SBCN# :2012-03
DATE: 02/8/2012
Requested by: Tom Eng

SYSTEMWIDE BASELINE
CHANGE NOTICE (SBCN)

DOCUMENT/TITLE/NUMBER/REVISION:

Add revisions to increase center walkway width on elevated structures to enhance safety; clarified language on requirement for emergency lighting on aerial structures.

The following changes were previously sent out for review with review comments incorporated: Modify Fire/Life Safety Criteria (add 2.7) to relocate mechanical criteria (8.1.D.1.a[partial] and b[all]) on Geometric considerations and Time of Tenability, and to revise tunnel walkway width requirements. Add requirement to section 8.1.4 D.1 to require FLSC sign-off on any design deviations from this criteria.

CHANGE IMPACT ASSESSMENT SUMMARY: (Attach written explanation of impacts identified)

SCHEDULE ISSUES?:	N	OTHER DOCUMENT REVISIONS REQUIRED?:			
ROM (RANGE):	**NO COST**	DESIGN ISSUES?:	N	COST RECOVERY POTENTIAL:	N
TIME IMPACT:	N/A	SAFETY ISSUES?:	N	OTHER CONTRACTS/PROJECTS?:	N/A
CAL DAYS	N/A	THIRD PARTY?:	N		

Related Request(s)-For-Change: **NONE**

JUSTIFICATION (including benefit or impact if not pursued):

Note: The updated Fire Life Safety Criteria is being issued for inclusion in Contract C0988 Crenshaw/LAX Transit Corridor RFP and for use by the Regional Connector and Westside Extension Projects. Although the Fire Life Safety Criteria went through an extensive review by all Metro interested departments, additional formal review and approval process, and sign-off by all will follow. Any additional changes identifed will be processed in a subsequent revision, and issued through the SBCN and Addenda process.

1) Evacuation on Elevated guideways has unique concerns that will be addressed with a center walkway (where provided) that extends to the train skirts.

2) Emergency lighting requirements on elevated guideways has been clarified to avoid any misinterpretation. E-lighting shall be provided to a public way at grade.

The following have previously been sent out for review with comments incorporated.

3) Current Mechanical Design Criteria section on Time of Tenability is more suited to FLS criteria. This has been discussed and agreed to with the " owners" of Mechanical Criteria Frank Castro and Al Ong.

4) Tunnel walkway width is changed from 36 inches to 30 inches minimum, with 36 inches being preferable. Requirement is downgraded based on discussions and agreement with LAFD representatives on FLSC.

5) Section 8.1.4 D.1 – Station Design Conditions. Reference added to require FLSC approval for any design deviation to train fire growth rate data. This section directly impacts fire/life safety and therefore requires FLSC involvement.

SBCN 2012-03
FIRE LIFE SAFETY CRITERIA REV. 1
DATE: 2/8/12
REQUESTED BY T. ENG

PROJECTS/CONTRACTS AFFECTED: For new projects only

PROJ	CONTRACT	CN #	ACTION STATUS	F

TOTAL ESTIMATED CHANGE COST: (DIRECT)
TOTAL ESTIMATED CHANGE COST: (INDIRECT: POTENTIAL COST RECOVERY)
TOTAL ESTIMATED CHANGE COST: (INDIRECT+ DIRECT)

RECOMMENDATION AND APPROVAL SIGNATURES: (R = RECOMMEND, A = APPROVE)

RTG	APPROVAL	NAME/TITLE	SIGNATURE	DATE
R	DIRECTOR CORPORATE SAFETY	V. KHAWANI		
R	DIRECTOR CONFIGURATION MANAGEMENT	D. CURZON		
R	DIRECTOR PROJ. ENG. FACILITIES	A. DAVIDIAN		
R	DIRECTOR PROJ. ENG. SYSTEMS	M. RATNASINGHAM		
R	DIRECTOR QUALITY MANAGEMENT	W. MOORE		
R	EO, PROJECT ENGINEERING	S. MAYMAN		1-27-12
A	EXECUTIVE DIRECTOR PROJECT TRANSIT DELIVERY	K.N. MURTHY		
A	IMPACTED PROJECT MANAGER – N/A			

METRO RAIL DESIGN CRITERIA

FIRE/LIFE SAFETY CRITERIA

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1.0 GENERAL

1.1 SCOPE

1.1.1 This Metro standard criteria covers fire protection requirements for underground, surface, elevated, trench and raised embankment fixed guideway transit systems including guideways, vehicles, transit stations, vehicle maintenance and storage areas; and for life safety from fire in transit stations, guideway vehicles, and outdoor vehicle maintenance and storage areas. Transit stations shall pertain to stations accommodating only passengers and employees of the fixed guideway transit systems and incidental occupancies in the stations. This standard establishes minimum requirements for each of the identified subsystems, and supercedes all other design criteria where a conflict may arise.

1.1.2 This standard does not cover requirements for the following:

A. Conventional freight or passenger railroad systems including those that provide commuter services

B. Buses and trolley coaches

C. Any other system of transportation not included in the definition of fixed guideway transit system.

D. To the extent where a system, including those listed in 1.1.2 A through C, introduces hazards of asimilar nature to those addressed herein, this standard may be used as a guide.

1.1.3 Nothing in this standard is intended to prevent or discourage the use of new methods, materials, or devices, provided that sufficient technical data are submitted to the authority having jurisdiction to demonstrate that the new method, material, or device is equivalent to or superior to the requirements of this standard with respect to fire/life safety.

1.2 PURPOSE

The purpose of this standard is to establish minimum requirements that will provide a reasonable degree of safety from fire and its related hazards.

1.3 CHARACTERISTICS OF FIRE SAFETY

Fire safety on a fixed guideway transit system is achieved through a composite of facility design, operating equipment, hardware, procedures, and software subsystems that are integrated to provide requirements for the protection of life and property from the effects of fire. The level of fire safety desired for the whole system shall be achieved by integrating the required levels for each subsystem.

1.4 APPLICATION

1.4.1 These criteria shall apply to all new Metro rail transit systems and to extensions of existing systems. These criteria, however, do not of themselves require any extensions, retrofits or modifications to existing facilities, equipment, or vehicle unless deemed necessary for public safety by the FLSC.

1.4.2 Changes to the criteria shall not affect design projects past prefinal level (85%) of design unless deemed necessary for public safety by the FLSC.

1.4.3 That portion of the standard dealing with emergency procedures shall apply to new and existing systems.

1.4.4 The standard shall be used for purchase of new rolling stock and retrofitting of existing equipment or facilities except in those instances where compliance with the standard will make the improvement or expansion incompatible with the existing system.

1.4.5 Where more than one adopted code, standard, or criterion is applicable, the most restrictive shall govern.

1.5 DEFINITIONS

Alternate Rail Operations Control (AROC) - A prearranged location(s) that is equipped, or can quickly be equipped, to function as the Operations Control Center in the event the Rail Operations Control (ROC) is inoperative or untenable for any reason.

Ancillary Area/Ancillary Space - The non-public areas or spaces of the stations usually used to house or contain operating, maintenance, or support equipment and functions.

Approved - Acceptable to the "authority having jurisdiction."

Areas of Rescue Assistance (ARA) - An area, which has direct access to an exit, where people who are unable to use stairs may remain temporarily in safety to await further instructions or assistance during emergency evacuation.

Auxiliary Emergency Management Panel (AEMP) - Secondary management panel that contains communications devices such as PA and telephone that is located at a secondary station entrance. Also known as a station command post or SCP.

Gap-tie power stations - Locations where traction power can be sectionalized via dc breakers and there is no incoming utility acfeed.

Metro - The Los Angeles County Metropolitan Transportation Authority who is legally established and authorized to construct and operate a fixed guideway transit system.

Authority Having Jurisdiction (AHJ) - The "authority having jurisdiction" is the organization, office or individual responsible for "approving" equipment, an installation or a procedure.

Note: The phrase "authority having jurisdiction" is used in a broad manner since jurisdictions and "approval" agencies vary as do their responsibilities. Where public safety is primary, the "authority having jurisdiction" may be a federal, state, local, or other regional department or individual such as a fire chief, fire marshal, chief of fire prevention bureau, building official, or others having statutory authority. In many circumstances the property owner or his designated agent, such as the Fire/life Safety Committee (FLSC), assumes the role of the "authority having jurisdiction".

Auxiliary Emergency Management Panels (AEMP) - Panels located at underground passenger stations which have a secondary entrance not readily accessible to the EMP and shall be used to augment the functions of the EMP. (In some documents also referred to as SCP or CP)

Blue Light Station (BLS) - A location along the guideway indicated by a blue light, where emergency service or authorized personnel may communicate with the ROC and disconnect traction power by use of an Emergency Trip Switch (ETS).

Central Control Facility (CCF) - The operations center where the Metro controls and coordinates the systemwide movement of passengers and trains and maintains communication with its supervisory and operating personnel, and with participating agencies when required. (Commonly referred to as the Rail Operations Center or ROC).

Central Supervising Station (CSS) - The principal manned location in the Operations Control Center where fire alarm, supervisory and trouble signals are displayed, and where personnel are in attendance at all times to supervise the circuits, monitor signals, and immediately retransmit any signal indicative of a fire to the public fire department communication center.

Communications - Radio, telephone, and messenger services throughout the system and particularly at the Central Supervising Station.

Design Fire Scenario - The approved engineering analysis method which considers vehicle combustible load, fire transmission between vehicles, and a sequence of events over time to determine the peak heat release rate from a vehicle fire.

Elevated Structure - All structures not otherwise defined as surface, underground, trench or raised embankment structures. Elevated structures typically are supported by columns or bents. Bridges are typical elevated structures.

Emergency Management Panels (EMP) - EMPs shall be provided for the purpose of consolidating all necessary on-site control and communication facilities necessary for effective response to emergency situations.

Emergency Trip Switch (ETS) - A device by which traction power may be removed from a designated segment of the guideway by authorized personnel. The device shall provide local mechanical lockout capability which will preclude restoration of power until the mechanical lockout has been reset. The ETS is an integral part of a BLS.

Enclosed Station - A station or portion thereof that does not meet the definition of an open station.

Engineering Analysis (Fire Hazard/Fire Risk Assessment) - An analysis that evaluates all various factors that affect the fire safety of the system or component. A written report of the analysis shall be submitted to the Metro indicating the fire protection method(s) recommended that will provide a level of fire safety commensurate with this standard.

Fire Emergency - The existence of, or threat of fire and/or the development of smoke or fumes that calls for immediate action to correct or alleviate the condition or situation.

Fire/Life Safety Committee (FLSC) - Established to facilitate the interchange of information, make evaluations and recommendations, and promulgate Fire/Life Safety Criteria. Permanent members include a representative(s) of the LAFD, Rail Operations, Safety, CPUC, and representatives from other involved authorities Having Jurisdiction. Fixed Guideway Transit System (The System) - An electrified transportation system, utilizing a fixed guideway, operating on right-of-way for the mass movement of passengers within a metropolitan area and consisting of its fixed guideways, transit vehicles and other rolling stock, power system, buildings, maintenance facilities, stations, transit vehicle yard, and other stationary and movable apparatus, equipment, appurtenances, and structures.

Fixed Guideway Transit Vehicle (The Vehicle or Car) - An electrically propelled passenger-carrying rail vehicle characterized by high acceleration and braking rates for frequent starts and stops, and fast passenger loading and unloading.

Guideway - That portion of the transit line included within right-of-way fences, outside lines of curbs or shoulders, underground tunnels, cut or fill slopes, ditches, channels, waterways, and including all appertaining structures (traction power substations, communications and signaling buildings, incoming electrical service buildings, etc.)

Incident Commander - The person in command at the scene of an emergency providing supervision and coordination of all personnel, equipment and resources.

Incident Command Post - The location during an emergency, selected by the person in command, for controlling and coordinating the emergency operation.

Incidental Occupancies in Stations - Refers to the use of the station by others who are neither transit system employees nor passengers.

Labeled - Equipment or materials to which has been attached a label, symbol or other identifying mark of an organization acceptable to the "authority having jurisdiction" and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

Listed - Equipment or materials included in a list published by an organization acceptable to the "authority having jurisdiction" and concerned with product evaluation, that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner. These organizations are Factory Mutual, Underwriters Laboratory, and State Fire Marshal.

NOTE: The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The "authority having jurisdiction" should utilize the system employed by the listing organization to identify a listed product.

Metropolitan Transportation Authority (MTA) - Legally established organization responsible for the design, construction, and operation of the Fixed Guideway Transit System. (Also known as Metro).

Noncombustible - A material that, in the form in which it is used and under the conditions anticipated, will not aid combustion or add appreciable heat to an ambient fire. Materials where tested in accordance with ASTM E136, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C, and conforming to the criteria contained in Section 7 of the referenced standard shall be considered as noncombustible.

On-Scene Coordinator - A representative of the operating authority acting as liaison between the

Incident Commander and operating authority personnel.

Open Station - A station that is constructed in such a manner that it is open to the atmosphere, and smoke and heat are allowed to disperse directly into the atmosphere. Design emphasis shall be for adequate natural smoke dispersal in an emergency.

Participating Agency - A public, quasi-public, or private agency that has agreed to cooperate with and assist Metro during an emergency.

Person in Command - A person designated by the operating authority or a responsible fire or police representative on the scene of an emergency fully responsible at the command post.

Point of Safety - An enclosed fire exit that leads to a public way or safe location outside the structure, or at-grade point beyond any enclosing structure, or other area that affords adequate protection for passengers.

Power Station - A public electric utility plant for generating and supplying electrical energy to the rail system.

Power Substation - A fixed facility within the rail system identified by an exterior blue light where electrical equipment is located for the specific purpose of receiving, converting, and/or transforming incoming alternating current (AC) to direct current (DC) for distribution of generated electrical energy to the rail system.

Raised Embankment - That portion of an unenclosed (open) alignment where the tracks are elevated above the adjoining land a minimum of 10 to 12 feet above adjoining grade spanning a distance of at least 270 feet, and surrounded on both sides by a drop-off in grade.

Replace-in-Kind - To furnish with new parts or equipment, as applied to vehicles, systems and facilities of the same type but not necessarily of identical design.

Request for Special Consideration (RFSC) - A form that may be used to request FLSC written approval to deviate from fire/life safety design criteria when alternate means of protection is demonstrated.

Retrofit - As applied to vehicles and facilities, to furnish with new parts or equipment to constitute a deliberate modification of the original design (as contrasted with an overhaul or replacement-in-kind).

Site Emergency Plan - Plan specific to a site that identifies evacuation points and procedures.

Station - A place designated for the purpose of loading and unloading passengers, including patron service areas and ancillary spaces associated with the same structure.

Station Command Post - See Auxiliary EMP

Station Platform - The area of a station used primarily for loading and unloading transit vehicle passengers.

Surface Structure - Any at-grade or unroofed structure other than an elevated or underground structure.

System - See "Fixed Guideway Transit System."

Trainway - That portion of the guideway in which the transit vehicles operate

Trench Guideway - That portion of an unenclosed (open) alignment where the tracks are directly surrounded on both sides by raised slopes or walls at least 10 to 12 feet in height spanning a distance of at least 270 feet.

Underground System - The system or that part of the system located beneath the surface of the earth or of the water.

1.6 COMPLIANCE

1.6.1 The prime responsibility for implementation of the FLS criteria lies with the organizations responsible for the design and construction of the System.

1.6.2 The Fire/Life Safety Committee (FLSC) shall develop and implement a review process to verify conformance with the Criteria.

1.6.3 The review process shall enable all participating fire departments to exercise their responsibility as the delegated authority in Title 19, California Code of Regulations (CCR).

1.6.4 Metro and their contractors (including consultants) shall be responsible for establishing and maintaining a document control system to ensure submittal to the FLSC of all relevant designs, specifications, criteria, and procedures for the entire Metro Rail System.

1.6.5 The FLSC shall be advised when any deviation from FLS Criteria occurs in any design, specification, procedure or aspect of construction.

1.6.6 A Request For Special Consideration (RFSC) may be submitted for FLSC review and approval to deviate from fire/life safety criteria when alternate means of protection can be demonstrated.

1.7 REVISION

1.7.1 The FLSC shall, by consensus, review, revise, and apply the FLS Criteria. Revisions to the FLS Criteria shall be made periodically following review and recommendations of the FLSC via the established Document Control Procedure.

1.7.2 Metro and responsible organizations shall present to the FLSC suggested revisions to the FLS criteria if changes in the Metro Rail System results in changing the conditions, assumptions or data upon which the original FLS criteria were based.

1.8 CODES AND STANDARDS

Applicable Codes and Standards include:

American National Standards Institute, Inc. (ANSI)

The Americans with Disabilities Act (ADA)

American Society for Testing and Materials (ASTM)

California Code of Regulations (CCR), Title 8

California Code of Regulations (CCR), Title 19

California Code of Regulations (CCR), Title 24

California Building Code (CBC)

California Public Utilities Commission (CPUC) General Orders.

California State Fire Marshal Approval

Factory Mutual (FM)

Institute of Electrical and Electronic Engineers (IEEE) 383

Institute of Electrical and Electronic Engineers (IEEE) 484

Los Angeles City Building Code

Los Angeles City Electrical Code

Los Angeles City Fire Code (LA Fire Code)

Los Angeles County Building Code

Los Angeles County Fire Code (LACo Fire Code)

NEMA WC70 , WC71, and WC74

NFPA 13 Standard for the Installation of Sprinklers

NFPA 14 Installation of Standpipe and Hose Systems

NFPA 70, National Electrical Code (NEC)

NFPA 91, Blower and Exhaust Systems

NFPA 101, Life Safety Code

NFPA 110, Emergency and Standby Power Systems

NFPA 111, Stored Electrical Energy Emergency and Standby Power Systems

NFPA 130, Fixed Guideway Transit Systems

Other NFPA National Fire Codes (as applicable)

Other city and county codes and standards dealing with fire/life safety which are referred to the FLSC for adjudication.

Underwriters Laboratories, Inc. (UL)

UFC, Uniform Fire Code

1.9 ABBREVIATIONS/ACRONYMS

AATCC	American Association of Textile Chemists and Colorists
ADA	Americans with Disabilities Act
AEMP	Auxiliary Emergency Management Panel
AHJ	Authority Having Jurisdiction
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
BLS	Blue Light Station
BTU	British Thermal Units
CBC	California Building Code
CCF	Central Control Facility (also known as the ROC)
CCR	California Code of Regulations
CALOSHA	California Occupational Safety & Health Administration
CFD	Computational Fluid Dynamics
CPUC	California Public Utilities Commission
CSS	Central Supervising Station
CTS	Cable Transmission Subsystem
dB	Decibel
DTS	Data Transmission Subsystem
DWP	Dept. of Water & Power
EMP	Emergency Management Panel
EP	Emergency Preparedness
ETEL	Emergency Telephone
ETS	Emergency Trip Switch
FAA	Federal Aviation Administration
FACP	Fire Alarm Control Panel
FD	Fire Department
FDC	Fire Department Connection
FHHR	Fire Heat Release Rate
FHV	Fire Hose Valve
FLS	Fire/Life Safety

FLSC	Fire/Life Safety Committee
FLSP	Fire/Life Safety Program/Plan
GC	General Consultant
HVAC	Heating, Ventilating, and Air Conditioning
ICP	Incident Command Post
IEEE	Institute of Electrical and Electronics Engineers
LA	Los Angeles
LACo	Los Angeles County
LACMTA	Los Angeles County Metropolitan Transportation Authority (also known as Metro)
LAFD	Los Angeles City Fire Department
Metro	Los Angeles County Metropolitan Transportation Authority
NEC	National Electric Code
NFPA	National Fire Protection Association
NST	National Standard Thread
ROC	Rail Operations Control
PA	Public Address
PVC	Polyvinylchloride
SCP	Station Command Post
SES	Subway Environmental Simulation
SOP	Standard Operating Procedures
SP	Standpipe
TBD	To be determined
UFC	Uniform Fire Code
UL	Underwriters' Laboratories
Vac	Alternating Current Volts
Vdc	Direct Current Volts
WSP	Wet Standpipe

END OF SECTION

2.0 STATION FACILITIES

2.1 GENERAL

2.1.1 Application

2.1.1.1 This Section is applicable to all transit stations whether they are entirely or in any part below, at, or above-grade.

2.1.1.2 This Section shall also be applicable to appurtenant facilities including traction power substations, gap-tie stations, train control and communication rooms, communication and signaling rooms, incoming electric service rooms or vaults, and emergency/standby generator rooms or enclosures along the guideway which adjoin stations.

2.1.2 Occupancy

2.1.2.1 The primary purpose of a station is its use by transit patrons who normally stay in a station structure for a period of time no longer than necessary to wait for and enter a departing transit vehicle, or to exit the station after arriving on an incoming transit vehicle. In its entirety, it essentially functions as a means of accessing and egressing transit vehicles. When contiguous commercial occupancies are in common with the station, or where the station is integrated into a building of non-transit occupancy, special considerations will be necessary beyond this standard, and FLSC approval will be required.

2.1.2.2 A station is also for the use of employees whose work assignments require their presence in the station structures.

2.1.2.3 The station public occupancy shall consist of all areas in which patrons may be allowed to enter, and shall include the full length of platforms, mezzanines, corridors, stairways, ramps, and passageways required for emergency egress. Occupancy classification shall be Group A as defined in the CBC.

2.1.2.4 The station ancillary occupancy shall consist of all spaces other than station public occupancies.

2.1.3 Codes and Standards - The design of stations and their appurtenances shall conform to NFPA 130, the California Building Code (CBC), as amended by California Code of Regulations (CCR) CCR Title 8, CCR Title 19, CCR Title 24, and Los Angeles City Building Code, the Americans with Disabilities Act (ADA), and California Public Utilities Commission (CPUC) General Orders, except as specifically set forth in this section.

2.1.3.1 Where more than one adopted/applicable code, standard, or criterion is applicable, the most restrictive shall govern.

2.1.3.2 Unless specifically stated in applicable local regulations or ordinances, each code and standard shall be the latest edition or issue and the most recent revision, amendment, or supplement in effect at the date of completion of pre-final design (85% submittal).

2.2 BASIC CONSTRUCTION OF STATIONS (SEE TABLE 2-2)

2.2.1 Underground Construction - Building construction for underground stations shall be not less than Type I construction as defined in the California Building Code (CBC).

2.2.2 At-grade Construction - Building construction for at-grade stations shall be not less than Type II construction as defined in the CBC. At-grade stations that have underplatform rooms for control or systems monitoring shall have these rooms designed for Underground construction.

2.2.3 Elevated Construction - Building construction for elevated stations shall be not less than Type II fire-resistive construction as defined in the CBC.

2.2.4 Safeguards During Construction - During the course of construction or major modification of any structure, provisions of the CBC, NFPA 130, and NFPA 241, as amended by local city codes and regulations shall apply. Refer to these standards for specific requirements pertaining to emergency lighting and fire protection.

2.2.5 Enclosure Requirements - Enclosure of normal patron use stairways and escalators and protection of floor openings are not required within areas of the station public occupancy. Stations having more than two levels below-grade or more than 80 feet to the lowest occupied level from grade will require protected level

separation or other protection features to provide safe egress regardless of exit time calculations.

Exception: Protected level separation shall not be required for fully sprinklered stations.

2.2.6 Fire Separations: Public Occupancy Areas - Fire separations shall be provided and maintained as follows:

2.2.6.1 Station public occupancy shall be separated from station ancillary occupancy by minimum 2-hour fire-rated construction.

Exception: A maximum of 2 station agents, supervisors, or information booths may be located within station public occupancy areas when constructed of approved noncombustible materials and limited in floor area to 100 square feet each. Automatic fire protection systems installed in the area in which the booth is located shall extend into the booth.

2.2.6.2 Station public occupancy shall be separated from power substations and transformer vault areas in station ancillary occupancies by 3-hour fire-rated construction.

2.2.6.3 Station public and ancillary occupancies shall be separated from non-transit occupancies by 3-hour fire-rated construction.

2.2.6.4 The fire separation for above-ground stations may be modified based on an engineering analysis of potential fire exposure hazards, as approved by the FLSC.

2.2.7 Fire Separations: Ancillary Areas - Fire separations within station ancillary areas shall be provided to separate individual occupancies as follows:

2.2.7.1 Electrical equipment areas which contain transformers and traction power equipment shall be separated from all other occupancies by 3-hour fire-rated construction.

2.2.7.2 All vaults shall be of not less than 3-hour fire-rated construction, and shall meet the requirements for oil-insulated electric transformers (see Section 5, Table 5-1) and shall meet the NEC requirements for vault construction, including door and sill requirements. Incoming Electric Service Rooms, Traction Power Substations, and Auxiliary Power Substations shall meet these requirements.

2.2.7.3 Electrical and emergency ventilation equipment rooms, electric rooms, battery rooms, train control and communication rooms, and trash rooms shall each be separated from other occupancies by 2-hour fire-rated construction.

2.2.7.4 Fire resistance ratings of separations between occupancies other than those specifically listed shall be established as required by the CBC.

2.2.8 Protection of Openings

2.2.8.1 Openings in 3-hour fire-rated separations shall be protected by labeled 3-hour fire-rated (Class A) assemblies.

2.2.8.2 Openings in 2-hour fire-rated separations shall be protected by labeled 1!4-hour fire-rated (Class B) assemblies.

2.2.8.3 Openings in 1-hour fire-rated separations shall be protected by 1-hour fire-rated (Class B) assemblies.

2.2.8.4 All openings from station public areas to all non-transit occupancies, i.e., private entrances, shall be protected by approved fire protective assemblies with an appropriate rating for the location in which they are installed. When a fire door is required to be open, it shall be automatic closing, activated by a listed smoke detector or, where a separate smoke barrier is provided, the operation may be by fusible links.

2.2.9 Protection from Flammable and Combustible Liquid Intrusion - The requirements of Paragraph 3.2.3 for protection of underground guideways shall be applied to underground stations.

2.2.10 Materials

2.2.10.1 All structural assemblies and building appurtenances shall conform to Chapters 5, 17, 18, and 19, of the CBC, as appropriate for the type of construction.

2.2.10.2 Combustible adhesives and sealants may be used when the requirements of Paragraph 2.2.10 are met.

2.2.10.3 All elevators and escalators shall be constructed of non-combustible materials and conform to CCR Title

24 and Title 8 Elevator Safety Orders. Safety-glazed elevator hoistways and cabs shall require the approval of an exception by CalOSHA.

2.2.11 Interior Finishes - Interior finishes of all surfaces exposed to the interior of the building, including fixed or movable walls and partitions, columns, and ceilings, shall meet the requirements as shown in Table 2-3.

2.2.11.1 Interior finishes shall be CBC Chapter 42 Class I for all enclosed exit access routes and exits. In transit stations, the platforms and mezzanines shall be considered Class II exit access routes.

2.2.11.2 Interior finishes in ancillary areas shall be considered Class III.

2.2.12 Elevators - Elevators shall be designed to accommodate the loading and transport of an ambulance gurney or stretcher in its horizontal position.

2.2.12.1 The clear opening provided by the elevator entrance shall be not less than 3 feet 6 inches wide nor less than 7 feet high.

2.2.12.2 The elevator car shall have a minimum inside clear dimensions of 5 feet 10 inches wide by 6 feet 8 inches deep, excluding the handrail.

2.3 VENTILATION

2.3.1 General

2.3.1.1 Normal and emergency ventilation may be necessary to preserve the safety of underground or enclosed facilities in the event of intrusion of toxic or flammable gasses. A back-up power supply shall be available to enable gas purging in the event of an area-wide utility power outage.

2.3.1.2 For unroofed and open, at-grade and elevated stations, which are constructed in such a manner that smoke and heat are allowed to disperse freely and directly to the atmosphere, provisions for emergency ventilation are generally not necessary.

2.3.1.3 For enclosed or underground stations, provisions shall be made for emergency ventilation for the protection of patrons and employees from fire, smoke, and products of combustion.

2.3.1.4 Ventilation shaft terminals at-grade shall be located as follows:

A. Openings for blast relief shafts, and underplatform and smoke exhaust shafts at-grade shall be separated by a minimum horizontal distance of 40 feet from the closest station entrance, elevator hoistway enclosure, surface emergency stair doorway, unprotected outside air intake or other opening, or from each other. Exhaust outlets which are not used for intake may be adjacent to each other.

B. Where this distance is not practical, the horizontal distance may be reduced to 15 feet if the closest blast relief or underplatform and smoke exhaust shaft terminal is raised a minimum of eight feet above the station entrance, emergency stair doorway and unprotected outside air intake or other opening, or the underplatform and smoke exhaust shaft terminal is raised a minimum of eight feet above the blast relief shaft terminal.

C. The minimum distance between the edges of adjacent openings for outside air intake shafts protected by smoke dampers and blast relief shafts or underplatform and smoke exhaust shafts shall be as follows:

$$D = 0.25 \times (L1 + L2)$$

Where: D = minimum distance in feet between the edges of the adjacent openings.

L1 and L2 = lengths in feet of the adjacent parallel sides of the openings.

2.3.1.5 No equipment or access panels shall be installed inside the emergency ventilation shafts such as mechanical ductwork or cable run access panels.

2.3.1.6 Emergency ventilation shaft geometry shall be simplified and direct to maximize efficient airflows through the facility.

2.3.2 Emergency Air Criteria

2.3.2.1 The design fire scenario and vehicle peak heat release rate shall be used to design the emergency

ventilation system. For heavy rail systems, the minimum vehicle design Fire Heat Release Rate (FHRR) shall be 86,528,000 Btu/hour. For Light Rail Systems, the minimum vehicle design FHRR shall be 67,712,000 Btu/hour.

2.3.2.2 The ventilation systems shall be so designed that:

A. A stream of non-contaminated air is provided to passengers in a path of egress away from a train fire; and

B. Airflow rates produced toward a train fire in a path of egress are sufficient to prevent back layering of smoke; and

C. The temperature in a path of egress away from a train fire is limited to 120° F, or less, for a minimum period of one hour. If the evacuation time is longer than one hour, the temperature requirement must be maintained for the evacuation period.

D. The most critical fan will be assumed to be out of service.

2.3.3 Emergency Ventilation Fans

2.3.3.1 Ventilation fans used for emergency service, their motors, and all related components exposed to the ventilation airflow shall be designed to operate in an ambient atmosphere as specified by NFPA 130 for a period of at least 1 hour or the time of evacuation, whichever is longer.. Ventilation fans and related components shall be capable of withstanding the maximum anticipated plus/minus pressure transients induced by train operations.

2.3.3.2 Local fan motor starters and related operating control devices for emergency ventilation equipment shall be isolated from the ventilation airflow by a separation having a fire-resistance rating of at least 1 hour or the time of evacuation, whichever is longer. This includes but is not limited to the fan and damper controls located inside the emergency fan rooms. If the evacuation time is longer than one hour, the temperature requirement must be maintained for the evacuation period.

2.3.3.3 Fans required for emergency operation shall be reversible and capable of satisfying emergency air-velocity criteria in either supply or exhaust modes. The minimum acceptable supply flow capacity shall be 90 percent of the exhaust flow capacity.

2.3.3.4 Sufficient emergency ventilation airflow to control smoke and heat for the vehicle design FHHR, as identified by SES or CFD simulations, shall be provided with the most critical ventilation fan or fan damper assembly out of service, whichever has the greatest impact on ventilation.

2.3.3.5 Thermal overload protective devices shall not be provided on motor controls of fans used for emergency ventilation.

2.3.3.6 Two power feeders from separate sources shall be provided for each of the emergency fans. Power feeders furnishing power for fans shall be physically isolated from each other and shall originate from separate distinct sources. Automatic transfer shall be provided in the event the normal supply source fails.

2.3.4 Ventilation Control

2.3.4.1 Emergency ventilation systems shall be supervised and controlled in all operating modes locally (motor control center and/or fan unit) and remotely at both the ROC and at the station EMP. Local controls and EMP controls shall have primary and secondary overriding capability, respectively.

2.3.4.2 The Motor Control Center for the emergency ventilation system fans and dampers shall be from a protected location near the fans separated from other areas by two hour fire-rated construction. Access shall be from the guideway and from the street level access adjacent to the fan shaft.

2.3.4.3 Power availability on each power source shall be annunciated in the local control panel and means shall be provided for transferring fan circuits from one power source to the other. When using manual transfer switches, both remote control locations should have similar annunciation and manual switch capability. With automatic transfer switches, the remote control locations shall have a single annunciation that power is available. Indication of power availability shall be provided at each remote control point with fan control capability.

2.3.4.4 Fan running shall be proven by air-flow sensing devices for each fan for operation in both the supply and

exhaust directions. Air movement at 90 percent of rated air flow shall be required to initiate the fan-running signal for both the high-speed and low-speed modes. Fan speed and direction shall be controlled and status fully annunciated at local and remote control locations.

2.3.4.5 Trouble status signals shall be annunciated in the local control room. A summarized trouble signal shall be annunciated at ROC and EMP.

2.3.4.6 Ventilation control and status annunciation circuits shall be monitored by the fire alarm control panel in a nearby station.

2.3.4.7 Emergency ventilation shall be designed to operate in full coordination with the guideway ventilation system.

2.3.5 Ventilation Systems in Ancillary Areas

2.3.5.1 Ancillary area ventilation systems shall be arranged so that air is not exhausted into station public occupancy areas. Controls for shut-down of ancillary area ventilation systems shall be provided at the ROC and EMP. Installation of such systems shall be in accordance with NFPA 90A.

2.3.5.2 Storage battery or similar ancillary rooms in which hydrogen gas or other hazardous gases may be released shall require mechanical ventilation and shall be ventilated in accordance with NFPA 91, IEEE 484, and NFPA 130 Section 5.5.2.2.1 as follows:

A. Exhaust ducts from battery rooms shall not connect with duct systems used for other purposes.

B. The battery exhaust ventilation system shall be provided with electrical power and air flow interlocks that will prevent operation of the battery charger if the ventilation fan motor is not energized or the air velocity in the exhaust duct is less than the designed velocity. Consideration may be given to the installation of hydrogen gas detection before the interlock is activated.

C. For functions that cannot tolerate de-energization of battery charging equipment, other protective means approved by the FLSC (i.e. gas monitoring, additional fan(s), delayed timer, etc.) may be provided. This configuration additionally requires the appropriate power transfer devices and remote status alarms/indications reporting to the ROC. Fan/battery charger interlocks are still required, but only after all other systems have failed.

Exception: If non-outgassing (sealed) batteries are used, fan/battery charger interlocks are not required.

2.3.6 Design Conditions for Emergency Operations-Underground

The most critical fan will be assumed to be out of service during the tunnel and station SES and CFD analyses. The temperature and air change rate design criteria in this paragraph are based on the emergency scenario of a serious fire involving a single three-car train: (Light rail), single six car train (Heavy Rail).

2.3.6.1 Station Design Conditions

The following design condition is applicable to platform areas and entrances, including the evacuation route of passengers in an emergency. Any design deviations to this section on Station Design Conditions must be approved by the Fire/Life Safety Committee (FLSC) via a Request For Special Consideration (RFSC).

Maximum Temperature in Evacuation Route

(Tenable environment): 120°F

2.3.7 Fire Heat and Smoke Release Rates for Stations

Station fire scenarios will be modeled using a three dimensional transient computational fluid dynamics modeling (CFD) to assure the ventilation system meets criteria. The CFD model shall model an arson type fire with the following design parameters, unless an alternate set of parameters are submitted to and approved by the FLSC via an RFSC. The following abbreviations are used:

AF- Air Fuel Ratio

FCORR- Fire Carbon Monoxide Release Rate

FHRR - Fire Heat Release Rate

FSRR - Fire Soot Release Rate

The following heat release rates may be modified if sufficient justification is provided to the AHJ. Such factors that may be considered are the use of proven fire protection methods or other factors to mitigate the potential build-up of the heat release rate.

- SUMMARY HEAVY RAIL TRAIN FIRE PROPERTIES

  Train fire growth rate - 2560 Btu/(hr-s)

  Fire Growth Time (one car) -130 s

  Duration of Fully-developed Fire -1930 s

  Fire Decay Time -130 s

  Time for fire to spread from car-to-car - 900 s

  Fully Developed Train FHRR (2 cars burning) - 86,528,000 Btu/hr

  Heat of Combustion (AHc) -10404 Btu/lb of fuel burnt AF-14

  Fully Developed Train FSRR - 0.3234 Ibs/s

  Train FSRR per unit heat release - 3.7379 E-03 Ibs/s per MBtu/hr

  Mass optical density -1611 ft^2/lb of fuel

  Fully Developed Train FCORR - 0.4135 Ibs/s

  Train FCORR per unit heat release rate - 4.7791 E-03 Ibs/s per MBtu/hr

- SUMMARY OF LIGHT RAIL TRAIN FIRE PROPERTIES

  Train fire growth rate- 2560 Btu/(hr-s)

  Train Fire Growth Time -115s

  Duration of Fully-developed Fire (one car) -1915 s

  Fire Decay Time -115s

  Time for fire to spread from car-to-car - 900 s

  Fully Developed Train FHRR (2 cars burning) - 67,712,000 Btu/hr

  Heat of Combustion (AHc) - 10404 Btu/lb of fuel burnt

  AF-14

  Fully Developed Train FSRR - 0.2531 Ibs/s

  Train FSRR per unit heat release - 3.7384 E-03 Ibs/s per MBtu/hr

  Mass optical density -1611 ft^2/lb of fuel

  Fully Developed Train FCORR - 0.3236 Ibs/s

  Train FCORR per unit heat release - 4.7791 E-03 Ibs/s per MBtu/hr

- SUMMARY FIRE PROPERTIES FOR NON-TRAIN FIRES

  Non-Train fire growth rate-160 Btu/(hr-s) Non-Train Fire Growth Time-150 s

  Fully Developed Non-Train FHRR- 3,600,000 Btu/hr (1.055 MW)

  Heat of Combustion (AH_C) -16068 Btu/lb of fuel burnt

AF-13.8

Fully Developed Non-Train FSRR - 1.2058E-02 Lbs/s

Non-Train FSRR per unit heat release - 3.3495E-03 Lbs/s per MBtu/hr

Mass optical density - 6863 ft^2/lb of fuel

Fully Developed Non-Train FCORR- 3.7807E-03 Lbs/s

Non-Train FCORR per unit heat release- 1.0502E-03 Lbs/s per MBtu/hr

2.3.8 Heavy Rail/Light Rail Visibility Criteria

NFPA 130 provides Smoke Obscuration Levels as follows:

"Smoke obscuration levels should be continuously maintained below the point at which a sign internally illuminated at 80 lx (7.5 ft-candles) is discernible at 30 m (100 ft) and doors and walls are discernible at 10 m (33 ft)." Therefore, light extinction levels caused by smoke shall be maintained at or below .08128/ft.

Station Air Velocities

During emergency situations, the ventilation system will operate at full capacity to maintain a tenable environment. Velocities do not have to be maintained at a comfortable level but they should not impede people from evacuating safely. NFPA 130 recommends an upper limit of 2,200 fpm opposing the direction of intended travel (egress).

2.3.9 Tunnel Design Conditions for emergency ventilation system design purposes.

For emergency ventilation design purposes, the path of evacuation is to include both the open tunnel and the annulus between the train and the tunnel walls as required. (The path of evacuation for evacuation time, etc. is defined in other Design Criteria.)

Appropriate ventilation will be maintained for at least one path of evacuation from the fire site to a point of safety.

The maximum temperature in the path of evacuation shall not exceed 120°F, ignoring radiant heating effects.

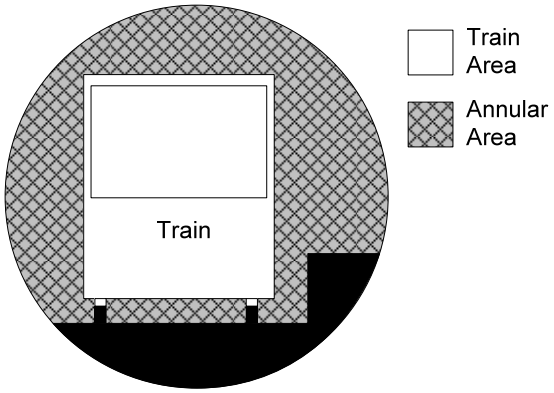
The air velocity in the path of evacuation shall not exceed 2,200 fpm opposing egress. Above 2,200 fpm people may experience difficulty in walking. The minimum airflow required during an emergency shall be at least 150 fpm in the full tunnel area in the path of egress.

The emergency ventilation operating modes must account for the adjacent tunnel acting as a path of egress. The capacity of the equipment must account for the adjacent tunnel acting as a path of egress.

2.3.9.1 Annular Critical Velocity

The Metro Project will adhere to critical air velocity calculations, which are based on the annular cross sectional area. This procedure is detailed in the SES 4.1 Users Manual. The annular cross sectional area is calculated by subtracting the cross section area of the train from the full cross sectional area of the tunnel. (See Figure 2-1.)

Figure 2-1 Annular Cross Sectional Area

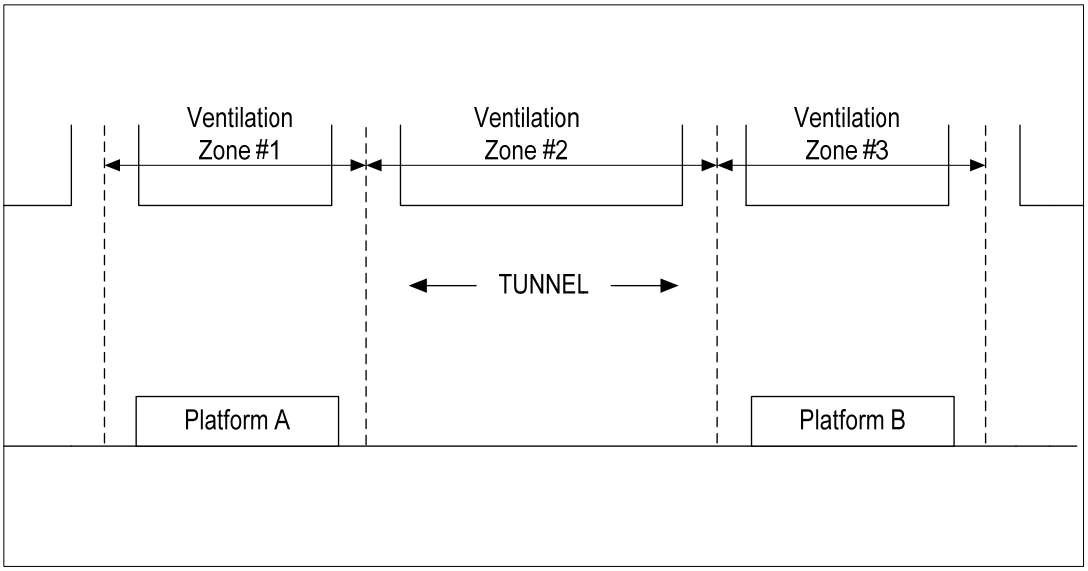


2.3.9.2 Trains in Ventilation Zone

A ventilation zone is defined as the area between two adjacent ventilation shaft inlets and/or portals. pictorial representation of this is provided in

Figure 2-2 below:

Figure 2-2 Ventilation Zones



The basis of design for the emergency ventilation system is one train per ventilation zone in single bored tunnels. See Figure 2-2.

Cross-passages open: One cross-passage open

Bypass Dampers: All heavy rail stations will include by-pass dampers.

2.4 ELECTRICAL REQUIREMENTS

2.4.1 Code Requirements - Electrical equipment and wiring materials and installations within stations shall conform to the requirements of NEC and, other than for traction power, shall satisfy the following requirements:

2.4.1.1 Materials manufactured for use as conduits, raceways, ducts, boxes, cabinets, equipment enclosures, and their surface finish materials shall be capable of being subjected to temperatures up to 932°F for 1 hour, and shall not support combustion under the same temperature condition. Other materials when buried or

embedded in concrete are acceptable.

2.4.1.2 All conductors shall be insulated. Ground wires may be bare. thicknesses of jackets shall conform to NEC.

All thicknesses of insulation and all

2.4.1.3 Insulation shall conform to Article 310 of NEC and be moisture and heat-resistant types, carrying temperature ratings corresponding to the conditions of application and in no case lower than 194°F.

2.4.1.4 Wire and cable construction used in operating vital train signal circuits and power circuits to emergency fans, lights, etc., shall pass the flame-propagating criteria of IEEE 383 and have a minimum short circuit time of five minutes in the flame test of IEEE 383. Single conductor wires shall also meet the requirements of NEMA WC70. Such tests shall be performed with the wire and/or cables protected as they will be when installed.

All conductors, except radio antennas, shall be enclosed in their entirety in armor sheaths, conduits, or enclosed raceways, boxes and cabinets, except in traction power substations, auxiliary power substations, electrical equipment rooms, train control rooms, or communications rooms. Conductors shall not be installed exposed or surface-mounted in air plenums which may carry air at the elevated temperatures accompanying fire-emergency conditions. In underground systems, the tunnels are considered plenums. Conductors in conduits or raceways may be embedded in concrete or run in concrete electrical duct banks.

2.4.1.5 Overcurrent elements which (a) are designed to protect conductors serving emergency equipment motors (fans, dampers, pumps, etc.), emergency lighting, and communications equipment, and (b) are located in spaces other than the main electrical distribution system equipment rooms, shall operate on magnetic principles and shall not depend upon thermal properties for operation.

2.4.1.6 The power supply for all essential emergency service shall consist of two separate electrical feeders. Each feeder shall originate from a different source and shall be separated physically to the extent possible.

2.4.1.7 Conductors for emergency fans, emergency lighting, communications, etc., shall be protected from physical damage by transit vehicles or other normal transit system operations, and from fires in the transit system by suitable embedment or encasement, or by routing such conductors through areas of low fire potential (light hazard) or external to the interior underground portions of the transit system facilities.

2.4.1.8 Switches, electrical outlets, and lighting fixtures installed in areas where batteries are installed/ charged shall conform to NEC and CBC.

2.4.1.9 Traction Power and Electrical Wiring and Cable - Provide compliance with the applicable requirements of Subsection 3.3. Interlock traction power with automatic fire sprinklers in trainways, and in other areas where sprinkler action poses a possible contact between sprinkler water and traction power rail, so that sprinkler action will result in a timed deactivation of traction power in the affected trainway in the station area (see paragraph 2.6.2.1).

2.5 MEANS OF EGRESS

2.5.1 Public Occupancy Areas - The transit station shall comply with the provisions of applicable building codes and NFPA 130, except as modified herein. Egress analyses shall be performed in accordance with NFPA 130 every 5 years or more frequent, as required by system expansion or significant operating changes.

2.5.2 Occupancy and Occupant Load

2.5.2.1 The occupant load for a transit station shall be based on the emergency condition requiring evacuation of that station to a point of safety. The station occupant load shall be the sum of the persons in the calculated train load of trains entering a station plus the entraining load of persons awaiting a train during a specified time period. The station occupant load is defined as follows:

A. Calculated train load

1. The calculated train load is the number of passengers on trains simultaneously entering the station on all tracks in normal traffic direction during the peak 15-minute period.

2. The following limitations to the calculated train load shall be applied:

a. No more than one train will unload at any one track to a platform during an emergency.

b. The load on any single train is limited to the maximum train capacity.

c. The calculated train load can be no less than the maximum passenger capacity of a single train.

B. Entraining load (on platform awaiting train)

1. The entraining load is equal to the number of passengers that would accumulate on the platform in the time period equivalent to two headways or 12 minutes during the peak 15-minute period, whichever is greater. This entraining load is constrained as defined in Paragraph 2.5.2.2.

2.5.2.2 Special Conditions and Design Considerations

A. Special consideration shall be given to stations servicing areas where events occur that establish occupant loads not included in normal passenger loads. These would include such areas as civic centers, sports complexes, and convention centers.

B. Access to the platform and/or the station must be operationally constrained to a platform net area occupancy equivalent to 4 square feet per person. For anticipated platform entraining loads that would result in area occupancies of less than 4 square feet per person, the calculated platform load will be limited to the net platform area divided by 4 square feet per person. (The minimum total exit width in feet shall be equal to this platform load divided by 50 patrons per foot of exit width.)

C. Notwithstanding other provisions in Paragraph 2.5.2, emergency exiting shall be provided, as a minimum, to accommodate the equivalent of 7 square feet per person; i.e.

$$\text{Exit Width (Feet) (stairs)} = \frac{\text{Net Platform Area}}{7\ \text{ft}^2\text{/Per Person}} \times \frac{.3}{12\text{in/ft}}$$

or

$$\text{Exit Width (Feet) (other)} = \frac{\text{Net Platform Area}}{7\ \text{ft}^2\text{/Per Person}} \times \frac{.2}{12\text{in/ft}}$$

2.5.2.3 At multi-platform stations, each platform shall be considered separately. Arrival of trains from all normal traffic directions, plus their entraining loads, shall be considered.

2.5.2.4 At concourses, mezzanines or multi-level stations, simultaneous platform loads shall be considered for all exit lanes passing through that area.

2.5.3 Number and Capacity of Exits

2.5.3.1 An exit is defined as a protected enclosure separated from all other spaces of a transit station or other structure by construction or equipment to provide a protected way of travel to the exit discharge a point of safety.

2.5.3.2 Exit capacities shall be calculated on the width at the clear and narrowest point except that individual handrails may project $3^{1}/_{2}$ inches into the required width.

2.5.3.3 There shall be sufficient means of egress to evacuate the station occupant load as defined in Paragraph 2.5.2.1 from the station platforms in 4 minutes or less (see Table 2-1, "Emergency Exit Capacity Calculations").

2.5.3.4 The station shall also be designed to permit evacuation from the most remote point on the platform to a point of safety in 6 minutes or less.

2.5.3.5 In at-grade or elevated structures so designed that the station platform is open to the elements and, when the concourse is below or protected from the platform by distance or materials as determined by an appropriate engineering analysis, that concourse may be defined as a point of safety, with FLSC concurrence (See Para. 2.5.3.4).

2.5.3.6 To calculate evacuation time, the walking travel time shall be tabulated using the longest exit route and travel speeds indicated in Paragraph 2.5.3.7. To this time shall be added the following factors:

A. (W1-T1) The waiting time at the vertical elements at platform level minus the longest walking travel time at platform level.

B. (W2-W1) The waiting time at the fare collection barriers minus the waiting time at the platform verticalcirculation elements.

C. (W3-Wx) The waiting time at the vertical or horizontal circulation elements from mezzanine to grademinus the waiting time at the mezzanine vertical circulation elements or fare collection barrier, whichever is greater.

D. (W4-Wx) The waiting time, if any, at any additional constriction minus the greatest previous waiting time. (Repeat for all additional constrictions.)

Note: The total of any of the factors in A through D above cannot be less than zero.

2.5.3.7 The capacity in persons per minute (ppm), patron travel speeds in feet per minute (fpm), and requirements for exit lanes shall be as follows:

A. Platforms, corridors, and ramps of 5 percent slope or less: Exit corridors, platforms, and ramps shall be a minimum clear width of 5 feet 8 inches. In computing the number of exit lanes available, 18 inches shall be deducted at each platform edge and one foot at each sidewall.

Per gate: Capacity - 50 ppm per exit lane
Travel speed - 200 fpm

B. Stairs, stopped escalators, and ramps of over 5 percent slope: Exit stairs shall be a minimum clear width of 48 inches. Exit ramps shall be a minimum clear width of 6 feet. Stopped escalators may be considered as a means of egress, provided they are of nominal 2 feet 8 inches width.

Per exit lane "up" direction: Capacity - 35 ppm

Travel Speed - 50 fpm*

Per exit lane "down" direction: Capacity - 40 ppm

Travel Speed - 60 fpm*

(*Indicates vertical component of travel speed)

C. Doors and gates: Exit doors and gates shall be a minimum of 3 feet wide.

Per exit lane: Capacity - 50 ppm

D. Fare collection gates: Fare collection gates, when deactivated, shall provide a minimum 20 in. clear unobstructed aisle. Console shall not exceed 40 in. in height.

Per gate: Capacity - 50 ppm

A turnstile-type collection gate is one that consists of a minimum 18 in. aisle and maximum 36 in. height of the turnstile bar, which, when deactivated, shall free wheel in the exit direction. Consoles shall not exceed 3 feet 4 inches in height.

Per gate: Capacity - 25 ppm

Gates fitted with approved panic hardware and opening in the direction of exit travel, with minimum nominal width of 3 feet.

Per gate: Capacity - 50 ppm per exit lane

Fare gates not qualifying for use in exit paths shall be prominently marked "Not an Exit."

2.5.3.8 In an enclosed station there shall be a minimum of one 44 inch wide exit from each end of each platform. Additional platform egress elements may be stairs, escalators stopped or moving in the direction of egress, emergency stairs, doorways, corridors or walkways to a point of safety. Routes from platform ends into the underground guideway shall not be considered as exits for calculating exiting requirements.

2.5.3.9 From each mezzanine there shall be a minimum of 2 means of egress, each at least 44 in. wide. Exits shall be separated by a minimum distance of 40 feet.

2.5.3.10 No point of the station platform(s) or mezzanine(s) shall be more than 300 feet from a point of safety.

2.5.3.11 All exit measurements shall be to a point of safety.

2.5.3.12 Exits other than fare collection gates shall provide for at least 50 percent of the exit capacity in any fare barrier.

2.5.3.13 In addition to the exits specified to obtain compliance with the foregoing requirements, means of ingress shall be provided from each guideway to the platform.

A. Two stairs, 2 feet 10 inches wide, or other arrangement having equivalent capacity, shall be provided at each end of the platform, arranged to provide full capacity exiting from either trackway.

B. Gates at the top of each stairway shall swing in the direction of access to the platform, and shall provide a clear opening width equal to, or exceeding, the capacity of the stair served, but in no case less than 2 feet 8 inches.

C. Gates, stairs, and landings shall conform to requirements of the CBC, as amended, and NFPA 101.

D. Except in underground stations, the access points from the guideway and the exit from the platform may be integrated for ends of platform where calculated capacity exits emanate within 25 feet from an end of platform.

2.5.3.14 Vertical circulation elements shall be comprised of stairs or stair/escalator combinations. Escalators shall not account for more than half of the units of exit at any one level in the public area. Escalators must be paired in combination with stairs in order to be included in exiting capacity calculations.

2.5.3.15 Because of the possibility of maintenance or malfunction, one escalator at each station shall be considered as being out of service in calculating egress requirements. The escalator chosen shall be that one having the most adverse effect upon exiting capacities.

2.5.3.16 Fare Collection Gates or Turnstiles shall assume an emergency exit mode (either open completely or freewheel in the exit direction) in the event of loss of power to the fare gates or turnstiles or upon actuation from a facility fire or gas alarm, or manually initiated evacuation command locally or remotely. Such operation shall be consistent with approved egress calculations per NFPA 130.

2.5.3.17 Fare collection gates or turnstiles shall be designed so that their failure to operate properly shall not restrict the flow of passengers in both directions (either open completely or freewheel in both directions).

2.5.4 Station Ancillary Occupancy Areas - Means of egress shall be arranged in accordance with the CBC, as amended, and NFPA 101, except that for the purpose of this criterion, exits from station ancillary occupancy areas into station public occupancy areas shall be considered as discharging into a protected passageway leading directly to a point of safety.

2.5.5 Emergency Lighting and Exit Signs

2.5.5.1 Station structures shall be provided with a system of emergency lighting in accordance with NFPA 101, except as otherwise noted herein.

2.5.5.2 Emergency lighting systems shall be designed, installed and maintained in accordance with NFPA 70, Article 700, "Emergency Systems" to provide a minimum illuminance level of one footcandle.

2.5.5.3 Exits shall be marked with readily visible signs complying with the requirements of CBC, as amended, and NFPA 101. Where emergency lighting is required, exit signs shall be illuminated by the emergency lighting source.

2.5.5.4 Exit lights, essential signs and emergency lights shall be included in the emergency lighting system and shall be powered by a standby power supply or a supply independent of the traction power system. Emergency fixtures, exit lights, and signs shall be separately wired from emergency distribution panels.

2.5.5.5 Emergency lighting for stairs, ramps, and escalators shall be designed to emphasize illumination on the top and bottom steps or landings. A minimum of one foot candle of emergency lighting shall be provided throughout the entire run of each stair, ramp, and escalator.

2.5.5.6 Emergency exit facilities shall be suitably identified as exits and maintained to allow for their intended use.

2.6 FIRE PROTECTION

2.6.1 Protective Signaling Systems

2.6.1.1 When required a fire alarm control system shall be installed in each station facility, conforming to NFPA 72 and CCR Title 24 and meeting ADA requirements.

A. Fire alarm devices in underground stations shall be protected by a Class A proprietary system Style D and Style 2, as defined in NFPA 72, Tables 3-5.1 and 3-6.1, respectively. Proprietary system protection shall be provided at other locations as determined by the FLSC.

B. The station facility fire alarm system shall be electrically supervised and operated on low voltage with battery standby power.

C. The public address system shall be utilized for sounding required building-audible fire alarm signals (temporal pattern) from the fire alarm control panel by means of a tone generator preceding verbal announcements to direct patron evacuation. Audibility level shall be a minimum of 10db over any background noise. An alternative option is to use a horn-strobe or strobe/voice evacuation system in lieu of the public address system to sound the building-audible fire alarm signal, with the approval of theAHJ.

D. All protective signaling system fire alarms, smoke detection, valve switches, and water flow indicator signals throughout the system shall, when activated, be transmitted simultaneously within the local station and to a central supervising station as defined by NFPA 72. Signals received from such devices shall be readily identifiable as to origin of signals.

E. The fire alarm control system shall provide means to trip special extinguishing systems and to control ventilation systems in accordance with applicable codes and standards.

F. The manual fire alarm capability (manual pull station) shall be provided by an emergency fire-reporting phone system to be used by the public or employees to report a fire or other emergency.

1. Emergency phones shall be located adjacent to each fire hose cabinet. When a fire hose cabinet is not provided, the maximum travel distance to an emergency phone shall not exceed 200 feet, so that every major section of the transit station has at least 1 such phone. Emergency telephone locations shall be plainly indicated by appropriate signs located at the ETEL and at locations visible along the length of each platform. For more information on ETEL's, see Communications Section 9 of the Design Criteria.

2. The emergency phones shall be a dedicated system that alarms at ROC. The emergency phone system shall annunciate at ROC and indicate the station of origin.

2.6.1.2 The Emergency Management Panel (EMP) (See Paragraph 7.2.4) shall include an annunciator panel which shall indicate by audible and visual alarm the activation and location of any fire signal generated at the station. Separate zones shall be established on the annunciator panel to monitor water flow and main control valve supervision on sprinkler and wet standpipe systems. It shall also indicate fire system supervisory signals and a fire alarm control panel trouble signal. An EMP shall be located in the vicinity of the station entrance at street level to which the fire department will respond. Locations shall be approved by the FLSC.

2.6.1.3 Automatic fire detection shall be provided throughout all station ancillary areas by the installation of listed combination fixed temperature, rate of rise detectors and/or listed smoke detectors. Listed smoke detectors shall be installed in ventilation systems in accordance with NFPA 90A and NFPA 72.

2.6.1.4 In the event of an emergency, audible evacuation notification shall be provided via the fire alarm panel. Alternatively, patron evacuation may be facilitated through provision of a supervised public address system and actuation of equipment necessary to prepare the station for evacuation, if approved by the AHJ.

A. The public address system shall be operable from the EMP, AEMP, and from ROC.

B. The public address system shall conform to NFPA 72 and meet all requirements for voice alarm systems for style Z, Table 3-7.1.

2.6.1.5 Seismic alarm devices and controls shall be provided to detect a seismic event and permit safe stopping of trains entering any zone of the system where a seismic event has occurred. The detection of a seismic event shall be annunciated in ROC. The location of seismic alarm devices should be sufficient to provide adequate notification of a seismic event. Locations shall be coordinated with the Metro FLSC and Engineering.

2.6.1.6 An investigation shall be conducted to establish whether hazardous gases are present along each underground alignment. A report which includes a detailed description of the location of gases, identification of gases and quantity found, potential hazards, and gas protective measures to be implemented shall be submitted to the FLSC.

A. Gas protective measures as used here include passive and active measures to prevent the intrusion, detect the presence, and remove gases.

B. If a gas detection system is recommended, the system shall provide two levels of alarm and the report shall identify the spaces to be monitored. Both levels of alarm shall be annunciated at ROC. The lower-, or minor-level alarm shall be a warning and provide for remedial actions, such as manual activation of ventilation. The higher-, or major-level alarm shall automatically implement remedial action that shall include, as a minimum, activation of ventilation of the space from which the alarm is being generated, and building evacuation system.

C. An alarm shall be annunciated when gas concentrations reach 25% of lower explosive limit (LEL). The annunciation shall be at ROC and relayed to the fire department having jurisdiction.

2.6.2 Fire Sprinkler Systems

2.6.2.1 Every enclosed station, enclosed room within an open station and/or underground station shall be protected by an automatic fire sprinkler system installed in conformance with NFPA 13. This includes both public and ancillary areas, and trainways between the ends of the platform of underground stations (see paragraph 2.4.1.10).

EXCEPTION:

Incoming electric service vaults, AuxPower and Traction Power Sub-stations, and air shafts without equipment.

2.6.2.2 Design density of the sprinkler system shall be for Ordinary Group I classification.

EXCEPTION:

Station entrance and "free" area shall be designed for Ordinary Group II classification.

2.6.2.3 Manually and remotely actuated undercar deluge systems, designed to provide a minimum density of 0.16 gpm per square foot of the projected floor area of the train, shall be provided at underground and enclosed stations, supplied from the standpipe systems. Separately controlled systems shall be provided on each track. Provisions for removing traction power shall be made so that power is automatically removed from the corresponding section of track, when actuating the undercar deluge system.

2.6.2.4 Train control and communication rooms shall be protected with an approved non-water based special extinguishing system (such as an inergen system or equivalent), that does not damage or affect the performance of installed equipment.

2.6.2.5 Graphics identifying fire protection system zone locations will be provided in each valve room.

2.6.3 Standpipe and Hose Systems

2.6.3.1 Class III automatic-wet standpipe system coverage shall be provided throughout underground/enclosed stations in accordance with NFPA 14 and CBC Chapter 38 as modified by local codes. Fire hose outlets shall be located so that any point may be reached, including in and around transit vehicles which may be stopped at the station, with 100 feet of hose and 30 feet of water stream.

2.6.3.2 Standpipe systems in underground and enclosed stations shall be provided with connections to two separate public water supply mains. The risers shall be interconnected by an 8 in. pipe. Standpipe and sprinkler system risers shall be combined.

2.6.3.3 Each elevated station, and station locations with limited access, as determined by the FLSC, shall have a Class I manual-wet standpipe system, in conformance with NFPA 14.

2.6.3.4 Elevated stations may be permitted to have a dry type standpipe with the approval of the Authority having Jurisdiction.

2.6.4 Fire Extinguishers

2.6.4.1 A portable fire extinguisher conforming to NFPA 10, CCR Title 24, and local city codes and standards shall be placed at each fire hose cabinet location and at other locations as required by hazard type and space utilization. Multipurpose dry chemical extinguisher having a capacity of 10 pounds and rated 4-A:30-B:C, shall be used, supplemented by 10 pound, 10-B:C carbon dioxide extinguisher in rooms used for electrical equipment.

2.6.4.2 The maximum travel distance to the nearest extinguisher shall not exceed 150 feet in public areas.

2.6.5 Emergency Access To Stations

2.6.5.1 Access to station entrances and emergency egress locations shall be from public streets, or an access road with a minimum paved width of 20 feet, with widened 28-foot turnouts wherever emergency vehicles may stop.

2.6.5.2 An access road to a station shall be continuous from a public street to a public street, or a 66-foot outside radius turnaround shall be provided.

2.6.5.3 The fire department inlet connections (FDC) for automatic sprinkler and standpipe systems shall be located within 25 feet of vehicular access. FDC and hydrant spacing and locations shall be as determined by the local city fire department and as approved by the FLSC.

2.6.5.4 Every emergency access to underground stations shall be designated a street address for the purpose of dispatch by emergency agencies. Appropriate signage with the address designation shall be mounted at station level at the point of entry to the emergency passage.

2.6.6 FIRE ALARM SYSTEM DESIGN

2.6.6.1 General

The fire alarm system shall generally consist of a fire control panel, smoke & heat detectors, monitor modules for water flow and valve tamper switches, monitor, relay, and control modules, and audible and visual notification devices.

If there is a fire, the fire alarm system shall provide alarm annunciation, and as applicable, automatic fan and damper shutdown, elevator recall and shunt trip, fire suppression activation, and evacuation by zone.

2.6.6.2 Design of the Fire Alarm System

A. Fire alarms, supervisory alarms, and trouble alarms shall be monitored at the ROC through the SCADA system.

B. At aerial and underground stations, the fire alarm system will report to the Emergency Management Panel (as well as to ROC via SCADA), where it will have a remote annunciator and a graphical and tabular display which will guide first responders to the location of the alarm.

C. There shall be two evacuation zones per station (at the underground and aerial stations) - an all evacuation zone, and an ancillary area only zone. The fire system will be programmed so that any one smoke or heat detector activation in the ancillary area will evacuate only the ancillary area. Any smoke detector in the public area will evacuate the entire station. Any two smoke or heat detectors anywhere in the station will evacuate the entire station. Any water flow alarm within the station will evacuate the entire station. Water flow or smoke detector alarms outside of the station will not evacuate the station.

D. Underground stations shall have two deluge systems - one for each track. Activation of the deluge system shall cause the power on the affected track to be removed. This removal of power should occur in two ways - one through the deluge button being pushed, and one through the flow switch that senses the deluge water flow (through the fire panel).

E. Underground and aerial station's TC&C rooms shall typically be protected by pre-action systems, which

will be activated by a cross zone of smoke detectors and the activation of a low pressure switch.

F. Elevators shall be recalled through the fire panel by activation of an elevator lobby smoke detector, or elevator equipment room detector. Alternate floor recall will be required as needed.

G. Elevator equipment rooms shall be shunt-tripped through the fire panel by activation of a heat detector in the elevator equipment room (present code requires a heat detector within 18 inches of each sprinkler head). The AC power used to shunt trip the elevator room must also be monitored. In addition, when the room is shunt-tripped, the battery lowering device must be disabled (also through a control or relay module from the fire panel).

H. Any combination of fans which total over 2000 cfm shall shut down through the fire panel, and fire smoke dampers shall close. In an underground station, a shutdown scheme should be designed so that a fire detector or a water flow switch in that area will shut down all fans and close all dampers in that area.

I. Fire system design shall minimize false alarms through the use of intelligent detectors, alarm verification, detector placement, and type of detector. Additionally, detectors in the public area and in cross passages should require carbon monoxide, infrared, smoke, and heat detection (or similar technology) to activate an alarm, in order to minimize the effects of false alarms on train movement and station evacuation.

J. In stations where a gas detection system is located, the fire alarm system may be used as the means of evacuating the station based on a high gas alarm (with AHJ approval). In this case, the notification devices must be marked "EVAC" and "Evacuation" instead of "FIRE". Coordination with the gas system design will be required.

Additional design may be required to accommodate changes in code.

2.6.6.3 Device Placement

The number and placement of all devices shall be determined by code. All devices must be accessible for maintenance, and shall not be installed directly over high voltage equipment. If a device cannot be accessed with an eight foot ladder, it must have a fall protection hook installed next to it.

Devices should be placed as follows, at a minimum. Additional devices may be required (or may be deleted) per AHJ.

A. Smoke detectors:

TC&C rooms and buildings TPSS rooms and buildings Signal bungalows

All ancillary rooms

Elevator lobbies

Cross passages

B. Heat detectors:

High voltage areas Elevator equipment rooms

C. Duct detectors shall be installed as required by code

D. Audible and visual notification devices:

TC&C rooms and buildings

TPSS rooms and buildings
Signal bungalows

Public areas in underground and aerial stations

All ancillary rooms

Stand alone TC&C, TPSS, and Signal buildings shall additionally have one strobe mounted outside the

main entrance door.

E. Manual pull stations in Stand Alone buildings:

TC&C buildings

TPSS buildings Signal bungalows

F. Manual pull stations in Underground and Aerial Stations - at the AHJ's discretion, manual pull stations shall be replaced by ETELS. The ETELS used for this purpose shall have fault reporting to the FCP. The ETELS shall be installed in the following areas:

Public areas

Areas of egress (emergency stairs, corridors, and hatches)

2.6.6.4 Power

Power supply and distribution for the fire alarm system, shall be furnished in accordance with applicable NFPA Codes.

2.7 TENABLE ENVIRONMENT

2.7.1 Geometric Considerations

"Some factors that should be considered in establishing a tenable environment in stations are as follows:

1) The evacuation path requires a height clear of smoke of at least 2.0 m (6.6 ft). The current precision of modeling methods is within 25 percent. Therefore, in modeling methods, a height of at least 2.5 m (8.2 ft) should be maintained above any point along the surface of the evacuation pathway.

2) Smoke obscuration levels should be continuously controlled so that a sign internally illuminated at 80 ix (7.5 ft-candles) is discernible at no less than 30 m (100 ft) and doors and walls are discernible at no less than 10 m (33ft).

3) The application of tenability criteria at the perimeter of a fire is impractical. The zone of tenability should be defined to apply outside a boundary away from the perimeter of the fire. This distance will be dependent on the fire heat release rate and could be as much as 30 m (100 ft)."

2.7.2 Station Time of Tenability

For a station, the ventilation system must maintain a tenable environment during a large fire for the platform. It is assumed that the entire platform, excluding the area directly adjacent to the fire, must maintain a tenable environment for this duration unless an engineering analysis can show how those who are unable to self-rescue can reach a tenable area. This includes first responders. The minimum time-of-tenability shall be the greater of one hour or the evacuation time. This may be revised with approval of Metro and the AH J subject to an engineering analysis adhering to NFPA 130. The calculation of time of tenability shall comply with NFPA 130.

The project should develop a time-of-tenability criterion for the stations and tunnels with the approval of the Authority Having Jurisdiction. Some factors that should be considered in establishing these criteria are as follows:

1) The time for fire to ignite and become established

2) The time for fire to be noticed and reported

3) The time for the entity receiving the fire report to confirm existence of fire and initiate response

4) The time for all people who can self-rescue to evacuate to a point of Safety.

5) The time for emergency personnel to arrive at the station platform or tunnel fire location.

6) The time for emergency personnel to search, locate, and evacuate all those who cannot self-rescue.

7) The time for fire fighters to begin to suppress the fire.

If a project does not establish a time-of-tenability criterion, the system should be designed to maintain the tenable conditions indefinitely."

If an act of terrorism or arson fire (accelerant involved) is assumed in the fire growth curve, then consistent assumptions should be used in the calculation of time of tenability. For example, an act of terrorism or arson fire may involve a mass casualty incident that will lengthen the time of tenability compared to a small fire that develops on its own.

TABLE 2-1

EMERGENCY EXIT CAPACITY

CALCULATIONS

Station _____

Occupancy Load _____

Exit Lanes and Capacity Provided

Platform to Mezzanine

Stairs _____ x _____ Lanes x _____ PPM = _____ PPM
Escalators _____ x _____ Lanes x _____ PPM = _____ PPM

Emergency Stairs _____ x _____ Lanes x _____ PPM = _____ PPM

TOTAL _____ PPM

Through Fare Barrier

Fare Gates _____ x _____ Lanes x _____ PPM = _____ PPM
Service/Emergency Gates _____ x _____ Lanes x _____ PPM = _____ PPM

TOTAL _____ PPM

Fare Barrier to Safe Area

Stairs _____ x _____ Lanes x _____ PPM = _____ PPM
Escalators _____ x _____ Lanes x _____ PPM = _____ PPM
Emergency Stairs _____ x _____ Lanes x _____ PPM = _____ PPM

TOTAL _____ PPM

EMERGENCY EXIT CAPACITY TESTS

Test 1

Evacuate station occupant load from station platform(s) in 4 minutes or less.

$$W1 \text{ (waiting time at platform exits)} = \frac{\text{(occupancy load)}}{\text{Exit Capacity}} = \_\_\_\_\_$$

$$W1 = \frac{\text{Persons}}{\text{PPM}} = \_\_\_\_\_ \text{Minutes}$$

Test 2

Evacuate station occupant load from the most remote point on the platform to a point of safety in 6 minutes or less.

Walking Time for Longest Exit Route $T = T1 + T2 + T3 + T4 + T5$

T1 (platform) = ____ Feet + ____ FPM = _____ Minutes
T2 (platform to mezzanine) = ____ Feet + ____ FPM = _____ Minutes
T3 (mezzanine to fare barrier) = ____ Feet + ____ FPM = _____ Minutes
T4 (fare barrier to safe area) = _____ Feet + ____ FPM = _____ Minutes
T5 (grade) = ____ Feet + ____ FPM = _____ Minutes

T= ____ MINUTES

Additional Waiting Time at Platform Exits

W1_____ - T1 _____= _____ Minutes

Additional Waiting Time at Fare Barrier

Total Occupant Load ____ - Emergency Stair 4 Minute Capacity
= _____ Occupant Load at Mezzanine

Occupant Load at Mezzanine
W2= _____

Gate Capacity

Persons
W2= _____ =_____ Minutes
PPM

W2 ____ - W1_____ =_____ Minutes

Additional Waiting Time at Mezzanine Exits

Occupant Load at Mezzanine
W3= _____

Exit Capacity

Persons
W3= _____ =_____ Minutes
PPM

W3 ____ - W1 _____= _____ Minutes

Total Exit Time

T____ + (W1 - T1) _____ + (W2 - W1) _____ + (W3 - W1) ____ = _____ TOTAL MINUTES

TABLE 2-2

MINIMUM CONSTRUCTION STANDARD

Underground Guideway Type I *
Station Type I
Ancillary Rooms 2 hour separation from public areas
3 hour separation Ancillary Structures 3 hour separation from tunnels

At-grade Guideway Type II
Station Type II
Ancillary Rooms 2 hour separation from public areas
Separate Structures Type II (as per CBC Ch. 5)

Elevated Guideway Type II (FR)
Station Type II (FR)
Exception: Canopy and canopy supports may be Type II (N)
Ancillary Rooms 2 hour separation from public area
Vaults 3 hour separation Separate Structures
Type II (FR) (under guideway or freeway)

* - CBC Table 17-A, Types of Construction
Note: for additional separation information refer to Section 2.2

TABLE 2-3

FLAMMABILITY AND SMOKE DENSITY OF STATION INTERIOR FINISHES

	FLAME SPREAD	SMOKE DENSITY
LOCATION	Is 75	Ds 450
Enclosed Exits	Is 25	Ds 50
Ancillary Areas	Is 200	Ds 450

END OF SECTION

3.0 GUIDEWAY FACILITIES

3.1 GENERAL

3.1.1 Application

3.1.1.1 The guideway shall be considered "at-grade" where track is placed on grade without supporting structure or roof; "aerial" where the track is placed on an aerial structure; and "underground" where the track is located beneath the surface of earth or water.

3.2 CONSTRUCTION AND PROTECTIVE SEPARATIONS FOR UNDERGROUND GUIDEWAYS

(See Subsections 3.9 and 3.10 for surface and elevated guideway requirements.)

3.2.1 Underground Guideway Construction

3.2.1.1 When line sections are to be constructed by the cut-and-cover method, perimeter walls and related construction shall be not less than Type I or Type II or combinations of Type I and Type II approved fire resistive construction as defined in the CBC, as amended, or as determined by an engineering analysis of potential for exposure hazards to the structure and approved by the FLSC.

3.2.1.2 When line sections are to be constructed by a tunneling method through earth, unprotected steel liners, reinforced concrete, shotcrete, or equivalent shall be used. (Exception: Rock tunnels may utilize steel bents with concrete liner if lining is required.)

3.2.1.3 Special liner requirements may be imposed to assist control of natural gas intrusion and, where utilized on the tunnel interior, shall be of noncombustible construction.

3.2.1.4 Walkways designated for evacuation of passengers shall be constructed of noncombustible materials. Walking surfaces shall have a uniform, level, slip resistant design. Open grating surfaces shall not be permitted.

3.2.1.5 Noncombustible rail ties or direct fixation fasteners shall be used in underground guideway.

3.2.1.6 Ancillary structures adjoining the guideway, including remote vertical exit shafts and ventilation structures, shall be not less than Type I approved fire resistive construction as defined in the CBC, as amended.

3.2.1.7 Safeguards During Construction - During the course of construction or major modification of any guideway facility, provisions of the CBC, NFPA 130, and NFPA 241, as amended by local city codes and regulations shall apply. Refer to these standards for specific requirements pertaining to emergency lighting and fire protection.

3.2.2 Protection Protective Separations for Underground Buildings

3.2.2.1 Ancillary structures and areas within tunnels shall be separated from trackway areas by three hour minimum fire-resistive construction with all openings protected with approved Class A (three hour rated) assemblies, except crosspassages shall be separated from trackways by two hour minimum fire resistive construction.

3.2.2.2 All non-transit system structures or facilities shall be separated from underground guideway structures by unpenetrated four-hour fire-rated construction.

3.2.3 Underground Guideway Protection Against Intrusion of Flammable and Combustible Liquids

3.2.3.1 If Vent or fan shafts are utilized for ventilation of subway tunnels, they shall not terminate at-grade in a roadway or parking lot.

3.2.3.2 Vent and fan shafts may terminate in the median strips of divided highways or on sidewalks designed to accept such shafts, or in open space areas, provided that the grade level of the median strips, or sidewalk, or open space, is at a higher elevation than the surrounding grade level and separated by a concrete curb. This curb shall be of sufficient elevation to exclude drainage into the shaft, but in no case shall the height be less than six inches. Consideration shall be given to raising any blast relief shaft or intake shaft to protect against unintentional or intentional release of hazardous materials into the subway.

3.2.3.3 Installation of underground storage tanks and related piping for Class I flammable or Class II or Class III combustible liquids shall not be permitted directly over any transit system subsurface structure, or within 25 feet (measured horizontally) from the outside wall of such subsurface structure. (See Paragraph 3.2.3.5 for

tanks in or under existing buildings.)

3.2.3.4 Installation of underground storage tanks and related piping for Class I flammable or Class II or Class III combustible liquids located in the area between 25 feet and 100 feet (measured horizontally) from the outside wall of any transit system subsurface structure, and within that same area such tanks and related piping which are within two feet (measured vertically) below the lowest point of subsurface structure excavation, shall meet the following requirements:

A. Tanks shall be of double wall construction.

B. Tanks shall be equipped with an approved automatic leak detection and monitoring system.

C. Tanks shall be provided with an approved corrosion protection system.

D. Installation, maintenance and inspection shall conform to the requirements specified by the authority having jurisdiction.

3.2.3.5 Existing underground tanks for Class I flammable or Class II or Class III combustible liquids located in or under buildings, and located directly above a subsurface transit structure, or within 25 feet (measured horizontally) from the outside wall of the subsurface transit structure, shall be removed and relocated outside the prohibited area. Where it is not possible to remove tanks, such tanks shall be abandoned in accordance with provisions of the authority having jurisdiction.

3.2.3.6 Aboveground atmospheric storage tanks storing, handling, or processing Class I flammable liquid or Class II or Class III combustible liquids and related piping shall not be located over or within 25 feet of a subsurface structure (measured horizontally) from the outside wall of such subsurface structure unless provided with an approved leak detection monitoring system.

3.2.3.7 Facilities dispensing Class I flammable liquids and Class II or Class III combustible liquids, and located in the area within 100 feet (measured horizontally) from the outside wall of the subsurface transit structure, shall comply with the following:

A. The surface around pump islands shall be graded or drained in a manner to divert possible spills away from subway vent gratings, entrances, or exits.

B. Appropriate continuous drains across driveways, ramps, and/or curbs of at least six inches in height shall be provided to separate facilities from adjacent subway property.

C. No connection (such as venting or drainage) of any storage tanks and related piping of Class I flammable liquids and Class II or Class III combustible liquids, to a subsurface fixed guideway transit structure shall be permitted.

D. Points of dispensing Class I flammable liquids and Class II or Class III combustible liquids, shall not be located less than 40 feet from the nearest side of a subway grating or entrance or exit from a subway.

3.2.3.8 Other fill or dispensing points for Class I flammable liquids and Class II or Class III combustible liquids, shall be subject to restrictions as prescribed in Paragraph 3.2.3.6.

3.2.3.9 Flammable or hazardous liquid or gas lines crossing the transit right-of-way, except when located in public roadways, shall be in accordance with local codes.

3.3 GUIDEWAY TRACTION POWER AND FACILITY WIRING

Traction power elements associated with the guideway may include contact rail, contact rail supports, wayside potheads, cable between pothead and contact rail, overhead contact conductor and its appurtenances, and special warning and identification devices. Facility wiring shall conform to the requirements specified in Section 2.4.

3.3.1 Contact Rail Protection

3.3.1.1 Contact rail conductors and side approaches shall be secured to suitable insulating supports, properly bonded at joints, and properly protected to prevent contact with personnel. Coverboards shall be capable of withstanding a load of 250 lb. (113.4 kg) when applied at any point with no permanent visible deflection.

3.3.1.2 The protective coverboard provided on contact rail sections shall be securely anchored. Coverboard materials shall be electrically insulating, capable of passing ASTM E84 with a flame spread rating of not more than 25, and a smoke density of 50 or less.

3.3.1.3 The coverboard shall be permanently and conspicuously marked to provide basic location identification by section of guideway and electrification feeder zone. Markings should be at the ends of station platforms, at each end of each contact rail gap, and at intervals along the coverboard, not to exceed 500 feet. Marking locations should be coordinated with graphics specified for emergency access points.

3.3.2 Contact Rail Appurtenances - Cables connecting the contact rail, pot heads, and energized hardware shall be covered with insulating material and installed so as not to present a tripping or electrical hazard to personnel on the walkway. Insulating material for cable connecting power to the rail shall meet the requirements of IEEE Standard 383, Section 2.5.

3.3.3 Contact Rail Location - The contact rail shall be located opposite the station platform and the safety walkway except at special trackwork areas. (See Paragraph 3.4.2.1C)

3.3.4 Overhead traction power conductor systems shall comply with CPUC G.O. #95 and shall meet the following requirements:

3.3.4.1 Nonconducting material shall be used to isolate the overhead catenary from any grounded structure.

3.3.5 Traction Power Isolation from the Utility - Isolation means shall be provided outside the traction power substation to enable the removal of the high voltage from the transit equipment.

3.3.6 Signage - Warning signs shall be posted on entrances to the guideway (e.g., station platforms, portals), on fences or barriers adjacent to the entrance, and at other locations where unauthorized, non-operating authority employees may attempt to enter the guideway. The warning sign shall clearly state the hazard (e.g., "Danger High Voltage 750 Volts") in letters, size, and colors as required by NFPA 70 (NEC), CALOSHA regulations, and ADA requirements.

3.3.7 Emergency power shut-off devices (ETS) shall be provided in accordance with Subsection 7.5 for both heavy rail and light rail systems.

3.4 EMERGENCY EGRESS AND ACCESS FOR UNDERGROUND GUIDEWAYS

(See Subsections 3.9 and 3.10 for surface and elevated requirements.)

3.4.1 An emergency means of egress from transit vehicles in tunnels and through tunnels to a point of safety shall be provided.

3.4.1.1 In order to be considered a point of safety the following conditions must be met:

A. Tunnels may be separated by either a minimum two hour rated fire barrier at each end of crosspassages protected by Class B (1 1/2 hour) fire assemblies, or a common minimum three-hour rated fire barrier between adjacent tunnels with openings protected by Class A (3-hour) fire assemblies.

B. Emergency ventilation facilities shall be provided at each unclosable opening (e.g. crossover) in the fire-rated barrier, as necessary for center platform stations or for special track sections, so that a vehicle fire can be prevented from passing beyond the opening for a minimum of one hour.

3.4.1.2 Each point of safety must be provided with the following:

A. A Blue Light Station shall be available at each point of access to enclosed points of safety.

B. Emergency lighting shall be provided. (See Paragraph 3.4.7)

C. The minimum illumination level for egress paths anywhere along the guideway shall be 0.25 foot-candles, measured at the walking surface.

3.4.1.3 Egress from within a point of safety shall not be back into the tunnel of fire origin.

3.4.2 Egress Paths - In addition to the requirements specified in Paragraph 3.2.1.4 the following identifies features necessary for effective emergency egress of patrons from disabled transit vehicles.

3.4.2.1 A safety walk shall be provided on one side of tunnels, and shall be placed at the height of the vehicle floor (plus 0 inches, minus 7 inches) to facilitate egress through vehicle side doors. The following additional requirements shall be met:

A. Level walkways, including ramps having a slope not exceeding 6% shall have a clear width not less

than 2 feet 6 inches, with 3 feet being preferable, a maximum cross slope toward the trackway of 0.5% and continuous wall handrails of 1% to *VA* inch standard galvanized pipe, mounted 34 to 38 inches above the walkway with *VA* inch minimum space between the handrail and the wall. The walkway clearance envelope above the walking surface shall measure 30 inches wide by 80 inches high and shall be clear of all obstructions including the tunnel handrail and the vehicle dynamic envelope.

B. Stairs and ramps having a slope in excess of 6 percent shall have a clear width of 2 feet 10 inches and shall be equipped with a 3 foot 6 inch high guardrail having an intermediate rail at mid-height. Cross slope shall be as required for level walkways. Stairs shall have a minimum of two risers, and shall be constructed in accordance with the CBC, as amended.

C. Safety walks shall be brought down to rail elevation at track level at each end of a station platform to provide access to the underside of vehicles for lengths not less than 15 feet but not greater than 150 feet. Safety walks shall also be brought down to rail elevation at crosswalks. Safety walks on the contact rail side of the trackway shall not be brought below the level of the contact rail coverboard. Where walkways are at track level, contact rail guards shall be provided to prevent inadvertent contact with the contact rail.

D. A minimum two feet 6 inch wide car-floor level walkway shall be provided for each track, with a 3 foot wide car-floor level walkway being preferable. The walkway clearance envelope above the walking surface shall measure 30 inches wide by 80 inches high and shall be clear of all obstructions including the tunnel handrail and the vehicle dynamic envelope. Wall handrails of 1% to *VA* inch standard galvanized pipe may be mounted 34 to 38 inches above the walkway. Handrails shall not protrude into the walkway further than 3 inches, and shall not intrude into the walkway clearance envelope.

E. Where pinch points exist along the walkway, provide signage or graphics to warn passengers of reduced walkway width. Pinch points are locations where the walkway width narrows, but in no case to less than 30 inches. Five-foot wide black and yellow striping on the tunnel face at each pinch point is acceptable warning graphics.

3.4.2.2 Crosswalks shall be provided at track level to assure walkway continuity where safety walks are discontinued on one side of the tunnel and continued on the opposite side and where access is required from safety walks and track walkways to emergency stairs or crosspassages. The crosswalks shall have a uniform level walking surface at top of rail, with a minimum width of 6 feet for a contact rail system and 3 feet 8 inches for an overhead catenary system. The crosswalk surface shall be sloped a maximum of 6% from track walkway elevation. Where the crosswalk is to extend to the side of the tunnel with the contact rail, the contact rail shall be discontinued not less than 5 feet from each side of the crosswalk.

[Note: Track-level center walkways in tunnels (except in pocket/tail tracks) will be permitted only for extreme space constraints and only by Request for Special Consideration from FLSC, and shall have a minimum width of 3 feet.] 3.4.2.2 moved to 3.8.8.

3.4.2.3 Walkway continuity shall be maintained at special track sections. Crosswalks shall be provided the full width of all trackways at both ends of special track sections.

A. For contact rail systems, safety walks of both mainline tracks shall be located at the exterior walls above the contact rail coverboard at vehicle floor height. The walkway clearance envelope above the walking surface shall measure 30 inches wide by 80 inches high and shall be clear of all obstructions including the tunnel handrail and the vehicle dynamic envelope.

B. For overhead catenary systems, safety walks of both mainline tracks shall be located at the exterior (outside the tracks) at vehicle floor height. The walkway clearance envelope above the walking surface shall measure 30 inches wide by 80 inches high and shall be clear of all obstructions including the tunnel handrail and the vehicle dynamic envelope.

C. Safety walks shall extend from crosswalk to crosswalk.

3.4.3 Emergency Exits to the Surface - The emergency exits provide a capability for patron egress and access by emergency personnel. They consist of fire-resistive enclosed stairways and passageways supplementary to access for underground trainways at stations and portals, and are required as follows:

3.4.3.1 Emergency exits to the surface shall be provided at intervals not exceeding 1250 feet when trackways are

not separated by solid walls or when the trackways are not accessible from each other.

3.4.3.2 Where trackways are separated from each other by solid walls with the required fire resistance and having crosspassages meeting the requirements of Paragraph 3.4.4, emergency exits to the surface shall be provided:

A. At unprotected openings in the separating wall away from stations, such as special track locations, and

B. At maximum 2,000 foot intervals where tunnel separation does not qualify as a point of safety asdefined by Paragraph 3.4.1.1.

3.4.3.3 Emergency exit enclosures shall be separate from ventilation shafts, although they may be adjacent. Stairs and passageways shall have a minimum clear width of 3 feet 8 inches. Stairways shall have: standard handrails or guardrail on each side, landings of a length equal to the stair width at the bottom and at not greater than 12 foot vertical intervals, minimum 6 feet 8 inch headroom, maximum 7 inch step risers, and minimum 11 inch wide deep step treads. Doors shall be single leaf, not in excess of 4 feet wide, Class B (1>2 hour) fire doors, arranged to open in the direction of travel and equipped with self-closing devices.

3.4.3.4 Emergency exit discharge shall be to a point of safety through an opening with a minimum width of 3 feet 8 inches and a minimum height or length of 6 feet 8 inches. The exit will normally be one of the following:

A. Vertical exit door in a surface kiosk or an adjacent building meeting CBC requirements for Class A occupancy. Such a door shall be equipped with panic hardware on the emergency exit stairway side and shall have a minimum fire rating of *VA* hours. The force required to open the doors fully shall not exceed 30 pounds applied to the latch side. Entrance from the outside shall be provided by a key or wrench.

B. Horizontal exit door or hatch flush with surface level. The flush exit doors shall be of solid non-combustible material such as solid steel or aluminum and shall be counterweighted or spring loaded so that they will open when pressure is put on a panic release bar on the emergency exit stairway side. The force required to open or close the hatch shall not exceed 30 pounds applied at the latch side. The hatch shall be equipped with a hold-open device which shall automatically latch the door in the open position so as to preclude accidental closure. Entrance from the surface side shall be provided by a LAFD hydrant wrench. Where the hatch is in a position subject to pedestrian traffic, a warning device at the surface shall be provided which can be activated at the bottom of the stairs, at an intermediate landing, or when the door is opened.

C. Exit doors at the surface shall not be provided in areas subject to vehicular traffic.

D. Every emergency access to underground guideway shall be designated a street address for the purpose of dispatch by emergency agencies. Appropriate signage with the address designation shall be mounted at tunnel level at the point of entry to the emergency passage.

3.4.4 Crosspassages - Distance between tunnel crosspassages shall be 750 feet nominally, and shall not exceed 800 feet, unless authorized by the FLSC. They shall meet the following requirements:

3.4.4.1 The sill of a crosspassage opening shall match the elevation of the service walkway or crosswalk to which it connects. The crosspassage shall have a minimum clear, unobstructed width of 6 feet 6 inches, and it shall have a desirable height of 8 feet and a minimum height of 7 feet. Ventilation and drainage shall be provided.

3.4.4.2 Crosspassages may be incorporated in pump or ventilation structures. The passageway shall be separated from the air plenums and sumps and be enclosed by construction with a minimum fire rating of 2 hours. Space for any ventilation or drainage equipment shall be provided exclusive of the 6 feet 6 inches required in Paragraph 3.4.4.1.

3.4.4.3 The minimum dimensions of the door opening shall be 3 feet eight inches wide by 6 feet 8 inches high. Doors shall be provided at each end and arranged to open into the crosspassages. The doors shall be offset to the same side of the crosspassage.

3.4.4.4 Doors, door frames, and hardware shall have a minimum fire rating of 1¦4 hours (Class B).

3.4.4.5 Doors shall be equipped with door closures and passage latch sets to allow opening from either side. All doors and hardware systems shall be designed to withstand an air pressure of 70 pounds per square foot

applied on either side of the entire door area.

3.4.5 Emergency Exit Doors - Emergency exit doors shall be provided at maximum 500 foot intervals in the common wall separating the trainways in cut-and-cover structures. A single sliding door shall be used with the door and hardware having a minimum fire rating of three hours (Class A). The door shall be self-closing and equipped with pull handles to allow opening from either side.

3.4.6 Identification of Exits - Cross-passage and exit doors shall be suitably identified by signs and lights. Cross-passages leading to the surface shall have illuminated exit signs colored green. All other cross-passages shall have illuminated exit signs colored red.

3.4.7 Emergency Lighting

3.4.7.1 Tunnel emergency lighting illumination levels of a minimum 0.25 footcandles shall be provided at the walking surface of walkways, stairs, crosswalks, crosspassages, and all other components of emergency exits.

3.4.7.2 Underground emergency lighting shall otherwise conform to requirements for station emergency lighting. (See Paragraph 2.5.5)

3.4.8 Emergency Access

3.4.8.1 In those locations where emergency egress from the guideway is provided, emergency access shall also be provided, meeting the requirements of Paragraph 2.6.5.

3.4.8.2 At such locations, a BLS as defined in Subsection 7.5 shall be provided.

3.4.9 Directional Signs - Directional signs indicating distances to nearest station or portal in both directions shall be provided on the walkway tunnel wall every 100 feet to guide passengers during an evacuation.

3.5 VENTILATION SYSTEMS FOR ENCLOSED GUIDEWAYS

3.5.1 Trainway ventilation systems shall comprise normal environmental control systems and emergency ventilation systems. Normal environmental control systems are required to operate continuously or intermittently for the purposes of maintaining safe working conditions for transit employees with duties in the underground guideway, providing makeup air required for transit vehicle passengers, cooling transit vehicles and wayside equipment, and removing flammable gases and vapors determined to be present in the underground environment. Sufficient normal ventilation shall be provided to meet the requirements of these conditions occurring simultaneously. Emergency ventilation facilities may be used under abnormal conditions to control unusually large gas and vapor penetrations, and under conditions of failure of the normal air handling control systems.

3.5.2 Emergency Ventilation System Capability

3.5.2.1 Guideway emergency ventilation systems shall be designed to operate in full coordination with station emergency ventilation systems, and to meet the requirements of Paragraphs 2.3.1 and 2.3.2.

3.5.2.2 Emergency ventilation systems shall be capable of controlling air quality for not less than 60 minutes in tunnels having unseparated guideways or lacking crosspassages. With guideways in separated tunnels having crosspassages, emergency ventilation shall control fire effects in the tunnel of fire origin for 60 minutes, and in the unaffected tunnel indefinitely. Where separated tunnels are to be designated as an area of refuge, emergency ventilation shall control the effects of fire indefinitely.

3.5.3 Emergency Ventilation Equipment Requirements - The requirements described in Paragraphs 2.3.3, 2.4.1.4 and 2.4.1.8 and 2.4.1 shall be met.

3.5.4 Supervision and Control - Comply with Paragraph 2.3.4. At mid-tunnel vent shafts EMPs shall be provided at locations approved by the FLSC.

3.5.5 Ventilation of Egress Routes

3.5.5.1 If ventilation systems are provided in egress routes from tunnels (e.g. crosspassages, stairs) for removal of flammable gases or vapors determined to be present in the underground environment, such systems shall

be designed to shut down upon activation of the emergency ventilation system. Any ventilation openings in the fire rated separation between the egress route and the guideway shall be protected with leakage rated dampers which shall close when the associated ventilation system is shut down.

3.5.5.2 Vertical crosspassages shall be analyzed to verify that smoke will not enter the vertical cross-passage from the incident tunnel during emergency ventilation system operation. If necessary, a stair pressurization smoke management system shall be provided.

3.5.6 Ventilation of Ancillary Areas

3.5.6.1 Ancillary area ventilation systems shall be installed in accordance with NFPA 90A. The systems shall be designed to shut down on activation of the emergency ventilation system. Any ventilation openings in the fire rated separation between the ancillary space and the guideway shall be protected with leakage rated dampers which shall close when the associated system is shut down.

3.5.6.2 An ancillary space housing batteries shall be provided with a ventilation system meeting all the requirements of Paragraph 2.3.5.2. Exhaust air from such spaces shall not be discharged into the tunnel.

3.5.7 Ambient wind conditions shall be considered in the design of the emergency ventilation system where it may have an impact on the effectiveness of the system. This is relevant in cases such as but not limited to where tunnel portals or partially open guideways are provided.

3.6 FIRE PROTECTION SYSTEMS

3.6.1 Protective Signaling Systems - Protective signaling systems shall be installed in auxiliary ancillary spaces as required in Paragraphs 2.6.1.1 and 2.6.1.3.

3.6.2 Automatic fire suppression sprinkler systems shall be provided in all mid-tunnel ancillary spaces as required in Paragraph 2.6.2. The status of all suppression sprinkler systems shall be monitored and displayed at the ROC.

3.6.3 Standpipe and Hose System - A Class I automatic-wet standpipe system shall be installed to provide protection throughout the underground guideway system, in accordance with NFPA 14, CBC Chapter 38, and the following requirements:

3.6.3.1 The standpipe system for underground locations shall be supplied through direct connections from the public water supplies at station locations, portals, and other access points to the system. Station standpipe supplies and guideway standpipe supplies may be combined.

3.6.3.2 Where water supplies divide to feed standpipe systems in two directions, check valves shall be provided at the point of connection to each feed main. When needed for required system reliability, a normally closed bypass may be employed.

3.6.3.3 Fire department inlet connections shall be provided at each point of connection to public supplies.

A. The inlet connection shall be arranged to join the public main supply at street level utilizing the standard valve pit arrangement of NFPA 24, including control valves and check valves.

B. Inlet connections shall be visible from a public way and comply with the requirements of Paragraph 2.6.5.3.

C. Graphics Signage identifying the portions of the trackway supplied shall be placed at each surface fire department inlet connection location. Graphics, Text and size of lettering shall be approved by the FLSC.

3.6.3.4 Control valves and check valves at points of system supply and subdivision shall only be located at stations, portals, street level valve pits, and within crosspassages and exit enclosures.

3.6.3.5 The guideway standpipe, where required, shall be a Class I automatic-wet standpipe system with a minimum 6 inch standpipe. All common supply piping shall be calculated and sized to provide a minimum flow of 250 GPM at a residual pressure of 65 pounds per square inch at each of the two hydraulically most remote hose connections, and for all standpipes connected to such supply piping, the total not to exceed 1250 GPM.

[Note: 3.6.3.5 combined with 3.6.3.7]

3.6.3.6 Fire hose outlets shall be equipped with $2^1/_2$ inch 90° lever actuated ball valves with $2Y_2$ inch NST fire hose thread, with cap and chain, and be positioned as follows:

A. Two outlets shall be provided within each crosspassage and within the enclosure of each emergency exit to the surface.

B. Outlets shall also be installed in each guideway with locations coordinated with crosspassages and exit enclosures to obtain a spacing not exceeding 250 feet between hose outlets.

C. In cut-and-cover subway structures, hose outlets shall be provided on each side of the separating common wall, near each exit door and at intervals not to exceed 250 feet.

D. Identifying graphics complying with Paragraph 3.6.3.3 C shall be affixed to tunnel walls at each hose outlet valve, or painted directly on the standpipe in white letters.

3.6.3.7 Standpipe system control valves shall be supervised from the fire alarm control panel in an adjacent station by means of valve-position indicators. One valve-position indicator shall be provided for each valve. One indicator signal (series wired indication circuit) from valves within each fire-rated enclosure is permitted. Valves which are to be normally closed shall be supervised in that position.

3.6.3.8 Class III automatic-wet standpipe systems shall be provided in mid-line vent structures and exit stair shafts adjoining ancillary spaces.

3.6.4 Standpipe Installations in Tunnels Under Construction

3.6.4.1 A manual-wet standpipe system, either temporary or permanent in nature, shall be installed in tunnels under construction, before the tunnel has exceeded a length of 200 ft beyond any access shaft, and shall be extended as tunnel work progresses.

3.6.4.2 Permanent standpipes shall conform to NFPA 14, as outlined in Paragraph 3.6.3.

3.6.4.3 Temporary standpipes, which may be used by contractors to furnish water for construction purposes, shall be equipped with hose outlets and valves with 2 1/2 inch hose thread conforming to NFPA 1963, Standard for Screw Threads and Gaskets for Fire Hose Connections, and may have suitable reducers or adapters attached for connection of contractor's hose. Such reducers or adapters shall be readily removable by use of fire fighter's hose spanner wrenches.

3.6.4.4 Permanent standpipes or temporary standpipes installed in tunnels during construction shall be provided with risers to the ground surface level. Such risers shall be equipped with approved fire department connections, which shall be identified with appropriate signs as outlined in Paragraph 3.6.2.3 and shall be readily accessible for fire department use, and protected from accidental damage. There shall be a check valve and ball drip or valved drain in the riser near the connection to the standpipe.

3.6.4.5 Permanent or temporary standpipes, installed during the construction phase, shall be securely and adequately supported and shall be of sufficient strength to withstand the pressure and thrust forces to which they may be subjected.

3.6.4.6 Temporary standpipes shall remain in service until the permanent standpipe installation is complete.

3.6.5 Fire Extinguishers - A portable fire extinguisher with a minimum rating of 4-A:30-B:C, ten pound capacity and UL approved, shall be provided adjoining each Blue Light Station (BLS) and each mid-tunnel emergency fan control room.

3.7 EMERGENCY COMMUNICATIONS

3.7.1 Emergency Telephones (ETEL)

3.7.1.1 Guideway emergency telephones shall be part of the emergency telephone system required in Subsection 7.4.2.

3.7.1.2 Emergency telephones shall be provided at each Blue Light Station.

3.7.1.3 Emergency telephones shall be provided in emergency fan control rooms.

3.7.2 Blue Light Stations (BLS) - Blue Light Station requirements for transit systems are described in Subsection 7.5.

3.7.3 Tactical Communications - Fire Department tactical communications capability shall be provided throughout underground guideways and shall be designed in accordance with the requirements of Subsection 7.3.

3.7.3.1 Deleted

3.7.3.2 Transmission medium shall provide capability to transmit and receive emergency organization radio channels at EMPs, CP's AEMPs and other locations where equipment is provided for use by public emergency organizations.

3.7.3.3 Materials used to support the radio antenna in the tunnel areas, ancillary spaces, and station areas shall be capable of being subjected to temperatures up to 932°F for one hour, and shall not support combustion under the same temperature conditions.

3.8 POCKET/STORAGE OR TAIL TRACK IN UNDERGROUND LOCATIONS

3.8.1 Trackway sections providing storage areas for trains parallel to the mainline shall be separated from the mainline by a two hour fire rated partition. Any opening in the partition shall be protected by a *VA* hr. rated assembly.

3.8.2 At termination ends, sufficient exiting shall be provided, as defined in Paragraph 3.4.3.2.

3.8.3 Emergency ventilation shall be provided in accordance with Subsection 3.5.

3.8.4 Wet standpipes shall be provided in accordance with Paragraph 3.6.3 except that Class III hose cabinets shall be provided not to exceed a spacing of 250 feet.

3.8.5 Approved automatic fire detection system meeting Paragraph 2.6.1 shall be installed in the trackway.

3.8.6 Access shall be provided at both ends of a maximum train length for each guideway section.

3.8.7 A minimum spacing of 6 feet 6 inches shall be provided between trains stored on the same track.

3.8.8 Track-level safety walks are required and shall have a uniform level walking surface, not less than 2 feet 6 inches wide. The surface shall be flat, slip-resistant and free from obstructions, holes, and drainage channels for the required width. No tripping hazards shall be permitted on the walking surface.

3.9 AT-GRADE GUIDEWAYS

3.9.1 Construction Materials

3.9.1.1 Construction shall be of not less than Type II approved construction as defined in the CBC, as amended, or as determined by an engineering analysis of potential fire exposure hazards to the structure and approved by the FLSC.

3.9.1.2 If other facilities such as train signaling equipment, communications equipment, or battery power supplies are incorporated into a traction power substation structure, occupancy separations shall be provided in accordance with the CBC. If such facilities are provided with separate structures, the structures shall comply with Paragraph 3.9.1.1.

3.9.2 Traction Power and Electrical Wiring and Cable - Provide compliance with the applicable requirements contained in Subsection 3.3.

3.9.3 Emergency Access

3.9.3.1 Access gates shall be provided in security fences, as deemed necessary by the operating authority Metro.

3.9.3.2 The gates shall be a minimum of 44 inches wide and shall be of the hinged or sliding type.

3.9.3.3 Graphics shall be provided on, or adjacent to, each gate to identify the geographic location, track section, and traction power feeder zone. Warning signs, identifying the appropriate hazards, shall also be posted on the access to the at fences and barriers.

3.9.3.4 Access to the guideway by emergency response personnel shall be through passenger stations, or directly from crossing or parallel public streets. Where conditions such as landscaping, structures, or contiguous private property ownership hinder emergency response personnel, special provisions may be necessary. Adjacent roadways or special access roads at maximum intervals of 2,500 feet shall be provided for all guideways on fenced right-of-way.

3.9.3.5 Within the right-of-way, the maintenance vehicle access areas shall be suitable for use by emergency vehicles, if more than 150 feet from a public roadway.

3.9.3.6 Crosswalks, 6 ft. wide for contact rail systems and 44 inches wide for overhead catenary systems, shall be provided at each end of special trackwork sections. (See Paragraphs 3.4.2.3 and 3.4.2.4)

3.9.3.7 Guideway lighting may be by ambient sources (street lights, signs, etc.). In areas where ambient lighting does not maintain a minimum level of 0.25 footcandles at the walking surface, supplemental lighting may be required, as determined by the FLSC.

3.9.4 Egress for Passengers - The system shall incorporate means for passengers to evacuate a train at any point along the guideway and reach a safe area. System egress paths shall be illuminated. (See Paragraph 3.9.3.7)

3.9.4.1 For surface structures a minimum two feet six inches wide track-level walkway, shall extend along the guideway and outside each track,. The walkway clearance envelope above the walking surface shall measure 30 inches wide by 80 inches high and shall be clear of all obstructions including the handrail and the vehicle dynamic envelope. Where possible, the walkway width shall extend to the skirt of the rail vehicle, and the required 30 inch walkway width located and delineated (applicable on concrete structures) clear of the vehicle dynamic outline. A center walkway may serve both tracks.

3.9.4.2 Track-level center walkways shall have a minimum width of 36 inches. The walkway clearance envelope above the walking surface shall measure 36 inches wide by 80 inches high and shall be clear of all obstructions including the handrail, signal cases, OCS poles, and the vehicle dynamic envelope. In no case shall appurtenances (catenary poles, light standards, signal cases, etc.) reduce walkway width to less than two feet six inches. Where center walkways are provided, the actual width of the walkway should extend to the rail vehicle skirts on both tracks, where possible, and the required 36 inch walkway width located and delineated (applicable on concrete structures) clear of the dynamic outline.

3.9.4.3 Walkways designated for evacuation of passengers shall be constructed of non-combustible materials. Walkway surfaces shall have a slip-resistant design. Open grating surfaces shall not be permitted. Ballasted walkways shall be tamped to maintain a level surface and shall use walkway ballast consisting of clean, smaller sized fractured rock. The walkway ballast shall extend to the skirt of the rail vehicle.

3.9.4.4 A transition in the walkway shall be provided at the abutment of at-grade structures to elevated structures.

3.9.5 Fire Protection Systems

3.9.5.1 Fire Alarm System - Smoke detectors and other devices shall be provided in all TCCBs, TPSSs, C/S buildings, radio bungalows, incoming electrical vaults, train control and communication enclosures under platform structures. Detection shall also be provided in electrical and communications enclosures located in the station foundation under the platform.

3.9.5.2 Automatic Sprinkler System - Pre-Action automatic sprinkler systems shall be required in Train Control and Communication Bungalows (TCCB), Traction Power Substations (TPSS), Communications and Signaling (C/S) buildings where located beneath the guideway or freeway.

3.9.5.3 Standpipe and Hose System - Class I or Class III standpipe systems shall be installed in train ways in accordance with NFPA 14 where approved fire department vehicular access to the guideway is not provided. Dry type standpipes may be permitted with the approval of the Authority having Jurisdiction.

3.9.6 Storage or Tail Track Areas - Storage and tail tracks, other than in the main yard and maintenance facility, shall provide a minimum 12 feet spacing between the centerline of adjacent tracks. Trains stored on the same track shall be separated by a minimum of six feet, six inches.

3.10 ELEVATED GUIDEWAYS

3.10.1 Construction

All structures necessary for guideway support shall be of not less than Type I or Type II or combinations of Type I and Type II approved non-combustible fire-resistive construction as defined in the CBC, as amended, or as determined by an engineering analysis of potential fire exposure hazards to the structure and approved by the FLSC. Structures located under or within 20 feet of the guideway shall have non-combustible roof coverings.

3.10.2 Traction Power and Electrical Wiring and Cable - Provide compliance with the applicable requirements of Subsection 3.3.

3.10.3 Emergency Access

3.10.3.1 Access to the guideway shall be from stations or by mobile ladder equipment from roadways adjacent to trackway. If no adjacent or crossing roadways exist, access roads at maximum 2500 foot-intervals shall be provided.

3.10.3.2 If security fences are used along the trackway, gates shall be provided to permit access (See Paragraph 3.9.3.2).

3.10.3.3 Information shall be provided adjacent to each Blue Light Station that identifies the route and location of the access. The graphics shall be legible from the ground level outside the guideway.

3.10.3.4 BLS shall be installed at designated access locations (See Subsection 7.5).

3.10.4 Egress for Passengers

3.10.4.1 The transit system shall incorporate a walk surface or other suitable means for passengers to evacuate a train at any point along the guideway so that they can either proceed to the nearest station or wait for an evacuation train to arrive. Illumination for System egress paths on the walking surface shall not be less than 0.25 foot-candles, including emergency lighting during a power failure condition, measured at the walking surface. The emergency lighting should extend to a point where the track alignment transitions to grade and where there is provision to egress to a public way.

A. For elevated structures a minimum two feet six inches unobstructed walkway, shall extend along the guideway and outside each track. The walkway clearance envelope above the walking surface shall measure 30 inches wide by 80 inches high and shall be clear of all obstructions including the handrail/guardrail and the vehicle dynamic envelope. Where possible, the walkway width shall extend to the skirt of the rail vehicle, and the required 30 inch walkway width located and delineated (applicable on concrete structures) clear of the vehicle dynamic outline. If a car-floor level walkway is provided, an approved guardrail shall protect the outside of the walkway.

B. A center walkway may serve both tracks. Track-level center walkways shall have a minimum width of three feet. A walkway clearance envelope above the walking surface shall measure a minimum of 36 inches wide by 80 inches high and shall be clear of all obstructions including the handrail, signal cases, OCS poles, and the vehicle dynamic envelope. In no case shall appurtenances (catenary poles, light standards, signal cases, etc.) reduce walkway width to less than two feet six inches. Where track-level walkways are provided, the actual width of the walkway should extend to the train skirts on both tracks, and the required 36 inch walkway width located and delineated (applicable on concrete structures) clear of the dynamic outline. Walkways designated for evacuation of passengers shall be constructed of non-combustible materials. Walkway surfaces shall have a slip-resistant design. Open grating surfaces shall not be permitted. Ballasted walkways shall be tamped to maintain a level surface and shall use walkway ballast consisting of clean, smaller sized fractured rock.

3.10.5 Fire Protection System

3.10.5.1 Fire Alarm System - Smoke detectors and other devices shall be provided in all ancillary rooms including TCCRs, TPSSs, C/S rooms, incoming electrical vaults, electrical rooms, elevator/escalator machine rooms and trash rooms

3.10.5.2 Automatic Sprinkler System - Automatic sprinkler systems shall be provided in all ancillary rooms.

3.10.5.3 Standpipe and Hose System - In portions of aerial structures, deep open cut trainways and other locations where fire department access is severely restricted, provide a Class I Automatic-wet Standpipe System, as defined in NFPA 14. Where an adequate water supply is not available, a Manual-wet Standpipe System

may be installed with FLSC approval. The standpipe system shall be capable of flowing 500 gpm. The Fire Department connection shall have four *2Vz* inch inlets and a 6 inch riser. A dry type standpipe may be permitted with the approval of the Authority having Jurisdiction.

3.10.6 Pocket/Storage and Tai I Tracks

3.10.6.1 Sufficient exiting shall be provided at both ends.

3.10.6.2 Wet standpipes shall be provided in accordance with Paragraph 3.10.5.3

3.10.6.3 The track length shall be sufficient to provide a spacing of six feet six inches between trains stored on the same track.

3.10.6.4 Storage tracks shall allow a minimum clearance of 3-0" between the sides of adjacent transit vehicles.

3.10.7 Guideway Fall Protection - Fall protection shall be provided on aerial guideway structures across from station boarding platforms to protect against inadvertent opening of train doors on the wrong side of train. Fall protection shall extend a minimum of 42 inches in height above top of vehicle floor height.

3.11 TRENCH GUIDEWAY

3.11.1.1 Construction shall be of not less than Type II approved construction as defined in the CBC, as amended, or as determined by an engineering analysis of potential fire exposure hazards to the structure and approved by the FLSC. If other facilities such as train signaling equipment, communications equipment, or battery power supplies are incorporated into a traction power substation structure, occupancy separations shall be provided in accordance with the CBC. If such facilities are provided with separate structures, the structures shall comply with Paragraph 3.9.1.1.

3.11.1.2 Traction Power and Electrical Wiring and Cable - Provide compliance with the applicable requirements contained in Subsection 3.3.

3.11.1 Emergency Access

3.11.3.1 Pedestrian access gates shall be provided in security fences every 1000 feet, as a minimum, or as deemed necessary by the AH J.

3.11.3.2 The gates shall be a minimum of 44 inches wide and shall be of the hinged or sliding type.

3.11.3.3 Graphics shall be provided on, or adjacent to, each gate to identify the geographic location, track section, and traction power feeder zone. Warning signs, identifying the appropriate hazards, shall also be posted on the access to the fences and barriers.

3.11.3.4 Access to the guideway by emergency response personnel shall be through passenger stations, or directly from crossing or parallel public streets. Where conditions such as landscaping, structures, or contiguous private property ownership hinder emergency response personnel, special provisions may be necessary. Adjacent roadways or special access roads at maximum intervals of 2,500 feet shall be provided for all guideways on fenced right-of-way.

3.11.3.5 Within the right-of-way, the maintenance vehicle access areas shall be suitable for use by emergency vehicles, if more than 150 feet from a public roadway.

3.11.3.6 Crosswalks, 6 ft. wide for contact rail systems and 44 inches wide for overhead catenary systems, shall be provided at each end of special trackwork sections. (See Paragraphs 3.4.2.3 and 3.4.2.4)

3.11.3.7 Guideway lighting may be by ambient sources (street lights). In areas where ambient lighting does not maintain a minimum level of 0.25 foot-candles at the walking surface, or in areas of restricted access, supplemental lighting of 0.25 foot-candles minimum shall be required, measured at the walkway surface. Emergency lighting may be required as determined by the AHJ.

3.11.4 Egress for Passengers - The system shall incorporate means for passengers to evacuate a train at any point along the guideway and reach a safe area. A means of egress to a point of safety shall be provided every 2500 feet, or more frequent, as required by the FLSC.

3.11.4.1 The following requirements apply to LRT only. For trench structures a minimum 30 inch wide walkway shall extend along the guideway and outside each track. The walkway clearance envelope above the

walking surface shall measure 30 inches wide by 80 inches high and shall be clear of all obstructions including the handrail and the vehicle dynamic envelope. Where possible, the walkway width shall extend to the rail vehicle skirt, and the required 30 inch walkway width located and delineated (applicable on concrete structures) clear of the vehicle dynamic outline.

A. A center walkway may serve both tracks. Track-level center walkways shall have a minimum width of three feet. The walkway clearance envelope above the walking surface shall measure 36 inches wide by 80 inches high and shall be clear of all obstructions including the handrail and the vehicle dynamic envelope. In no case shall appurtenances (catenary poles, light standards, signal cases, etc.) reduce walkway width to less than two feet six inches. Where track-level center walkways are provided, the walkway width should extend to the rail vehicle skirts, where possible, and the required 36 inch walkway width located and delineated (applicable on concrete structures) clear of the dynamic outline.

B. Walkways designated for evacuation of passengers shall be constructed of non-combustible materials. Walkway surfaces shall have a slip-resistant design. Open grating surfaces shall not be permitted.

C. Ballasted walkways shall be tamped to maintain a level surface, and shall utilize walkway ballast consisting of clean, smaller sized fractured rock.

3.11.4.2 A transition in the walkway shall be provided at locations where the trench changes to a different alignment classification such as an elevated, surface, or raised embankment.

3.11.5 Fire Protection Systems

3.11.5.1 Protective Signaling System - Smoke detection shall be provided in all TCCBs, TPSSs, C/S buildings and incoming electrical vaults. Detection shall also be provided in electrical and communications enclosures located in the station foundation under the platform.

3.11.5.2 Automatic Sprinkler System - Automatic sprinkler systems may be required in TCCBs, TPSSs, C/S buildings where located beneath a structure such as a freeway or building.

3.11.5.3 Standpipe and Hose System - Class I or Class III standpipe systems shall be installed in trainways in accordance with NFPA 14 where approved fire department vehicular access to the guideway is not provided. A dry type standpipe may be permitted with the approval of the Authority having Jurisdiction.

3.11.6 Storage or Tail Track Areas - Storage and tail tracks, other than in the main yard and maintenance facility, shall provide a minimum 12 feet spacing between the centerline of adjacent tracks. Trains stored on the same track shall be separated by a minimum of six feet, six inches.

3.12 RAISED EMBANKMENT GUIDEWAYS

3.12.1 Construction

All structures necessary for guideway support shall be of not less than Type I or Type II or combinations of Type I and Type II approved non-combustible fire-resistive construction as defined in the CBC, as amended, or as determined by an engineering analysis of potential fire exposure hazards to the structure and approved by the FLSC. Structures located under or within 20 feet of the guideway shall have non-combustible roof coverings.

3.12.2 Traction Power and Electrical Wiring and Cable - Provide compliance with the applicable requirements of Subsection 3.3.

3.12.3 Emergency Access

3.12.3.1 Access to the guideway shall be from stations, staircases, or by mobile ladder equipment from roadways adjacent to trackway. If no adjacent or crossing roadways exist, access roads at maximum 2500 foot-intervals shall be provided.

3.12.3.2 If security fences are used along the trackway, lockable pedestrian gates shall be provided to permit access every 1000 feet, or more frequent s determined by the AHJ.

3.12.3.3 Information shall be provided adjacent to each Blue Light Station that identifies the route and location of the access. The graphics shall be legible from the ground level outside the guideway.

3.12.3.4 BLS shall be installed at designated vehicular access locations (See Subsection 7.5).

3.12.4 Egress for Passengers

3.12.4.1 For raised embankment alignments, a minimum two feet six inches walkway shall extend along the guideway and outside each track. The walkway clearance envelope above the walking surface shall measure 30 inches wide by 80 inches high and shall be clear of all obstructions including the handrail/guardrail and the vehicle dynamic envelope. Where possible, the walkway width shall extend to the skirt of the rail vehicle, and the required 30 inch walkway width located and delineated (applicable on concrete structures) clear of the vehicle dynamic outline. A guardrail or other approved means of protection on the outside of the walkway shall be provided when there is a potential fall hazard.

A. A center walkway may serve both tracks. Center walkways shall have a minimum width of three feet. The walkway clearance envelope above the walking surface shall measure a minimum of 36 inches wide by 80 inches high and shall be clear of all obstructions including the handrail and the vehicle dynamic envelope. In no case shall appurtenances (catenary poles, light standards, signal cases, etc.) reduce walkway width to less than two feet six inches. Where track-level center walkways are provided, the walkway width should extend to the rail vehicle skirts, where possible, and the required 36 inch walkway width located and delineated (applicable on concrete structures) clear of the dynamic outline.

B. Walkways designated for evacuation of passengers shall be constructed of non-combustible materials. Walkway surfaces shall have a slip-resistant design. Open grating surfaces shall not be permitted. Ballasted walkways shall be tamped to maintain a level surface, and shall utilize walkway ballast consisting of clean, smaller sized fractured rock. Fall protection such as fencing shall be provided on the field side of the tracks (outer sides) where a fall hazard exists.

3.12.4.2 Guideway lighting may be by ambient sources (street lights). In areas where ambient lighting does not maintain a minimum level of 0.25 foot-candles at the walkway surface, or in areas of restricted access, supplemental lighting of 0.25 foot-candles minimum, measured at the walkway surface, shall be required. Emergency lighting may be required as determined by the AHJ.

3.12.5 Fire Protection System

3.12.5.1 Fire Alarm System - Smoke detectors and other devices shall be provided in all ancillary rooms including TCCRs, TPSSs, C/S rooms, incoming electrical vaults, electrical rooms, elevator/escalator machine rooms and trash rooms

3.12.5.2 Automatic Sprinkler System - Automatic sprinkler systems shall be provided in all ancillary rooms.

3.12.5.3 Standpipe and Hose System - Class I or Class III standpipe systems shall be installed in trainways in accordance with NFPA 14 where approved fire department vehicular access to the guideway is not provided. A dry type standpipe may be permitted with the approval of the Authority having Jurisdiction.

3.12.6 Pocket/Storage and Tail Tracks

3.12.6.1 Sufficient exiting shall be provided at both ends.

3.12.6.2 Wet standpipes shall be provided in accordance with Paragraph 3.10.5.3

3.12.6.3 The track length shall be sufficient to provide a spacing of six feet six inches between trains stored on the same track.

3.12.6.4 Storage tracks shall allow a minimum clearance of 3'-0" between the sides of adjacent transit vehicles.

TABLE 3-1

FLAMMABILITY AND SMOKE DENSITY OF TUNNEL INTERIOR FINISHES

LOCATION	FLAME SPREAD	SMOKE DENSITY	TEMPERATURE
Tunnels	Is 25	Ds (4.0) 300	932°
Ancillary Areas	IS 25	DS (4.0) 450	

END OF SECTION

4.0 PASSENGER VEHICLE

4.1 GENERAL

4.1.1 New passenger-carrying fixed guideway transit vehicles shall be, as a minimum, designed and constructed to conform with the requirements set forth in this Section, consistent with paragraph 1.4.3.

4.1.2 If existing transit vehicles are retrofitted for any purpose, the appropriate sections of this Section shall apply only to the extent of such retrofit, consistent with paragraph 1.4.3.

4.2 CONSTRUCTION: MATERIALS AND FIRE BARRIERS

The intent of this subsection is to provide minimum requirements for those instances where noncombustible materials are not used due to other considerations in the design and construction of the vehicle.

4.2.1 Testing - It is recognized that the tests cited in this Section may not accurately predict the behavior of material under hostile fire conditions. Therefore, the use of tests that evaluate material in subassemblies and full-scale configurations is encouraged where such tests are more representative of the fire source heat flux levels and surface area to volume ratios.

4.2.2 Combustible Content - Total combustible content of each light rail transit vehicle should not exceed a heating value of 800,000 BTU (British thermal units) per foot of vehicle length, of which no more than 55 percent of the total combustible value, or 45,000 BTU per sq. ft. of gross floor area, whichever is less, shall be permitted above the floor assembly. Each combustible material shall be specifically identified by supplier's name and type, shape and use in the vehicle, and total weight and heating value. The heating values from this list shall be totaled for vehicle interior surface materials (including ducting, etc.), for other interior materials, for exterior materials not underfloor, and for all underfloor materials.

Total combustible content of each heavy rail transit vehicle should not exceed 60 million BTU, of which no more than 55 percent of the total combustible value, or 33 million BTU, whichever is less, shall be permitted above the floor assembly.

4.2.3 Interior Fire Propagation Resistance - Materials and finishes installed in the vehicle shall have sufficient resistance to fire propagation in the interior of the vehicle by an internal fire for a period consistent with the safe evacuation of a full load of passengers from the vehicle. The aforementioned materials and finishes shall be evaluated under a fire risk assessment for transit vehicles including material characteristics other than fire propagation resistance such as smoke emission, ease of ignition, rate of heat and smoke release. Two methods for assessing the fire risk for materials and finishes used in a vehicle interior are to do a hazard load analysis or use appropriate materials properties. The aforementioned materials and finishes include interior walls, floor coverings, ceiling, seats, glazing, transparencies, partitions, elastomer, and non-electrical insulation. Materials used shall be tested to demonstrate compliance with the requirements set forth in Paragraph 4.9.

4.2.4 See Appendix D of NFPA 130 for non-mandatory guidelines for performing a vehicle interior hazard load analysis. Test procedures and minimum performance requirements for interior materials shall be as follows: (See Table 1 for test procedures)

4.2.4.1 Upholstery and other fabric materials shall be tested by FAR Regulations 25.853 vertical test, Appendix F, with the following modifications:

A. The average flame time after removal of the flame source may not exceed 10 seconds.

B. Burn length shall not exceed 6 inches.

C. Flaming dripping shall not be allowed.

D. Fabrics that must be machine washed or dry cleaned must meet the requirements of parts A, B, and C above, after washing, according to Federal Test Method 191 A, Method 5830, or after dry cleaning according to ASTM D2724. Fabrics that cannot be machine washed or dry cleaned must be so labeled and must pass parts A, B, and C after being cleaned as recommended by the manufacturer.

4.2.4.2 Seat cushions shall be capable of passing the ASTM D-3675 with a flame-propagation index (Is) not exceeding 25. Additional provisions are as follows:

A. There shall be no flaming running or flaming dripping of the material during the test.

B. Testing is performed without upholstery.

4.2.4.3 The composite of seat cushions and seat upholstery coverings shall be capable of passing the procedures required in Paragraph 4.2.4.2, with an Is not exceeding 35.

4.2.4.4 Thermal and acoustical insulation, tested in its end-use configuration shall be capable of passing ASTM E 162 with an Is of not more than 25, with the additional provisions in Paragraph 4.2.4.2.

4.2.4.5 Seat frames and seat shrouds, tested in end-use configuration, shall be capable of passing ASTM E162 with an Is of not more the 35, with the additional provisions of Paragraph 4.2.4.2.

4.2.4.6 Wall and ceiling panels, windscreens, partitions, and ducting (including all materials in air-handling enclosures) shall be capable of passing the ASTM E 162 with an Is not exceeding 35, with the added provision that there shall be no flaming running or flaming dripping.

4.2.4.7 Transparencies such as windows and light diffusers shall be capable of passing ASTM E 162 with an Is not exceeding 100. Testing shall be on the car interior side and when these transparencies are located at the end of vehicles, the exterior side shall be tested as well.

4.2.4.8 The floor-covering material placed over the structural floor shall be capable of passing ASTM E648 with a minimum critical radiant flux of 0.50 watts/cm^2. The flooring material shall be tested together with an underlay that may be used. The flooring shall pass this test after being cleaned; the number of such cleanings shall be specified. Additionally, floor covering shall also pass ASTM E162 with an Is of not more than 25.

4.2.4.9 Elastomers, used as door nosing and seals, and window gasketing shall be capable of passing ASTM C 542.

4.2.5 Smoke Emission of Vehicle Interior Materials - All material listed in Paragraph 4.2.4 shall be tested for smoke emission in accordance with the ASTM E 662, "Smoke Generated by Solid Materials." The optical density, Ds, in both flaming and non-flaming modes, determined in accordance with the test, shall not exceed 100 in 1.5 minutes and 200 in 4 minutes, except floor covering, upholstery, HVAC ducting, and thermal and acoustical insulation. The optical density for upholstery shall not exceed 200 (coated) in 4 minutes. The optical density for HVAC ducting and insulation shall not exceed 100 in 4 minutes.

4.2.6 Fire Characteristics of Exterior Vehicle Materials

4.2.6.1 Vehicle design shall arrange equipment external to the passenger compartment, whenever practical, to isolate potential ignition sources from combustible material and to control fire and smoke propagation. Where it is necessary to install apparatus in passenger vehicles, suitable shields or enclosures shall be provided to isolate the equipment from the passenger compartment.

4.2.6.2 Battery cases should be spaced well away from compressed air sources and combustible materials at the vehicle trucks, and away from under-vehicle sources of high temperatures such as resistor banks and compressors.

4.2.6.3 Exterior surfaces of vehicle end caps and component boxes shall be capable of passing ASTM E 162 Radiant Panel Test with an Is not exceeding 35.

4.2.6.4 Vehicle end caps and floor shall be designed to preclude propagation of underfloor fire to vehicle interior.

4.2.6.5 Vehicle end caps shall be completely separated from the vehicle interior by vehicle exterior panels, or the void space fully filled with thermal insulation meeting Paragraph 4.2.4.4 requirements. Additionally, the interior surface of the end caps shall meet the liner material requirements of Paragraph 4.2.4.4.

4.2.6.6 Materials used for underfloor ducting and plenums serving the car interior shall be noncombustible.

4.2.7 Toxicity - Those materials and products generally recognized to have high toxic products of combustion shall not be used.

4.2.8 Structural Fire Resistivity

4.2.8.1 The vehicle floor assembly shall be capable of passing the ASTM E-119 fire endurance test for its classification. The test time period selected shall be equal to that time necessary for safe evacuation of a maximum load of passengers from the vehicle in the worst case situation, but not less than one hour. The following criteria shall be met:

A. Resist temperature rise of 250°F average and 325°F single point temperature rise on the unexposed surface of the specimen.

B. Resist flaming ignition of cotton waste on the unexposed surface of the specimen.

C. This floor shall be tested with a loading equivalent to a crush passenger load.

4.2.8.2 The test specimen shall be a full-width vehicle section, including a portion of the vehicle walls which extend below the upper surface to the vehicle floor. Minimum size of the exposed portion of the floor assembly shall be 10 feet long by the normal vehicle floor width. No fewer than one representative floor joint and two typical floor penetrations shall be included in the test specimen, which should be spaced from each other at a distance no greater than will exist in the actual construction.

4.2.8.3 Specimen under test shall be placed within the combustion chamber with a clearance not less than 8 inches from the furnace wall.

4.2.8.4 Conditions of acceptance for this test shall be those required for unrestrained assembly.

4.2.8.5 Where vehicles are powered by overhead supply (trolley wire, catenary, etc.), roof design consideration shall be given to prevention of arc penetration and susceptibility of ignition in materials in the roof assembly.

4.2.8.6 All floor, wall, and roof openings and penetrations shall be adequately sealed/protected in order to maintain the fire and smoke integrity of the structure, in addition to mechanical considerations (e.g., waterproofing).

4.3 ELECTRICAL REQUIREMENTS

4.3.1 General Construction - All motors, motor control, current collectors, and auxiliaries shall be of a type and construction suitable for use on fixed guideway transit vehicles.

4.3.2 Gap and Creepage

4.3.2.1 Electrical circuits and associated cabling shall be designed with gap and creepage distance between voltage potentials and car body ground in accordance with the environmental conditions to which the circuits and cabling will be subjected.

4.3.2.2 The air gap distances between voltage potentials (up to 2,000 volts) and ground in enclosed, clean, dry environments shall comply with the requirements specified in the following documents:

NFPA 130 - For voltages above 300 V ac or dc

UL 508 - For voltages up to and including 300 V ac or dc

In selecting air-gap distances, special consideration shall be given to the presence of contaminants encroaching upon the normal free air environment.

4.3.2.3 Creepage distance for voltage potentials (up to 2,000 volts) to ground shall comply with the requirements specified in the following documents:

NFPA 130 - For voltages above 300 V ac or dc.

UL 508 - For voltages up to and including 300 V ac or dc

4.3.2.4 In other than ordinary enclosed environments, creepage distances shall be modified according to the anticipated severity of the environment. Appropriate creepage distances may be selected from Appendix E of NFPA 130.

4.3.3 Propulsion Motors

4.3.3.1 Rotary motors shall be rated and tested per IEEE 11, Standard for Rotating Electric Machinery for Rail and Road Vehicles.

4.3.3.2 Motor leads shall have an insulation suitable for the operating environment and shall be so supported and protected as to offer the least possible chance of mechanical damage. Motor leads where entering the frame shall be securely clamped and shall fit snugly so as to prevent moisture from entering the motor case. Drip loops shall be formed in motor leads so as to minimize water running along the lead onto the motor case. The current value used in determining the minimum size of motor leads shall be not less than 50 percent of the maximum load current seen under the most severe normal duty or as determined by root-mean-square (RMS) calculation, whichever is greater.

4.3.3.3 Other car-borne propulsion configurations shall be designed and constructed to provide a similar level of rating and testing as that for rotary motors.

4.3.4 Motor Control

4.3.4.1 Motor control shall be rated and tested per IEEE 11, Standard for Electrical Control Apparatus for Land Transportation Vehicles.

4.3.4.2 Control equipment enclosures shall be arranged and installed to provide protection against moisture and mechanical damage.

4.3.4.3 Metal enclosures that surround arcing devices shall be lined with insulating material approved by the authority having jurisdiction, with the exception that lining will not be required when the arc chutes extend through the enclosure and vent the arc to the outside air. Adequate shields or separations shall be provided to prevent arcing to adjacent apparatus and wiring.

4.3.5 Power Resistors

4.3.5.1 Self-ventilated propulsion and braking resistors shall be mounted with air space between resistor elements and combustible materials. Heat-resistant barriers of at least 1/4 inch noncombustible insulating material, or sheet metal not less than 0.04 inch thickness, shall extend beyond resistor supports, horizontally, to ensure protection from overheated resistors. Forced ventilated resistors shall be mounted in ducts, enclosures, or compartments of noncombustible material and shall be mounted with air space between the resistor enclosure and combustible materials. Provisions shall be made to filter the air where the operating environment is severe.

4.3.5.2 Power resistors and heating circuits should incorporate protective devices for the following failures:

A. Ventilation air flow, if appropriate

B. Temperature controls, if appropriate

C. Short circuit in supply wiring.

4.3.5.3 Resistor elements shall be electrically insulated from the resistor frames, and frames shall be electrically insulated from supports. The insulation shall be removed from resistor loads a minimum of 3 inches back from their terminals except where such removal introduces potential grounding conditions. When forced ventilation is provided, the resistor leads shall be separated, secured, and cleated for protection in the event of loss of air circulation of the ventilation system. Leads shall be routed or otherwise protected from resistor heat.

4.3.5.4 The current value used in determining the minimum size of resistor leads shall not be less than 110 percent of the load current seen by the lead under the most severe normal duty cycle or as determined by RMS calculations.

4.3.6 Current Collection

4.3.6.1 Clearance or shielding shall be provided between any part of the current collector assembly that is at line voltage and any other portion that is at ground potential. The shielding material shall be noncombustible.

4.3.6.2 The minimum size of current collector leads shall be determined by adding the maximum expected auxiliary loads to the propulsion motor loads. For a propulsion system equipped with regenerative capability, the equivalent regenerative load must be included in the expected motor load. For vehicles that have more than one current collector, all current-carrying components shall be sized for continuous operation in the event power collection to the vehicle is restricted to a single collector.

4.3.7 Wiring

4.3.7.1 In no case shall wire smaller than the sizes listed below be used:

A. No. 14 AWG; for wire that is pulled through conduits or wireways or installed exposed between enclosures.

B. No. 22 AWG; for wire used on electronic units, cards, and card racks.

C. No. 18 AWG; for all other wire including wire laid in (rather than pulled through) wireways.

4.3.7.2 Conductor sizes shall be selected on the basis of current-carrying capacity, mechanical strength, temperature and flexibility requirements, and maximum allowable voltage drops. They shall be no smaller than minimum sizes in Paragraph 4.3.7.1.

4.3.7.3 Conductors shall be de-rated for grouping and for ambient temperature greater than manufacturer's design value, in accordance with criteria specified by the authority having jurisdiction.

4.3.7.4 Electrical insulation for control wiring and power cable shall be capable of passing the following tests:

A. Wires for lighting auxiliary circuits and for control, signal, and other low-voltage (less than 100 V ac and 150 V dc) functions shall meet the requirements of ICEA S-19-81/NEMA WC3 (with Amendment FR-1) paragraph 6.19.6, or of Underwriters Laboratories Standard 44 for thermosetting insulation and UL Standard 83 for thermoplastic insulation.

B. Power cable shall meet the requirements of IEEE Standard 383, Section 2.5, with the additional requirement that circuit integrity continues for 5 minutes after the start of the test.

C. All other electrical insulation shall meet suitable tests for the proposed use.

4.3.7.5 Conductors of all sizes shall be provided with mechanical and environmental protection and shall be installed, with the exception of low voltage dc circuits, in any one or combination of the following ways:

A. In raceways: metallic and nonmetallic, rigid or flexible.

B. In enclosure boxes, cabinets for apparatus housing.

C. Exposed: cleated, tied, or secured by other means.

4.3.7.6 Sufficient firestops shall be provided in raceways to control the spread of fire. Wires connected to different sources of energy shall not be cabled together or 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 come in contact with wires connected to a higher voltage source of energy than control voltage.

4.3.7.7 Conduits, electrical metallic tubing, non-metallic ducts or tubing and all wires with their outer casings shall be extended into devices and cases where practical. They shall be rigidly secured in place by means of cleats, straps, or bushings to prevent vibration or movement and to give 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 except as specifically approved by Metro. Connections and terminations shall be made in a manner to assure their tightness and integrity.

4.3.7.8 Conductors and enclosures of any kind shall be protected from the environment and from mechanical damage including damage from larger conductors.

4.3.8 Overload Protection

4.3.8.1 A main automatic circuit line breaker or line switch and overload relay for the protection of the power circuits shall be provided. If a circuit breaker arc chute is utilized, it shall be vented directly to the outside air.

4.3.8.2 If cartridge-type fuses are used in addition to the automatic circuit breaker, they shall be installed in approved boxes or cabinets. If railway-type ribbon fuses are used, they shall be in boxes designed especially for this purpose and shall be equipped with arc blowout aids. Third rail shoe fuses mounted on the shoe beams shall be mounted so as to direct the arc away from grounded parts.

4.3.8.3 Circuits used for purposes other than propelling the vehicle shall be connected to the main cable at a point between the current collector and the protective device for the traction motors. Each circuit or group of

circuits shall be provided with at least one circuit breaker or a fused switch or fuse located as near as practicable to the point of connection of the auxiliary circuit, except that such protection may be omitted in circuits controlling safety devices.

4.3.9 Battery Installation - The design of battery installation and circuitry shall include the following:

4.3.9.1 Minimal use of organic materials, particularly those having hygroscopic properties.

4.3.9.2 Fire-retardant treatment for necessary organic materials used.

4.3.9.3 Battery chargers designed for protection against overcharging.

4.3.9.4 Use of smoke and heat detectors, if appropriate.

4.3.9.5 Use of an emergency battery cut-off switch, if appropriate.

4.3.9.6 Isolation of battery compartment from car interior using materials identified as non-combustible, as defined in Subsection 1.5, Definitions.

4.4 VENTILATION AND HEATING SYSTEMS

4.4.1 Control of Ventilation Equipment - Vehicles shall have provision to deactivate all ventilation systems.

4.4.2 Heater Protection

4.4.2.1 Heater forced air distribution ducts and plenums shall incorporate over-temperature sensors, fusible links, or means of detecting insufficient air flow.

4.4.2.2 Heater elements shall incorporate protective devices for the following failures:

A. Ventilation air flow, if appropriate

B. Temperature controls, if appropriate

C. Short circuits in supply wiring.

4.5 EMERGENCY EGRESS FACILITIES

4.5.1 Emergency Exits

4.5.1.1 Each vehicle shall be provided with emergency exit facilities on the sides or in the end(s). Alternate emergency exit facilities (e.g. windows or panels), as necessary for the type of vehicle, may be as approved by the authority having jurisdiction.

4.5.1.2 A means to allow passengers to evacuate the vehicle safely to a walk surface or other suitable area in case of an emergency shall be provided.

4.5.2 Emergency Lighting and Power Supply - Emergency lighting facilities shall be provided. The level of illumination of means of egress and power sources shall conform with CBC, NFPA 101, Life Safety Code and NFPA 110A, Stored Electrical Energy and Standby Power Systems, whichever is more restrictive.

Exception (1): Emergency lighting facilities shall be arranged to maintain an illumination of one footcandle in the event of failure of the normal lighting.

Exception (2): The power for the emergency lighting system shall be automatically obtained from the storage batteries for a period of time to permit evacuation but in no case for less than one (1) hour.

4.6 FIRE PROTECTION

Fire Extinguisher - Each vehicle shall be provided with at least two UL approved portable fire extinguishers of the 10-pound class, rated at 4-A.30-BC. The extinguishers shall be located for use by patrons or the operator, as necessary.

4.7 COMMUNICATIONS

4.7.1 Manually Operated Vehicles

4.7.1.1 Each vehicle shall be equipped with a public address system by which train operators and the ROC can communicate emergency information to passengers. Audibility level shall be a minimum of 10 db over any

background noise.

4.7.1.2 Direct radio voice communication shall be provided between the train operator and ROC.

4.7.1.3 Devices shall be provided in each car by which passengers may alert and communicate with the train operator in emergencies.

4.7.2 Automated Vehicles (Driverless Mode) - (Not required. For future use.)

4.7.3 Power for Communication Systems - The above communication systems shall be powered by the onboard emergency power supply referenced in Paragraph 4.5.2.

4.8 TESTING AND MAINTENANCE

4.8.1 Testing - Qualification testing shall be performed by the equipment manufacturer in accordance with IEEE 16, American Standard for Electric Control Apparatus for Land Transportation Vehicles, and IEEE 11-80, Standard for Rotating Electric Machinery for Rail and Road Vehicles, and any additional tests specified by the Metro.

4.8.2 Maintenance - Maintenance manuals furnished by the equipment manufacturer shall contain recommendations for periodic maintenance. The degree and frequency of maintenance shall be based on operating experience as determined by Metro. (See Paragraph 5.5.2 for electrical maintenance requirements.)

4.9 VEHICLE SUPPORT AND GUIDANCE SYSTEM

The vehicle support and guidance system (wheels, tires, magnetic or pneumatic levitation) shall be capable of safely supporting and guiding the vehicle in normal service. Failure of support and guidance systems shall not result in a condition that is unsafe to passengers. Under loss of the guideway clearance the system shall be capable of safe operation until such time that the failure is detected by operations and/or maintenance personnel and the vehicle is taken out of service.

FUNCTION OF MATERIAL	TEST PROCEDURE	PERFORMANCE CRITERIA
Seat cushion	ASTM D3675	Is 25
Seat cushion	ASTM E662	Ds(4.0) 100
Seat frame	ASTM E162	Is 35
Seat frame	ASTM 662	Ds(1.5) 100 Ds(4.0) 200
Seat shroud	ASTM E162	Is 35
Seat shroud	ASTM E662	Ds(1.5) 100 Ds(4.0) 200
Upholstery	FAR 25.853	Flame Time 10 sec.
	(Vertical)	Burn Length 6 inch.
	Appendix F	
Upholstery	ASTM E662	Ds(4.0) 200 coated Ds(1.5) 100 uncoated
Wall panel	ASTM E162	Is 35
Wall panel	ASTM E662	Ds(1.5) 100 Ds(4.0) 200
Ceiling panel	ASTM E162	Is 35
Ceiling panel	ASTM E662	Ds(1.5) 100 Ds(4.0) 200
Partition panel	ASTM E162	Is 35
Partition panel	ASTM E662	Ds(1.5) 100 Ds(4.0) 200
Windscreen panel	ASTM E162	Is 35
Windscreen panel	ASTM E662	Ds(1.5) 100 Ds(4.0) 200
HVAC ducting	ASTM E162	Is 35
HVAC ducting	ASTM E662	Ds(4.0) 100
Windows	ASTM E162	Is 100

FUNCTION OF MATERIAL	TEST PROCEDURE	PERFORMANCE CRITERIA
Windows	ASTM E662	Ds(1.5) 100 Ds(4.0) 200
Light diffuser	ASTM E162	Is 100
Light diffuser	ASTM E662	Ds(1.5) 100 Ds(4.0) 200
Flooring (structural)	ASTM E119	1 Hour
Flooring (covering)	ASTM E648	Minimum 0.5w/cm2
Thermal insulation	ASTM E162	Is 25
Thermal insulation	ASTM E662	Ds(4.0) 100
Acoustic insulation	ASTM E162	Is 25
Acoustic insulation	ASTM E662	Ds(4.0) 100
Elastomers	ASTM C542	Pass
Exterior shell	ASTM E162	Is 35
Exterior shell	ASTM E662	Ds(1.5) 100 Ds(4.0) 200
Component box covers	ASTM E162	Is 35
Component box covers	ASTM E662	Ds(1.5) 100 Ds(4.0) 200

END OF SECTION

5.0 VEHICLE YARD AND MAINTENANCE FACILITIES

5.1 GENERAL

5.1.1 Vehicle yard and maintenance facilities occupancies shall include any or all of the following: the vehicle maintenance facility, vehicle storage yards, yard train control and communication facilities, yard control tower, maintenance of way facility, component repair facility, operations personnel facility, gap tie station, traction power substations, blowdown facility, paint shop, vehicle car wash facility, test track, test building, and occupancies ancillary to these facilities.

5.1.2 The vehicle yard and maintenance facility occupants are employees or contractors whose work assignment requires their presence in these facilities.

5.1.3 For the purpose of interpretation, the vehicle yard and maintenance facilities shall be classified by the following occupancies in accordance with CBC :

A. Vehicle maintenance - Group B, Division 4

B. Maintenance of way - Group B, Division 2

C. Yard control tower - Group B, Division 2

D. Operations personnel facility - Group B, Division 2.

E. Blowdown facility - Group B, Division 2

F. Car wash facility - Group B, Division 4

G. Electrical Substation - Group B, Division 4

H. Paint Shop - Group H, Division 2

I. Body Shop - Group H, Division 4

J. Satellite Yard Building - Group B, Division 2

K. Train Control Communications Buildings - Group B, Division 2

5.1.4 Facilities, such as the blowdown facility, car wash facility, and test building shall be given appropriate classification when contained in a separate structure. Where these facilities are integrated with major facilities, classified above, the classification will usually be that of the major facility. (See CBC Section 503)

5.1.5 It is anticipated that several of the separate maintenance functions may be located in a single structure. For the purpose of interpretation, the largest area (vehicle maintenance facility) shall determine the requirements for the integrated buildings, except that occupancies separated in the manner set forth in the CBC may be individually classified within a single structure.

5.2 YARD FACILITIES

5.2.1 Fire Protection Water Supply and Distribution - An adequate, reliable water supply from two separate sources (two mains) shall be available for fire protection including a sufficient number of properly located hydrants, approved by the FLSC and in accordance with other appropriate local fire ordinances.

5.2.2 Emergency Access/Egress

5.2.2.1 Emergency access approved by the FLSC shall be provided to system structures, guideway facilities, yards, and outside storage areas in accordance with appropriate local ordinances.

5.2.2.2 Access to any structure shall be from public streets or transit access roads.

5.2.2.3 Access to the inside perimeter of the vehicle yard and maintenance facility area, including yards, shall be by transit access roads.

5.2.2.4 Transit access roads shall be a minimum all-weather paved width of 20 feet with a widened minimum of

28 feet at turnouts for emergency vehicles or where pumping aerial apparatus is expected to operate.

5.2.2.5 Minimum vertical clearance shall be 14' in height. Dead ends shall be no greater than 200' with cul-de-sac or "T" turnaround provisions. Transit access road pavement design shall provide for an all-weather hard surface roadway.

5.2.2.6 Yard tracks shall allow a minimum clearance of 3'-0" between the sides of adjacent transit vehicles. In storage areas, a minimum unobstructed access of 6' shall be provided on one side of the vehicle. Prime consideration shall be given to providing a clear exit path to evacuate personnel in an emergency.

5.2.3 Fire Extinguisher - Portable fire extinguisher of 10 pound capacity, UL approved and rated 4-A:30-B:C (dry chemical), shall be provided, suitably housed and spaced in accordance with LAFD and LACoFD standards or other local ordinances. Fire extinguisher shall be provided at each emergency phone location.

5.2.4 Alarm and Communication Systems

5.2.4.1 Blue Light Stations (BLS) as described in Subsection 7.5 shall be provided as follows:

A. Outside each wall where vehicles enter and leave building vehicle maintenance areas.

B. At ends of storage tracks arrays

C. At trackways near normal and emergency entrances to the yard including test track areas

D. Throughout the maintenance yard and train storage areas, at intervals that limit the travel distance to a BLS to 500 ft. maximum.

5.2.4.2 Disconnect switches - Disconnect switches for de-energization of OCS sections within the Shops shall also
ground the associated OCS section.

5.2.5 Oil Filled Transformers - Oil Filled Transformers shall conform to the following requirements:

5.2.5.1 Separation distances between oil-filled transformers and other structures shall be as shown in Table 5-1.

5.2.5.2 Drainage for oil-filled transformers shall be provided under the transformers by means of a gravel-filled enclosure that includes a trench drain of sufficient capacity to hold 100% of the oil contents of the largest transformer. As an alternative, the transformers shall be located on a concrete slab, sloped away from the transformers and adjacent structures and toward a collection area. The collection area shall have sufficient capacity to hold 100% of the oil contents of the largest transformer.

5.2.5.3 The use of less flammable transformer fluids may reduce or eliminate exposure protection requirements. Less flammable transformer fluids shall be UL listed or FM approved and shall have a fire point of at least 572°F (300°C) and the convective and radiative heat release rates shall be known.

5.3 STRUCTURES

5.3.1 Structural Facilities - Structures shall conform to the CBC. Full automatic sprinkler protection shall be provided, where required. (See Section 2.6.2 for exception.)

5.3.1.1 A yard control facility for yard operations, if utilized, shall be constructed and separated in accordance with the ROC facility requirements of Subsection 8.2.

5.3.1.2 Fire separations shall be provided and maintained to separate occupancies as required by the CBC.

5.3.1.3 Emergency exiting for maintenance facilities shall be as required by the CBC.

5.3.1.4 Emergency Lighting - Emergency lighting shall be provided for all means of egress and exits within the maintenance facilities and, in accordance with the CBC.

5.3.2 Drainage Systems - Where there is a potential for fire and/or explosion, drainage systems shall use noncombustible piping. Where piping is not enclosed, as direct a routing as possible to a safe outside location shall be provided.

5.3.2.1 Oil separators, grease and sand traps shall be installed on all floor drainage systems which service

maintenance and vehicle storage areas to provide for the extraction of oil, grease, sand and other substances that are harmful or hazardous to the structure or public drainage systems. Where areas are protected by sprinkler systems, a bypass shall be provided around the separator and grease traps. Separators and grease traps shall be of approved design and of sufficient capacity to meet the level of waste discharged from the areas. The separator storage capacity shall be of sufficient size to retain all the sludge between cleanings.

5.3.2.2 Periodic maintenance checks and flushing shall be conducted on all drains, oil separators and grease traps to assure that they are clear of obstructions and perform their designed function. Any flammable liquids and greases shall be removed to an area approved for disposal.

5.3.3 Floors - The surface of the grade floor of storage or maintenance areas shall be of noncombustible slip-resistant material.

5.3.4 Roofs - Roof deck coverings shall be tested in accordance with CBC, NFPA 256, Class A or B, and local codes, and shall be UL listed.

5.3.5 Electrical Requirements

5.3.5.1 The installation of electric wiring for structure light and power and the installation of all electrical devices not supplying traction power shall be in accordance with NEC; the ANSI C2; and applicable local codes.

5.3.5.2 Traction power equipment shall meet the following requirements:

A. Overhead Conductors - Nonconducting and non-combustible material shall be used as a runway on which to mount overhead feed trolley wires. Overhead trolley power installations shall have a minimum height of 10 ft for isolation of the power lines from shop and storage activity (except from vehicle roof top activity) unless an enclosed feed rail system is used with portable cord connectors that have insulated plugs and similar safety features.

B. Power Rail Conductors - Power Rails (DC or AC power supply to the vehicle for propulsion and other loads) shall be secured to suitable insulating supports, properly bonded at joints, and properly guarded to prevent contact with personnel.

C. Emergency Power Shutoff - All traction power circuits shall have emergency power shutoff devices or means in accessible locations.

5.3.6 Maintenance Pit Areas

5.3.6.1 Where flammable/combustible liquids and/or hazardous materials are used in pit areas and associated below floor level areas, such areas shall be designed to meet required code provisions (NEC, and Paragraphs 5.3.8.1 and 5.3.8.2).

5.3.6.2 Walls, floors, and piers shall be of masonry or concrete.

5.3.6.3 Pits shall have at least 2 exits. Steps shall be noncombustible and constructed with no free space underneath.

5.3.6.4 Emergency lighting shall be provided in all pit areas to provide adequate means of egress at lighting levels consistent with those typically required by other sections of metro design criteria and CBC.

5.3.7 Overhead Cranes - Overhead cranes installed in the maintenance area shall adhere to the standard for cranes, and monorails as required by NEC, Article 610.

5.3.8 Ventilation

5.3.8.1 In all pit areas where undercar maintenance may generate vapors of a combustible nature (e.g., blowdowns of transit vehicles) a positive mechanical exhaust ventilation system shall be provided capable of ten air changes per hour or 1 cfm/ft2 of pit floor area, whichever is greater, during normal operation and designed to discharge to the outside atmosphere.

5.3.8.2 When a mechanical ventilating system is employed in shop maintenance areas, the ventilating system shall be designed and installed in accordance with NFPA 90A. When blower and exhaust systems are

installed for vapor removal, the systems shall be designed and installed in accordance with NFPA 91. (See also CBC)

5.3.8.3 Areas where batteries are charged shall be well ventilated to the outside to ensure that the maximum hydrogen/air mixture that may be generated during charging is held below the lower explosive limits. In addition, where mechanical ventilation systems are required, they shall be installed in accordance with NFPA 91, Blowers and Exhaust Systems. The battery exhaust ventilation system shall be provided with electrical power and air-flow interlocks that will prevent operation of the battery charger if the ventilation fan motor is not energized or the air velocity in the exhaust duct is less than the designed velocity. The entire electrical system shall be in accordance with NEC.

5.3.8.4 Large building open areas will require a means for smoke and heat venting.

5.3.8.5 Permanent draft stops in sprinklered buildings shall be installed in structures having a height of over 25 feet to top of roof trusses. Draft stops shall be constructed of rigidly supported noncombustible material. (See NFPA 204, CBC, and local codes)

5.3.8.6 Emergency ventilation of Enclosed Yard areas - As a minimum, an engineering analysis shall be conducted to determine mechanical emergency ventilation requirements for covered areas between 200 feet and 1000 feet in length. Covered areas in excess of 1000 feet in length shall require mechanical emergency ventilation.

5.4 FIRE PROTECTION SYSTEMS

5.4.1 Sprinkler Systems - Sprinkler systems shall be installed in all areas of enclosed structures in accordance with NFPA 13 and local codes.

5.4.1.1 Electronic maintenance and control areas shall have an automatic sprinkler system or other approved special extinguishing system in accordance with NFPA and other applicable standards such as Factory Mutual, dealing with fire/life safety, which are referred to the FLSC for adjudication.

5.4.1.2 Sprinkler systems for storage areas where racks, shelves or other storage devices are used shall comply with NFPA 231, NFPA 231C and local codes, as appropriate.

5.4.1.3 Hydrants shall be provided in all yard storage areas in readily accessible locations at maximum intervals of 300 feet.

5.4.2 Protective Signaling Systems

5.4.2.1 Automatic Fire Detection Systems conforming to NFPA 72 shall be installed in traction power rooms and train control rooms in each facility structure except where normally charged automatic sprinklers are installed or where required for control of ventilation equipment.

5.4.2.2 Water flow alarm and section control valve supervision shall be provided for automatic sprinkler systems. Fire pumps shall be supervised in accordance with NFPA 20.

5.4.2.3 The fire alarm system shall provide means to supervise and trip special extinguishing systems and to control ventilation equipment per the appropriate NFPA standards and local codes.

5.4.2.4 A fire alarm control panel shall be provided in each principal building or building group and include a fire management panel provided near the point of emergency access to each principal building or building group consisting of an annunciator panel from the associated fire alarm control panel.

5.4.2.5 The fire alarm system shall be electrically supervised and operated on low voltage with local source standby power (Reference: NFPA 72). The fire alarm system shall alarm at each separated principal facility of alarm origin and at a central supervising station.

5.4.2.6 A fire alarm system, zoned by building, shall be used for fire alarm annunciation in principal maintenance facilities buildings. Small separated buildings may be included in the zone of a nearby principal building. Emergency messages shall be preceded by an audible tone. Audible fire alarms shall also be provided to alert personnel throughout the yard and outside storage areas. The PA system shall comply with NFPA 72.

5.4.2.7 Manual pull stations shall be provided per NFPA 72, throughout the maintenance facilities. Manual pull stations shall be located to limit travel distance to an instrument to 200' maximum..

5.4.3 Standpipe Systems

5.4.3.1 A Class III wet standpipe system complying with the requirements of NFPA 14 and CBC Chapter 38 shall be installed throughout the vehicle maintenance facility, including mezzanine and upper floor areas.

5.4.3.2 The spacing of standpipes in the large open areas of the vehicle maintenance facility will require special design consideration to obtain hose stream access around, under and within vehicles.

5.4.3.3 Fire extinguishers shall be provided at entrances to pit areas. In no case shall the distance to an extinguisher in the same pit be greater than 75 feet.

5.4.4 Fire Extinguishers

5.4.4.1 Portable fire extinguishers of the type and size specified shall be installed throughout all maintenance facilities buildings:

A. Multipurpose dry chemical -10 pound capacity, UL approved and rated 4-A:30-B:C

B. Carbon Dioxide (C02) -10 pound capacity, UL approved and rated 10-B:C

5.4.4.2 Suitable UL approved portable fire extinguishers shall be installed in areas protected by special extinguishing systems.

5.5 OPERATIONS AND MAINTENANCE

5.5.1 Vehicle Placement - Transit vehicles shall be so placed to allow a minimum clearance of 3 feet 0 inches between the sides of adjacent transit vehicles and 2 feet 6 inches between the ends of two uncoupled cars. A clear exit path to evacuate personnel from the structure in an emergency shall be maintained in accordance with CBC. In storage areas, a minimum of 6 foot clear access shall be maintained on one side of the vehicle.

5.5.2 Vehicle Maintenance

5.5.2.1 Vehicle electrical systems, including battery circuits, shall be de-energized except in those cases where an energized circuit is necessary to accomplish the required maintenance.

5.5.2.2 Transit vehicle batteries shall be disconnected or removed during maintenance operations which require the de-energizing of all electrical circuits.

A. Exception: Batteries need not be disconnected or removed when the vehicle is equipped with a battery cutout switch which fully isolates the battery and is physically located immediately adjacent to the battery.

B. When moving batteries, including removal and replacement, precautions shall be taken to prevent short circuits which may result in fires or explosions.

C. Batteries shall be charged at a rate (amperage and length of charge) that will not produce a dangerous concentration of hydrogen or excessive heat. In addition, the following safety practices shall be followed:

1. Access to battery rooms shall be limited to authorized personnel only.

2. Smoking shall be prohibited and open flames, sparks, arcs and other sources of ignition shall be kept away from the immediate vicinity of batteries which are being charged. Appropriate warning signs shall be prominently displayed.

3. Precautions shall be observed while working near battery terminals. Wrenches and other hand tools shall be used carefully to avoid short circuits.

4. Brushes used to clean batteries shall have neither a metal frame nor wire bristles.

5.5.3 Painting/Cleaning/Paint Removal

5.5.3.1 In selecting materials for cleaning and paint removal purposes, nonflammable materials shall be specified whenever possible. The use of flammable or combustible cleaning agents shall be in accordance with NFPA 30 and local codes.

5.5.3.2 A location in which painting or cleaning is to be done shall be chosen that will provide good general ventilation, ease of cleanup and convenience.

5.5.3.3 Where major cleaning, painting and paint removal operations are being conducted, no concurrent potentially hazardous operations shall be conducted within 50 feet of the area being worked on. Operation and facilities shall conform to NFPA 30 and 33 and local codes.

5.5.3.4 The use of heat lamps to accelerate the drying of painted surfaces shall be prohibited unless used as part of an approved drying booth or enclosure in accordance with NFPA 33 and local codes.

5.5.3.5 When cleaning or paint removal agents are applied through spray nozzles under pressure, the nozzle shall be of the self-closing type so that, when the hand of the operator is removed, the nozzle will automatically close.

5.5.3.6 For touch-up operations, any ignition sources within the areas being worked shall be eliminated; such areas shall be maintained hazard free during the work period.

5.5.4 Storage of Painting/Cleaning Liquids - Storage of painting/cleaning liquids shall be in accordance with local codes.

5.5.5 Welding

5.5.5.1 All welding operations performed on component transit vehicle parts on the transit vehicle shall be in accordance with NFPA 50, 51, and 51B and local codes.

5.5.5.2 Welding shall not be done in an area which contains fuel or other flammable or combustible liquids or vapors. No other work shall be permitted within a 35-foot radius of the location of any gas shielded arc welding operation, unless the welding area is vented and enclosed in an approved manner to prohibit flammable and combustible vapors from entering the work area.

5.5.5.3 Welding equipment shall have no electrical components other than flexible lead cables within 1 foot 6 inches of the floor.

5.5.5.4 Only qualified welders, trained in the techniques and familiar with the hazards involved, shall be permitted to do this work.

5.5.6 Industrial Trucks - Industrial trucks shall mean fork trucks, tractors, platform lift trucks and other specialized industrial trucks and their operation and usage shall be in accordance with NFPA 505, American National Standard Safety Code for Powered Industrial Trucks, ANSI 356.1.

5.5.7 Fuel Handling

5.5.7.1 The storage and handling of liquefied petroleum gas (LP-Gas) shall be in accordance with local codes.

5.5.7.2 The storage and handling of liquid fuels (gasoline and diesel) shall be in accordance with local codes.

5.5.8 Service Stations - Service station facilities for road or hi-rail vehicles shall conform to CBC, Chapter 9; UFC Article 79, Division IX; and local codes. (See also Paragraph 3.2.3)

5.5.9 Other Requirements

5.5.9.1 Crude oil drilling, production, storage and handling operations shall be in accordance with local codes.

5.5.9.1 Provision shall be made for the removal of all flammable/combustible liquids and greases to an area approved for disposal or storage.

5.5.9.2 Pits and subfloor work areas shall be kept clean. Smoking shall be prohibited in pits and subfloor maintenance areas.

TABLE 5-1

OIL-FILLED TRANSFORMER SEPARATION REQUIREMENTS

Structure Type	Distance (feet) <100MVa	100 MVa
Non-system structures of wood construction	100	100
Passenger station and shelter stop public areas	50	75
Transformers and structures of noncombustible construction	25	50

When separation distances cannot be maintained, one of the following mitigating measures shall be provided:

- Water spray protection, meeting the requirements of NFPA 15, for transformers and wire glass in all openings of noncombustible construction when located within 25' of transformers of less than 100 MVa capacity or within 50' of transformers of 100 MVa or greater capacity.

- Three-sided masonry (2-hour) enclosure with noncombustible roof for each transformer of less than 100 MVa capacity within 25' of exposed noncombustible walls and for larger capacity transformer within 50' of noncombustible walls.

END OF SECTION

6.0 SYSTEM FIRE/LIFE SAFETY PROCEDURES

6.1 EMERGENCY PROCEDURES

6.1.1 Objective - To anticipate and plan for emergency situations through development of emergency procedures. These procedures shall be contained in the Standard Operating Procedures (SOPs) of the operating rail system.

6.1.2 Organization - A committee shall be established consisting of representatives from the Metro and the participating agencies which serve the areas traversed by the system. The committee shall be charged with the responsibility of guiding the Metro and the participating agencies in developing and following the necessary emergency procedures in the areas of fire and life safety that require immediate response.

6.1.3 Site Emergency Plans - Rail Divisions and the ROC shall have a Site Emergency Plan available that describes the response to various typical emergencies or incidents that may occur.

6.2 EMERGENCIES

6.2.1 Types of Emergencies - As a minimum the following types of emergencies shall be addressed in the SOPs:

A. Fire and/or smoke on a train or any other part of the system

B. Fire and/or smoke adjoining or adjacent to the system that threatens the system or disrupts service

C. Collision and/or derailment involving one or more cars

D. Loss of electric power resulting in a stalled train(s) and/or loss of illumination

E. Evacuation of passengers from a train under adverse conditions

F. Panic of passengers

G. Disabled and/or stalled trains under adverse conditions

H. Serious flooding

I. Structural collapse or threat of imminent collapse that threatens system

J. Seepage of flammable, toxic or irritating products into system

K. Serious vandalism or other criminal acts

L. Emergency medical attention required by passengers

M. Extreme weather conditions causing disruption of service

N. Gas in a tunnel or cross-passage

O. Gas in a station ancillary room

6.3 STANDARD OPERATING PROCEDURES (SOP)

6.3.1 The SOPs shall include but not be limited to, the following:

A. Date adopted, reviewed and revised

B. Statements of purpose, scope and definitions as applicable.

C. Any additional information and data that may be deemed necessary.

D. Safety procedures during emergency operations.

6.4 DELETED

6.5 RAIL OPERATIONS CONTROL (ROC)

6.5.1 The operating authority shall staff an ROC for the operation and supervision of the system.

6.5.2 Standards of Operation

6.5.2.1 The ROC shall be staffed by trained and qualified personnel and utilize the essential apparatus and equipment to communicate with, supervise, and coordinate all personnel and trains operating in the system, and movement of passengers in trains, right-of-way, and stations.

6.5.2.2 ROC personnel shall be thoroughly conversant with the SOPs and trained to employ it effectively whenever required.

6.5.3 Emergency Communication Procedures

6.5.3.1 Procedures shall be developed for ROC to communicate rapidly with participating agencies, such as fire and police, utilizing direct telephone lines used for emergencies involving the system, in accordance with NFPA72.

6.5.3.2 Details shall be developed defining equipment availability and procedures for recording radio and telephone communications during an emergency.

6.5.3.3 Should the ROC be out of service or unable to fully execute its functions, the following capabilities will remain:

A. Train operations shall continue, although in a degraded state if necessary.

B. All portions of the underground Metro Rail System shall have, as a minimum, system telephone service at EMPs and at local control panels in the Train Control rooms.

Procedures shall be developed for manning selected local control panels and all underground station EMPs and for defining the communications and procedures to be used in the event the ROC is out of service for any reason.

6.5.4 Protection from Fire

6.5.4.1 Procedures shall be developed to maintain ROC operations in the event of fire or other emergency in adjoining or adjacent structures. (See Section 8.0)

6.5.4.2 Procedures shall be developed to minimize detection and extinguishment times for any fire in the ROC by effective utilization of fire detection, protection, and extinguishing equipment. (See Section 9.0)

6.6 DELETED

6.7 INCIDENT COMMAND POST (ICP)

6.7.1 During an emergency on the System, an Incident Command Post (ICP) shall be established by the person in command for the supervision and coordination of all personnel, equipment and resources at the scene of the emergency.

6.7.2 Appointment of Supervising Party - The SOPs shall clearly delineate the operating authority organization or participating agency that is in command and the individuals within each organization who are responsible for supervision, correction, or alleviation of the emergency.

6.7.3 Appointment of Liaison Person - Participating agencies should assign a liaison person to the ICP when appropriate.

6.7.4 Location of Incident Command Post - The ICP shall be at a site convenient for responding personnel, easily identifiable, suitable for supervising, coordinating and communicating with participating agencies as requested by the incident commander.

6.7.5 Ready Identification of Incident Command Post - Designated markers shall be employed to identify the ICP easily during day or night, and under bad weather conditions. The SOPs shall define the specific identification markers to be used for the ICP.

6.7.6 Communication Between Agencies - The most effective use shall be made of specified radio channels and telephones to communicate with participating agencies operating at an emergency.

6.8 TRAINING, EXERCISES, DRILLS, AND CRITIQUES

6.8.1 Personnel Training - Operating authority and participating agency personnel shall be trained to function efficiently during an emergency. They shall be conversant with all aspects of the SOPs and the incident command system. (See Subsection 9.2)

6.8.2 Exercises, Drills, and Debriefings - Exercises and drills shall be conducted semi-annually, at minimum, to prepare operating authority and participating agency personnel for emergencies. Debriefings shall be held after the exercises and drills. Procedures shall be developed which assure thorough critiques of emergencies occurring after start-up.

6.8.3 After Action Report (AAR) - An After Action Report shall be prepared in a timely manner after each drill is completed in the field, but no later than two weeks after completion of the drill. The AAR shall address the strengths and weaknesses of the drill, and include an action item matrix for any issues that remain open upon the completion of the drill.

6.9 REMOVING AND RESTORING TRACTION POWER

6.9.1 The SOPs shall have a clearly defined procedure for removing and restoring traction power.

6.9.1.1 Prior to participating agency personnel operating on the guideway, consideration shall be give to removal of traction power. Verification procedures for removal shall be established.

6.9.1.2 When traction power is removed by activation of an emergency traction power disconnect switch (ETS), the ROC shall be contacted by telephone or radio to give the full name, title, agency, and reason for removal by person responsible.

6.9.1.3 When shutdown of traction power is no longer required by a participating agency, control of such power shall be returned to the operating authority. Procedures for transfer of such control shall be established.

6.9.1.4 During an emergency, the operating authority and participating agency(s) personnel shall be carefully supervised so that only the minimum number of essential persons operate on the guideway.

END OF SECTION

7.0 COMMUNICATIONS

7.1 GENERAL

Comprehensive and dependable communications are essential for a serviceable and efficiently operated fixed guideway transit system during emergencies.

7.2 RAIL OPERATIONS CONTROL COMMUNICATIONS

7.2.1 To provide the fundamental emergency coordination for all rail transit facilities in conformance with NFPA 72, the ROC facility shall be equipped to:

A. Receive, log, and annunciate fire alarm, trouble alarm and supervisory alarm

B. Receive, record, and log emergency telephone messages

C. Have direct multi-channel radio communication with rail vehicles

D. Have access to appropriate fire and emergency organization radio channels

E. Have direct line telephone communication with each fire jurisdiction dispatch facility

F. Have the capability to use the station public address system to advise and direct patron response to emergencies

G. Have the control capability to prepare stations for evacuation

H. Have capability for emergency removal of traction power.

7.2.2 An area for fire department operations shall be provided at the ROC facility as recommended by the fire department and shall provide at that area, access to the following information:

A. Emergency telephone and public address system displays

B. Selected fire department radio channels (reception only)

C. Fire detection and alarm system annunciator displays

D. Sprinkler valve and water flow detector displays

E. Standby power controls and status indicators

F. Ventilation and air handling status indicator and controls.

7.2.3 Yard Control Facility - The yard control facility shall provide emergency coordination for all transit facilities within the vehicle yard and maintenance facility.

7.2.3.1 The control facility shall be arranged to function as a CSS for the yard and maintenance facility in conformance with appropriate standards.

7.2.3.2 The control facility shall be equipped to perform functions as required for ROC in Subsection 7.2.1, except for the station related facilities requirements.

7.2.3.3 Two-way voice communication shall be provided between ROC and the control tower for coordination of emergency operations within the transit system.

7.2.4 Emergency Management Panels (EMP) - EMPs shall be provided for the purpose of consolidating all necessary on-site control and communication facilities necessary for effective response to emergency situations.

7.2.4.1 EMPs shall be provided at all underground stations, elevated stations, trench structures, and mid-line vent structures. Consideration may be given to locating these at the street level in coordination and with the approval of the FLSC. EMPs shall contain:

A. Two Emergency telephones (ETEL) (with outside direct-dial capability). See Paragraph 7.4.2.8

B. (Deleted)

C. Annunciation from the fire alarm control panel (FACP)

D. Emergency ventilation control and status indications (where fans are provided)

E. Capability for facilitating evacuation of patrons, including controls for elevators and fare gates.

F. PA system access

G. Appropriate station, ventilation, and alarm zone graphics

H. Keys necessary for access to all areas of station in nearby lockbox.

7.2.4.2 Auxiliary Emergency Management Panels (AEMP) shall be provided at underground passenger stations which have a secondary entrance not readily accessible to the EMP and shall be used to augment the functions of the EMP. The AEMP shall contain:

A. Emergency telephone (ETEL)

B. Capability for facilitating evacuation of patrons, including controls for homing of elevators, and releasing fare gates.

C. PA system access

7.2.4.3 As a minimum, street access shall be provided at underground passenger station locations for CCTV control and viewing via a hookup for a laptop. Consideration should be given to provision of a Public Address System, ETEL and emergency ventilation control at this street access location. Acceptable means for ventilation control include an ethernet connection for hookup to a laptop that utilizes the software at the primary EMP.

7.3 EMERGENCY FUNCTIONS REQUIRING COMMUNICATION

7.3.1 Alarm and Notification - Alarm and notification communication facilities shall be provided to advise of an emergency condition for the following interface situations:

7.3.1.1 Communications between ROC and the following:

A. Patrons in stations and on vehicles

B. Station agents (where provided)

C. Train operators

D. Other transit personnel (operations/maintenance)

E. Emergency response agencies (fire, police, medical, etc.).

F. Universal Fare Control Center Facility (if used)

7.3.1.2 Communications between station agents, where utilized, and the following:

A. Patrons in stations

B. Transit system law enforcement

C. Other Transit personnel (maintenance, operations, etc.)

D. ROC.

7.3.1.3 Communications between train operators and the following:

A. Vehicle passengers

B. ROC.

7.3.1.4 Local police and fire departments to ROC.

7.3.1.5 Automated fire detection alarm and control equipment to ROC (or yard control tower) and EMP.

7.3.2 Emergency power removal and train stopping requirements are primarily met through alarm or notification to ROC. Where potential hazards require immediate action, on-site traction power removal devices (ETS) shall be provided.

7.3.3 Patron evacuation capability shall be provided in passenger stations including operation of appropriate station facilities and providing patron instructions.

7.3.4 Tactical communication is required for each responding organization to provide operations control at the site of an emergency.

7.3.4.1 A communication subsystem shall be provided for responding transit personnel that can be dedicated exclusively to this purpose during times of emergency.

7.3.4.2 Any transit system facility in which fire department radio communications are not expected to function shall be provided with repeater or other equipment necessary to meet FD requirements.

7.3.4.3 The dispatching communications for public emergency organizations shall be their own equipment.

7.3.5 Direct Emergency Voice Communications - Direct emergency voice communications such as telephone or radio shall be provided as shown in Table 7-1.

7.4 TELEPHONES

7.4.1 General - The System shall have a telephone network (transit central office exchange) or fixed telephone lines and instruments capable of communication with all stations, structures, offices, power stations and substations, control towers, ancillary rooms and spaces, and locations along the guideway (not normally used by patrons).

7.4.2 Emergency Telephone Subsystems (ETEL)

7.4.2.1 An emergency telephone subsystem shall be provided for the transit system. The emergency telephone may be used by the public, employees, and emergency personnel.

7.4.2.2 The emergency telephone subsystem shall be used for the manual fire alarm function for passenger stations, for medical requests and for other emergencies. As such they shall conform to supervision and alarm requirements of NFPA 72.

7.4.2.3 The emergency telephone subsystem shall also serve employees and emergency personnel with emergency communications from areas removed from public access, along the guideway at BLS locations and at wayside equipment locations.

7.4.2.4 The emergency telephone subsystem shall annunciate at an attended console at ROC and indicate the origin of the call. The yard control tower emergency telephone subsystem shall identify the origin of the call at the tower.

7.4.2.5 Operation of any emergency telephone other than at the EMP shall require only lifting the hand set, or pressing the button on the ETEL faceplate. This action shall cause an emergency indication to be displayed and an audible alarm to sound at the associated control console at ROC. The indication shall identify the caller's geographic location.

7.4.2.6 Recordings shall be made of all communications on the emergency telephone subsystem. The subsystem shall have instant replay capability for verification of emergency messages. A separate means shall be provided for origin identification.

7.4.2.7 Attendants at ROC shall have the capability to initiate calls to any emergency telephone.

7.4.2.8 EMP ETELs shall allow direct outside dialing with no special codes required to gain access to the line. Call-waiting shall be provided.

7.4.2.9 Platform ETEL Signs shall be installed and be visible along the length of the platform edge.

7.4.3 Fire Department Telephone (FTEL)(sound-powered) - Not used.

TABLE 7-1

DIRECT EMERGENCY VOICE COMMUNICATIONS MATRIX

Response FromTo	Facility	Stations	Patron on trains	Patrons in stations	Veh Operator	ROC	On duty transit Staff	Emerg Resp Org.
Facility	X	X				X		
Stations	X	X				X		
Patrons in trains					X			
Patrons in stations						X		
Vehicle operator			X			R		
ROC	X	X		X	X		R	R
On duty transit staff						R	R	
Emerg Resp Org						X		

R = via Radio communications
Facility refers to structures such as TCCB, TCCR, C&S Bungalow, and TPSS.

7.5 BLUE LIGHT STATIONS (BLS)

7.5.1 Activation of the ETS at any BLS shall trip the traction power feeder breakers for all tracks in the power zone covered by the BLS. The device shall provide local mechanical lockout capability which shall preclude restoration of power until the mechanical lockout is reset. ROC shall have the ability to selectively restore power to any power zone in which the ETS has been activated.

7.5.2 An emergency telephone shall provide communication to ROC. This phone is intended for fire or other emergency uses.

7.5.3 Blue Light Stations shall be provided at the following locations:

A. Each end of subway and aerial station platforms (four total per platform)

B. Tunnel cross-passages (one per track)

C. Emergency access points, as required

D. Traction power substations.

E. Tunnel Portals (one per track)

F. Elevated alignments (one per track)

G. Other locations, as required by the AHJ.

7.5.4 Adjacent to each BLS, graphic information shall be provided which identifies the location of that station and the distance to an exit in each direction.

7.5.5 The BLS shall have de-energization zone graphics installed and be oriented geographically to the user so that the graphical orientation of tracks is consistent with the user perspective when the BLS door is opened. Adjacent passenger stations shall be shown on the graphics.

7.6 RADIO SUBSYSTEM

7.6.1 The radio system shall operate on FCC authorized radio channels in accordance with specified functions (maintenance, security, operations, etc.). Radio transmissions from radios operating from any location in the transit system shall be received and re-transmitted via repeater/amplifier to all other locations in the transit system. The centralized repeater shall be the primary mode of operation and shall be located at the ROC for transit radio channels. Public safety channels shall be repeated at the designated radio system repeater location.

7.6.2 At least one separate 2-way voice communications RF channel shall be provided within the radio subsystems of the transit system for use in emergency conditions.

7.6.3 Two-way radio voice communications from non-transit police and fire emergency personnel shall operate using their own portable equipment from all locations in the transit system. Repeater/amplifier facilities for local police and fire departments shall be provided by Metro throughout the transit system tunnels and stations.

7.6.4 At least one radio communications link from ROC facility shall be maintained with the most appropriate public emergency frequency.

7.6.5 A minimum of two channels of radio communications shall be provided for line security force use.

7.6.6 The LAFD shall be provided underground communications for eight (8) LAFD radio channels in accordance with the agreements reached in phase one Red Line system. Other public safety agencies fire and police departments shall be provided with their own underground radio communication capability as required by the FLSC.

7.7 PUBLIC ADDRESS SYSTEM

7.7.1 Trains and stations shall have a public address system for communicating with patrons and employees.

7.7.2 ROC shall have the capability of using the public address system to make announcements on trains and throughout stations.

7.7.3 The capability of making announcements throughout the stations on the public address system shall be provided from the EMP.

7.7.4 Train operators shall have the capability of making announcements throughout their trains on the public address system. During interruptions of train service or delays for any reason, the patrons and employees shall be kept informed by means of the public address system.

7.7.5 At times of emergency, the public address system shall be used effectively to communicate to patrons, employees, and emergency personnel.

7.7.6 The station public address system shall conform essentially to NFPA 72.

7.7.7 Override access to the passenger station or maintenance facilities PA subsystems shall be provided at emergency management panels associated with the specific facility.

7.8 FIRE SUBSYSTEM

7.8.1 The fire subsystem shall consist of the following:

7.8.1.1 Automatic fire detection, alarm and supervision.

7.8.1.2 Fixed extinguishment equipment actuation, alarm and supervision.

7.8.1.3 EMP(s).

7.8.1.4 Public address system supervision.

7.8.2 The fire subsystem shall be controlled and supervised through a fire control panel, provided in each passenger station or remote facility.

7.8.3 Water flow alarm and valve supervision shall be provided at ROC/FACP for automatic sprinkler and combined automatic sprinkler/standpipe systems.

7.8.4 The fire alarm system shall provide means to supervise and trip special extinguishing systems and to control ventilation systems in accordance with applicable standards.

7.8.5 The fire subsystem shall be electrically supervised and provided with UPS standby power. The system shall be multi-zoned and capable of using interchangeable combination rate of rise/fixed temperature, smoke, and fixed temperature detectors.

7.8.6 The fire alarms, trouble alarms, and supervisory alarms shall be transmitted to ROC via the DTS or separate multiplex system (see Subsection 7.10.1).

7.9 EVACUATION CONTROL

7.9.1 Remote actuation capability shall be provided for preparation of stations for evacuation, including operation of appropriate station facilities and initiation of pre-taped announcements.

7.9.2 The Transit Passenger Information System (TPIS) is a system that consists of a Public Address (PA) and a Visual Message Sign (VMS) that shall be used to notify the passengers and employees within a station of the need to evacuate, when initiated by the ROC staff.

7.10 SUBSYSTEM FOR INTER-FACILITY TRANSMISSION

7.10.1 Cable Transmission Subsystem - Transmission of emergency communications between ROC and passenger stations, or the vehicle yard and maintenance facility, may be by the Cable Transmission Subsystem (CTS).

7.10.1.1 Emergency communication subsystems that can be transmitted via CTS voice channels include radio signals from satellite receivers, repeaters, emergency telephones, public address, and direct line telephones. The data transmission subsystem (DTS) may be provided consisting of terminals converting data, serial transmissions via the CTS and reconversion to parallel output data.

7.10.1.2 When, in addition to train control, traction power status and communication alarms, the DTS is used for transmission of fire and intrusion status and alarm, the DTS provided for fire alarm shall conform to the requirements of NFPA 72.

7.10.1.3 The DTS common to other elements of the transit system may be utilized for fire alarm functions if all requirements of data transmission for the fire alarms are satisfied by this subsystem and no impairment of the fire alarm functions is permitted into the normal use of the common DTS.

7.10.1.4 The cable transmission subsystem shall be arranged so that a single loss-producing incident (intemal or external to the subsystem) will not result in loss of transmission capability from the ROC facility to locations preceding the location of the incident.

END OF SECTION

8.0 RAIL OPERATIONS CONTROL (ROC)

8.1 GENERAL

8.1.1 The ROC is a controlled space for offices, equipment, and supporting facilities to be used by those persons responsible for train control, communications, and fire and security management. ROC is the portion of the facility used for data processing, status reporting, and transit system control, and excludes ancillary spaces and supporting facilities.

8.2 BASIC CONSTRUCTION

8.2.1 Rail Operations Control - The ROC shall comply with Type I fire resistive construction requirements of the CBC for Group B, Division 2 occupancy.

8.2.2 Rail Operations Control Building - The building housing the ROC shall conform to the CBC, Type I fire-resistive construction and shall be protected throughout by automatic sprinklers. The ROC shall not be located above hazardous use areas.

8.2.3 Fire Separations - Two-hour minimum fire separations shall be provided and maintained to separate occupancies as required by the CBC, and are as follows:

8.2.3.1 The ROC, including ancillary rooms, shall be separated from uncontrolled public access areas and any other occupancy or building by minimum 3-hour fire-rated construction having protected openings.

8.2.3.2 ROC data processing and control areas shall be separated from all ancillary rooms by minimum 2-hour fire-rated separations.

8.2.3.3 Separation of ancillary areas within the ROC building shall be as established in NFPA 75, Chapters 3 and 4.

8.2.3.4 The routing of all cabling to transit system operating areas and other services essential to the operation of the ROC shall be separated from other occupancies and buildings by minimum 2-hour fire-rated separations.

8.2.3.5 Openings in 2-hour fire-rated separations shall be protected by labeled 1^{1}>4-hour fire-rated (Class B) assemblies.

8.2.3.6 Openings in 3-hour fire-rated separations shall be protected by labeled 3-hour fire-rated (Class A) assemblies.

8.2.3.7 Fire-rated assemblies protecting openings in fire-rated separations shall be automatic or self-closing. Automatic closing assemblies protecting openings into ROC areas shall be activated by smoke detectors at the opening, and by means of a fixed temperature device. Alternatively, automatic closing assemblies may be released by the fixed temperature device alone where a separate smoke barrier is provided. Installation shall be in accordance with CBC, Chapter 43.

8.2.3.8 Egress routes commonly serving the ROC and other occupancies shall be separated from the other occupancies by 2-hour fire-rated separations.

8.2.3.9 All other protection of vertical openings shall be in accordance with the CBC for Type I construction.

8.2.4 Materials - All structural assemblies and building appurtenances in ROC areas shall be of noncombustible materials.

8.2.5 Interior Finishes - Interior finishes consisting of all surfaces exposed to ROC areas of the building, including fixed or movable walls and partitions, columns and ceilings, shall meet CBC Chapter 42 Requirements for Class I and Class II interior finishes.

8.2.5.1 Interior finishes shall be Class I for all means of egress and the ROC area.

8.2.5.2 Interior finishes in all other areas shall be Class I or Class II.

8.3 MEANS OF EGRESS AND EMERGENCY ACCESS

8.3.1 The ROC shall comply with the minimum egress requirements of Table 33-A of the CBC.

8.3.2 The ROC shall be located in a building that is adjacent to existing public streets and other access routes.

8.4 BUILDING SERVICES AND UTILITIES

8.4.1 Light and Power

8.4.1.1 Electrical equipment and wiring materials and installations shall conform to the requirements of NEC, and satisfy the criteria requirements for station facilities, Subsection 2.4 and the applicable local code.

8.4.1.2 Emergency lighting shall be provided for all means of egress from and throughout the entire ROC area.

8.4.1.3 A separate on-site emergency power system shall be provided for the ROC facility such that loss of normal electrical power will not impair any critical ROC functions, and shall meet NFPA 72 and NFPA 110.

8.4.2 Fire Protection Water Supplies

8.4.2.1 Site fire flows (water supplies) and hydrants shall be required to conform to LA Fire Department Master Plan or other appropriate local codes.

8.4.2.2 Standpipe and automatic sprinkler water supplies shall meet the requirements of NFPA Standards 13 and 14 and the local code.

8.4.2.3 For ROC within buildings having non-transit occupancies, the ROC standpipe and automatic sprinkler systems shall be supplied from an independent connection to the municipal system.

8.4.3 Heating, Ventilating, and Air-conditioning Systems (HVAC)

8.4.3.1 ROC HVAC systems shall be physically and operationally separated from HVAC systems serving any other area.

8.4.3.2 Redundant fans and/or air conditioning units shall be provided to serve the ROC.

8.4.3.3 Emergency smoke removal capability shall be provided for the ROC. Systems shall be arranged for exhausting with 100% outside air make up. Two full-capacity outside air intakes shall be provided, arranged so as to not be subject to the same source of contamination. A minimum of 6 air changes per hour shall be provided.

8.4.4 Personnel Facilities - The ROC shall contain all personnel facilities necessary so that on-duty operating personnel are continuously available.

8.5 FIRE PROTECTION, ALARM, AND COMMUNICATIONS

8.5.1 Fire Alarm System

8.5.1.1 A fire alarm system complying with the requirements of the CBC and NFPA 72 shall be provided for protection throughout the ROC building.

8.5.1.2 Manual fire and emergency reporting capabilities shall be provided by an emergency fire-reporting phone system (ETEL) that alarms at ROC, with annunciation as a separate zone.

8.5.1.3 The fire alarm shall sound an evacuation signal which can be heard throughout the ROC building. To facilitate selective evacuation from larger facilities so that transit system control functions can be maintained to the greatest possible extent, a public address system shall be provided and supervised by the fire alarm system in accordance with NFPA 72 and CBC.

8.5.1.4 Water-flow alarm and control valve and fire pump supervision shall be provided for automatic sprinkler systems.

8.5.1.5 The fire alarm system shall provide means to supervise and actuate special extinguishing systems and, where required, to control the ventilation system.

8.5.1.6 The fire alarm system shall be electrically supervised and equipped with battery standby power. The ROC fire alarm system shall be multi-zoned and capable of using smoke detectors, combination rate-of-rise/fixed temperature detectors.

8.5.1.7 The fire alarms, trouble alarms, and supervisory alarms shall be annunciated in ROC in accordance with NFPA 72.

8.5.1.8 The ROC fire alarm system shall be separated from any fire alarm system in any other occupancy or building, except that remote alarm annunciation from this system may be provided at locations outside ROC approved by the local fire authority.

8.5.1.9 If located within a building having other occupancies, the ROC shall be provided with at least one summary alarm for fire or evacuation notification initiated from any part of the building.

8.5.1.10 As the central supervising station, ROC shall:

A. Receive and annunciate fire alarm, trouble alarm, and supervisory alarm for all portions of the transit system, except that the maintenance facility may have an independent system

B. Have direct dedicated telephone communications with each fire jurisdiction dispatch facility serving any portion of the transit system

C. Perform those additional functions as required in other Sections of these criteria

D. Contain dedicated area for fire department liaison.

8.5.2 Automatic Fire Detection

8.5.2.1 Products of combustion detectors, other than heat detectors, shall be installed in all areas of the ROC, in accordance with NFPA 72. HVAC systems detectors shall be installed in accordance with NFPA 90A.

8.5.2.2 Products of combustion detectors, other than heat detectors, shall be installed throughout the ROC area to activate the pre-action sprinkler or other approved special extinguishing systems.

A. Detectors shall be installed in all rooms and under-floor spaces protected by a pre-action sprinkler or approved special extinguishing system.

B. The detectors shall be cross-zoned so that activation of 2 zones in any single protected area is necessary for operation of the fire suppression system.

C. The activation of a single detector or manual operation of the special extinguishing system shall provide a pre-discharge alarm signal and appropriate activation of auxiliary devices including release of hold-open devices on doors to ancillary rooms and control of ventilation systems.

8.5.3 Fire Extinguisher

8.5.3.1 Portable fire extinguishers of the type and size specified shall be installed throughout the ROC as required in accordance with NFPA 10.

Multipurpose dry chemical -10 pound capacity, UL approved and rated 4-A:30-B:C

Carbon Dioxide (C02) -10 pound capacity, UL approved and rated 10-B:C.

8.5.3.2 Suitable UL approved portable fire extinguisher shall be installed in areas protected by special extinguishing systems.

8.5.4 Standpipe Systems - Standpipes as required by the CBC and local codes shall be installed in the ROC building.

8.5.5 Automatic Sprinklers - Automatic sprinkler protection shall be provided throughout the ROC building.

8.5.6 Special Extinguishing Systems

8.5.6.1 Pre-action automatic sprinkler systems or other approved special extinguishing system protection shall be provided for underfloor areas of equipment rooms and operations rooms. A separate system shall be provided for each room or area.

8.5.6.2 Single-interlock pre-action automatic sprinkler systems or other approved special extinguishing system protection shall also be provided for other areas containing critical communications, telephone, and train control equipment and systems, such as tape storage rooms, invertor rooms, etc.

8.5.6.3 Pre-action and special extinguishing systems shall be installed in accordance with NFPA and LAFD or local fire department requirements.

END OF SECTION

9.0 INSPECTION, MAINTENANCE, AND TRAINING

9.1 OPERATIONAL PROCEDURES

9.1.1 Objectives - Metro shall establish the necessary operational procedures, including the inspection and maintenance program necessary to ensure that all fire/ life safety related equipment is in proper condition and all associated personnel are appropriately familiar with fire/life safety related equipment and emergency preparedness plan procedures.

9.1.2 Organization - Metro and FD's shall be primarily responsible for accomplishing the above objectives.

9.1.3 Functions - Metro and FD's shall develop a program of testing and inspection of fire/life safety related equipment and an operational program to ensure that necessary maintenance and/or repair is performed on all fire/life safety-related equipment.

9.1.4 Testing and Inspection Program

9.1.4.1 The testing and/or inspection program shall be in accordance with applicable Sections of the following documents and requirements of the FLSC:

A. NFPA 10, Portable Fire Extinguisher

B. NFPA 13, Installation of Sprinkler Systems

C. NFPA 14, Standpipe and Hose Systems

D. NFPA 70, National Electrical Code (Article 760)

E. NFPA 72, Protective Signaling Systems

F. NFPA 72E, Automatic Fire Detectors

G. LA County Fire Code, LA City Fire Code, or local fire code

H. CCR Title 19.

I. FM, Factory Mutual

9.1.4.2 Metro and local fire authority shall develop a fire/life safety equipment testing and/or inspection program, and it shall include agreements and procedures to conduct the testing and inspection at regular intervals as prescribed by the appropriate codes. The program shall include testing and inspection requirements and record-keeping procedures to substantiate and document the program.

9.1.5 Maintenance Program - The fire/life safety equipment maintenance programs shall be subject to maintenance and testing as contained in the local fire codes. It shall include, but not be limited to:

9.1.5.1 Manual or portable fire suppression equipment

9.1.5.2 Fire alarms and detection systems

9.1.5.3 Automatic fire suppression systems

9.1.5.4 Auxiliary fire service equipment

9.1.5.5 Emergency communications systems.

9.1.5.6 Emergency lighting.

9.2 TRAINING

9.2.1 Training Programs - Metro shall establish the training programs and coordinate the fire/life safety services interfaces to educate and/or familiarize employees and emergency personnel with the transit system's fire/life safety equipment, operations, and emergency procedures. Approval by the FLSC shall be required.

9.2.2 Public Emergency Personnel Training Program - Metro shall develop and implement a comprehensive joint training and indoctrination program for emergency personnel which, with FLSC approval, will include, but not be limited to, the following:

9.2.2.1 Ventilation systems, functions and controls

9.2.2.2 Emergency access facilities

9.2.2.3 Communications procedures and facilities

9.2.2.4 Facilities indoctrination

9.2.2.5 Transit vehicle indoctrination

9.2.2.6 Electrification system

9.2.2.7 System fire control and alarm systems

9.2.2.8 Yard and shop indoctrination

9.2.2.9 Arrangements for fire equipment tests

9.2.2.10 Emergency medical aid procedures and policies

9.2.2.11 Identification of personnel authorized to make decisions in emergencies

9.2.2.12 Emergency procedures plans.

9.2.3 Employee Training Program

9.2.3.1 Metro, in conjunction with the local fire authority, shall develop and implement a fire/life safety employee training program which, with FLSC approval, will include, but not be limited to, the following:

A. Emergency procedures plans

B. System fire control operations

C. Yards and shops fire brigade training

D. Test and inspection procedures

E. Communications procedures and facilities

F. Facilities indoctrination

G. Electrification system

H. Identification of personnel authorized to make decisions in emergencies.

9.2.3.2 The Metro and local fire authority shall also develop and implement an ROC operator training program on all ROC functions to be performed during emergencies anywhere within the transit system.

END OF SECTION