2), the means of platform edge protection shall be analyzed for these risks by a hazard analysis per Section 3.1.2.1.

10.2.1 Intrusion Prevention System

An intrusion prevention system consisting of station platform edge barriers and their associated doors, when provided, shall meet the following requirements:

1. Platform edge doors shall be compatible with the requirements of Section 5.2.2, with height equal to or greater than that of the vehicle door opening.

2. The platform edge barriers, door assembly, supporting tracks, and linkages shall withstand a force of 1,110 N (250 lb) applied at right angles to and approximately at the center of a panel, distributed over an area of approximately 10 cm × 10 cm (4 in. × 4 in.) without permanent deformation or binding of the door mechanism. Platform edge barriers and their associated doors shall also be designed to withstand wind loads and buffeting forces when applicable.
3. If glass is used in station platform edge barriers or platform doors, the glass shall comply with the requirements of ASTM C1048-04 (2004) and ASTM C1036-06 (2006b); ANSI Z97.1-2004 (2004); and 16 CFR 1201. Markings as specified in ANSI Z97.1-2004 (2004) shall be on each separate piece of glass and shall remain visible after installation.
4. Platform edge doors shall comply with Sections 5.1.10 and 5.1.11 and all applicable requirements of Section 7.8 regarding locking, closing forces, obstruction detection, and emergency egress. A keyed platform side-lock release shall be provided to allow authorized access to the guideway for maintenance and evacuation purposes. Moreover, to avoid any injury, the kinetic energy of the moving parts (door leaf and all pieces of equipment mechanically coupled to it) shall be limited to 10 J (88.5 in. lb), computed for the average door speed. 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 25 mm (1 in.) away from the open jamb to a point 25 mm (1 in.) away from the point of closure of the doors. Demonstration of compliance by test in lieu of calculation may be provided.
5. Initiation of platform edge door closing shall be annunciated by audio and visual warning signals, as specified in Section 6.3.2.
6. The space between the platform doors and the vehicle doors shall be designed to prevent door closure when passengers are in the space between the vehicle doors and the platform doors, unless the gap is less than 130 mm (5 in.) from the platform level up to 1.1 m (42 in.) above the platform level.
7. Vehicle and station platform door opening and closure shall be coordinated per Section 5.2.3.

10.2.2 Intrusion Control System

An intrusion control system, when provided, shall include barriers with a minimum height of 1.1 m (42 in.) and automatic horizontal sliding doors or gates and shall meet the following requirements:

1. Doors or gates shall be compatible with the requirements of Section 5.2.2, with height at least equal to that of the associated barriers.
2. The platform edge barriers, door or gate assembly, supporting tracks, and linkages shall withstand a force of 1,110 N (250 lb) applied at right angles to the panel and 1 m (3.3 ft) above floor level, distributed over an area of approximately 10 cm × 10 cm (4 in. × 4 in.), without permanent deformation or binding of the door or gate mechanism.
3. Where glass is used in barriers, doors, or gates, the glass shall comply with the requirements of ASTM C1048-04 (2004) and ASTM C1036-06 (2006b); ANSI Z97.1-2004 (2004); and 16 CFR 1201. Markings as specified in ANSI Z97.1-2004 (2004) shall be on each separate piece of glass and shall remain visible after installation.
4. Doors or gates shall comply with Sections 5.1.10 and 5.1.11 and all applicable requirements of Section 7.8 regarding locking, closing forces, obstruction detection, and emergency egress. A keyed platform side-lock release shall be provided to allow authorized access to the guideway for maintenance and evacuation purposes. Moreover, to avoid any injury, the kinetic energy of the moving parts (door leaf and all pieces of equipment mechanically coupled to it) shall be limited to 10 J (88.5 in. lb), computed for the average door speed. 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 25 mm (1 in.) away from the open jamb to a point 25 mm (1 in.) away from the point of closure of the doors. Demonstration of compliance by test in lieu of calculation may be provided.
5. Door or gate closing shall be annunciated by audio and visual warning signals, as specified in Section 6.3.2.
6. The space between the doors or gates and the vehicle doors shall be designed to prevent closure when passengers are in the space between the vehicle doors and the doors or gates, unless the gap is less than 130 mm (5 in.).
7. Vehicle and station platform door opening and closing shall be coordinated per Section 5.2.3.
8. Openings or spaces between elements of the door, gate, or barrier shall be designed such that a 100-mm- (4-in.-) diameter sphere will not pass

through. Fences and gates shall be constructed to inhibit contact with the vehicle per Section 7.2.

10.2.3 Intrusion Detection System

If provided, an intrusion detection system shall be capable of detecting the intrusion of a sphere 0.3 m (1 ft) in diameter or larger weighing 9 kg (20 lb) or more, falling or otherwise passing from the platform to the guideway at any open location, at a height between platform level and 1.1 m (42 in.) above the platform surface.

When activated, the detection system shall initiate the following:

1. Command for appropriate braking for trains entering or approaching the station, as determined by a hazard analysis per Section 3.1.2.1;
2. Command to stop any moving apparatus on the guideway exposed to potential contact by the intruder (for example, drive ropes) in the vicinity of the detected intrusion; and
3. An alarm to central control.

The procedures used to reset the detection system and to restore traffic after an intrusion detection shall be analyzed through a hazard analysis per Section 3.1.2.1.

10.3 EVACUATION OF MISALIGNED TRAINS

A means shall be provided to allow egress from a misaligned train onto the station platform. Such means shall meet the requirements of Section 11.3. Where auxiliary egress doors or gates are used, a latching mechanism shall be provided on the guideway side to allow passengers to exit onto the platform. Permissible misalignment shall be per Section 5.2.2.

Access shall be provided for authorized personnel to the interior of each car of a train at any location along the guideway, including any location within the station. If auxiliary egress doors or gates are used for access through station barrier walls, then a keyed platform side-lock release shall be provided in these auxiliary egress doors or gates to allow authorized access to the cars. The opening of any such auxiliary egress door or gate shall result in the facility door detection and response requirements specified in Section 5.1.9.

10.4 EMERGENCY LIGHTING AND VENTILATION

For APM station platforms located within airport terminals or office, retail, entertainment, or other such buildings, the station lighting and ventilation shall be in accordance with local building codes, as applicable, and NFPA 101 (2006), Sections 7.9 and 9.2. For interpretation of such building codes, the APM platforms shall be treated, for lighting and ventilation issues only, as elevator lobbies. (Refer also to Section 10.5.1, Fire Detection.)

For freestanding stations dedicated to the APM system, the station emergency ventilation and emergency lighting provisions shall comply with NFPA 130 (2007), Sections 5.3 and 5.6, respectively. Lighting fixtures shall be designed as vandal resistant.

10.5 FIRE PROTECTION

A fire protection system shall be provided. Station design may be considered in combination with platform doors to provide fire-rating compliance, as approved by local fire authorities.

10.5.1 Fire Detection

All stations and associated equipment rooms shall be provided with smoke and/or heat detection and alarm devices that shall be annunciated on a fire monitoring display in central control. Upon activation of a smoke or fire alarm, appropriate automatic or operational procedures shall be implemented to address the hazards associated with fire or smoke as required by a hazard analysis per Section 3.1.2.1.

10.5.2 Fire Containment

Station platform barriers and doors, if intended to serve as fire barriers, shall comply with the requirements of NFPA 130 (2007), Sections 5.2.3.2 and 5.2.3.3. The fire separation of all stations shall be based on an engineering analysis of potential fire exposure hazards conducted in accordance with Section 3.1.2.1, Hazard Analyses.

10.5.3 Fire Suppression

A fire suppression system, if specified by the authority having jurisdiction, shall comply with local building codes and/or NFPA 130 (2007).

Chapter 11
GUIDEWAYS

The requirements given in this section apply to all rigid guideways: elevated, at-grade, and underground.

Systems suspended by wire rope or cable are addressed by the requirements given in ANSI B77.1-2006 (2006).

The guideway shall be designed and constructed in such a way that the ride quality criteria and the vehicle clearance restrictions are met along the entire alignment. The guideway shall be designed to support all loads and forces associated with vehicles, vehicle interfaces, the environment, and any other facilities affixed to the guideway.

11.1 BLUE LIGHT STATIONS

Blue light stations shall be provided as defined in Sections 6.1.2 and 9.1.1 of this standard and in NFPA 130 (2007), in Section 6.2.7 and Section 10.4.1 in its entirety.

11.2 INTRUSION PROTECTION AND DETECTION

The system shall be designed to protect against unauthorized persons or foreign objects entering the vehicle dynamic envelope. This protection shall be in the form of fencing or other suitable barriers, as determined by a hazard analysis per Section 3.1.2.1.

Where deemed appropriate from the hazard analysis per Section 3.1.2.1, intrusion detection devices shall be provided to alert the system to unauthorized access.

11.3 EMERGENCY EVACUATION AND ACCESS

The automated people mover (APM) guideway emergency evacuation and access shall be designed in accordance with the requirements of NFPA 130 (2007), Sections 6.2.1, 6.2.2, and 6.2.3. In addition, the APM guideway shall meet the following two stipulations:

1. Under NFPA 130 (2007), Section 6.2.1 regarding evacuation of passengers from a disabled train, guidance and control by authorized personnel shall involve voice communication by the central control operator, and such involvement shall be sufficient to meet the intent of Section 6.2.1.
2. If any passenger activates the door release within any vehicle, creating a condition allowing passengers to exit the vehicle onto the guideway or its associated emergency walks, or other suitable means of evacuation, passengers shall be protected, as determined by a hazard analysis per Section 3.1.2.1. Hazards shall include making contact with an energized power rail or any other device of dangerous electrical potential and entering any portion of the guideway where other vehicles are still moving.

All station or guideway doors that do not provide emergency egress shall be so identified and clearly labeled “Not an Exit.” Emergency egress doors shall not be locked on the inside at any time. Emergency exits shall have the capability of being readily opened from the outside by the fire department or other rescue personnel.

11.3.1 Tunnel Guideway

Emergency exits shall comply with the requirements of NFPA 130 (2007), Sections 6.2.1 and 6.2.2. This requirement includes doors, exit hatches, and emergency lighting. When interpreting NFPA 130 (2007) requirements, a “point of safety” shall be defined as an enclosed fire exit that leads to a public way or safe location outside the structure, or an at-grade point beyond any enclosing structure, or another area that affords adequate protection for passengers.

11.3.2 Surface Guideway

For an at-grade or any unroofed structure other than elevated structures, the emergency access and egress should comply with NFPA 130 (2007), Sections 6.2.1 and 6.2.3.1.

11.3.3 Elevated Guideway

Elevated structures are all structures not defined in this standard as surface or underground structures. For elevated structures, the emergency access and egress should comply with NFPA 130 (2007), Sections 6.2.1 and 6.2.3.2.

Passenger egress from elevated guideways shall comply with NFPA 130 (2007), Sections 6.2.1 and

6.2.3.2. An acceptable "other suitable means" to using an elevated emergency walkway shall be a means that evacuates the maximum number of passengers who can be in a maximum-length train to a point of safety within no more than 15 min from the time the evacuation is initiated. The means and duration shall be subject to a hazard analysis per Section 3.1.2.1.

11.4 FIRE PROTECTION

For tunnels, the fire protection provisions of NFPA 130 (2007), Section 6.5, shall apply. Tunnel construction materials shall comply with Sections 6.3.1.1.1, 6.3.1.1.2, and 6.3.1.1.3 of NFPA 130 (2007).

A fire suppression system, if specified by the authority having jurisdiction, shall comply with local building codes and/or NFPA 130 (2007).

11.5 SIGNAGE

Signage shall be provided along the guideway and in the adjacent right-of-way to inform passengers, operating personnel, and emergency services personnel of features that may be critical for safe evacuation or to minimize the severity of a life-threatening incident and to enhance system operation.

The types and location of signs shall comply with the requirements of NFPA 130 (2007), including Sections 6.2.6, 6.2.8, and 6.2.9. Where not otherwise specified, ANSI 117.1-2003 (2003) should be consulted for signage lettering size, color, and contrast. In addition, the following types of signage shall be provided:

Emergency Exit—The emergency evacuation route to the point of safety shall be provided with the following signage: (a) direction to nearest exit (signs spaced no more than 30 m [100 ft] apart); (b) designation of exit; (c) instructions for using the exit; and (d) warning sign of potential hazards in the exit area. Emergency exit signage shall be visible at all times.

Power Section—The boundaries of each power section shall be clearly marked.

Location Information—Location information shall be provided on, and visible from, the guideway at intervals of no more than 100 m (325 ft).

Exposed Power-Delivery Device—Clearly visible signs shall be provided to warn of hazard greater than 50 V presented by exposed power rails or other exposed power-delivery devices, in accordance with NFPA 130 (2007), Section 6.2.6.2.

Signs shall be provided on the guideway at station locations and at intervals of no more than 30 m (100 ft) along the guideway.

11.6 EMERGENCY LIGHTING AND VENTILATION

For underground systems, lighting provisions shall be in accordance with NFPA 130 (2007), Section 6.2.5. Underground systems shall comply with the ventilation requirements of NFPA 130 (2007), Section 6.3.3.2.9.

For elevated and at-grade systems, the egress route shall have a level of illumination of no less than 2.7 lux (0.25 ft-candles).

11.7 EMERGENCY POWER SUPPLY

For underground systems, the power supply for emergency ventilation provisions of NFPA 130 (2007), Section 6.3.3.2.9, shall apply.

11.8 GUIDEWAY ALIGNMENT

The guideway shall be designed and constructed in accordance with vehicle ride quality criteria per Section 7.7.3.

Horizontal alignment may consist of any combination of straight (tangent) sections, spiral transitions, and curved sections.

The effects of centrifugal forces, superelevation, ride comfort criteria, and the related limitation of operating speed shall be considered in establishing the guideway horizontal alignment. Vehicle turning restrictions shall also be considered.

Vertical alignments may also consist of any combination of straight sections, spiral transitions, and curved sections. The effects of centrifugal forces, ride comfort criteria, and vehicle geometric limitations to vertical curve radius (crest and trough) shall be considered in establishing guideway vertical alignment.

When the vehicle is stopped at a station, the guideway shall be designed so that the vehicle floor shall not be inclined by more than 1% in any direction with respect to a horizontal plane.

When the vehicle is stopped at any other location along the guideway, (a) the angle at which the vehicle floor is inclined laterally shall not exceed 12% with respect to a horizontal plane, and (b) the angle at which the vehicle floor is inclined longitudinally shall

be limited by the normal longitudinal limits for maximum sustained acceleration, including the effects of grade, per Section 7.7.3.1.1.

11.8.1 Clearances

The vehicle dynamic envelope per Section 7.2 shall be separated from any other vehicle dynamic envelope on an adjacent trackway by at least 100 mm (4 in.).

Nonstructural system components that provide less clearance shall be permissible subject to a hazard analysis per Section 3.1.2.1.

The vehicle dynamic envelope shall be separated from any fixed structure by at least 100 mm (4 in.). Station platform edges and APM system equipment that are designed to physically interface with the vehicles are excluded from this requirement.

The maximum allowable clearance between the vehicle threshold and the station platform edge shall be per Section 7.3.

If the vehicle is designed to come in contact with the platform edge under normal operating conditions, the platform edge shall be designed so that the vehicle ride quality criteria given in Section 7.7.3 are met, except that the jerk limit in all directions shall be 0.1*g*/s for standing passengers.

If the vehicle dynamic envelope is such that the vehicle may come in contact with the platform edge under failure conditions, the platform edge and/or vehicle shall be designed to allow no more than cosmetic damage to the vehicle when the vehicle impacts the platform edge while operating at design speed.

11.8.2 Operating Equipment Interfaces

The guideway shall provide support and guidance to passenger vehicles and service vehicles throughout the APM system. The design of the guideway shall accommodate all elements of the APM system that are to be installed on the guideway.

11.8.3 Drainage

If the guideway design is such that water may accumulate on the surfaces, provisions shall be made in the design for draining the water. The drainage system shall route the water to a location acceptable to all local, state, and national codes and regulations and shall not cause drainage water or hazardous accumulations of snow or ice to fall onto pedestrian or vehicular paths.

In cases in which a drainage system is included in the design of the guideway, surfaces shall be sloped toward the drains with a minimum 1% slope (excluding the running surface as long as provisions are made for minimizing water accumulation on the running surface).

The drainage system shall be designed to operate in all environmental conditions per Section 2.1.

11.9 STRUCTURAL CRITERIA

The guideway for an APM shall comply with the following structural design requirements and the applicable requirements in local codes.

11.9.1 Loads and Forces

The guideway shall be designed for the following loads and forces, with appropriate consideration of point loads, distributed loads, and interrelated loads that occur for a specific technology's suspension, propulsion, and entrainment characteristics.

Dead Load—The dead load shall consist of the maximum weight of all permanent structures, including the weight of permanently fastened material and equipment.

Live Load—The live load shall consist of the weight of the applied load of one or more maximum-length, crush-loaded trains under normal and failure conditions, including any specified push or pull retrieval capability, plus any additional service and emergency equipment included in the system that might be brought out on the guideway for maintenance or during failures. Multiple trains shall be considered if the guideway supports multiple lanes. The weight of the applied load of passengers on the emergency walkway(s), if provided, also shall be considered. Crush load shall consider both a static AW3 load and a dynamic AW2 load.

NOTE: Load imbalance and the potential for future increases in AW2/AW3 should be considered in the design.

Walkway Load—Live load on service or emergency walkways shall be at least 4.0 kPa (85 lb/ft^2). The total live load transferred from the walkway to the guideway need not exceed the total weight of evacuated passengers.

Dynamic, Vibratory, and Impact Forces—The ratio of vehicle crossing frequency (*VCF*) to span fundamental frequency (*SF*) shall be computed for each span, where:

VCF is defined as the number of spans crossed per second by a vehicle, computed as vehicle speed in meters per second (feet per second) divided by span length in meters (feet).

SF is defined as the lowest guideway natural frequency excited by vertical train loading on the