



RAPID TRANSIT SYSTEM EXTENSIONS
COMPENDIUM OF DESIGN CRITERIA

VOLUME I
SYSTEMWIDE DESIGN CRITERIA

CHAPTER 7
SYSTEM SAFETY DESIGN CRITERIA

INTERIM RELEASE
REV 1

OCTOBER 30, 2008

PROGRAM MANAGEMENT CONSULTANT

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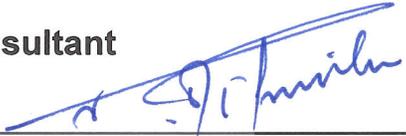
VOLUME I – SYSTEMWIDE

CHAPTER 7 – SYSTEM SAFETY DESIGN CRITERIA

REVISION 1

Program Management Consultant

Submitted


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Date

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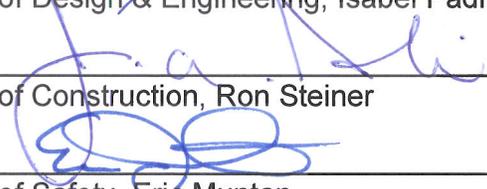
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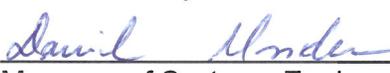
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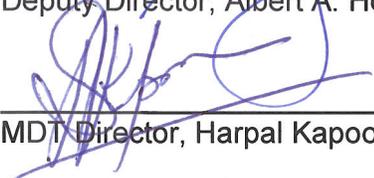
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	7.3.1.1 C System Element - Station Facilities - General
	7.3.1.3 System Element - Station Facilities - Station Attendant's Booth
	7.3.5.1 Communications - General - Central Control Console
	7.3.6.2 System Element - Station Facilities - Fire Detection Alarms and Fire Management Panels

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7.1 SYSTEMWIDE SAFETY DESIGN CRITERIA

7.1.1 GENERAL

These criteria describe the System Safety design requirements and applicable management tools for Miami Dade Transit (MDT) projects. Supplementing these criteria are the Standard, Directive and Project Drawings. This document should be used concurrently with Chapter 8 Systems Security and Chapter 9 Fire/Life Safety Criteria.

Unless otherwise mandated the code of precedence shall be:

- National Fire Protection Association (NFPA) 130 Standard for Fixed Guideway and Passenger Rail Systems.

Additional codes, standards, guidelines and regulations include, but are not limited, to the following:

- Florida Building Code Chapter 11 Florida Accessibility Code for Building Construction
- American National Standards Institute (ANSI) A17.1 Safety Code for Elevators and Escalators
- Department of Homeland Security Publications
- Department of Transportation Hazard Analysis Guidelines for Transit Projects (use MIL_STD 882C)
- Department of Transportation Handbook for Transit Safety and Security Projects
- Department of Transportation Circular 5200.1.A Full Funding Agreement Guidelines
- Florida Fire Protection Code
- Institute of Electrical and Electronic Engineers (IEEE)

- Illumination Engineers Society (IES)
- Insulated Cable Engineers Association (ICEA)
- Miami Dade County Fire Prevention and Safety Code
- Miami Dade Transit Safety and Security Certification Plan
- Handbook for Safety and Security Certification
- National Electric Manufacturers Association (NEMA)
- National Electric Safety Code (NESC)
- National Fire Protection Association (NFPA) 13 Standard for Installation of Sprinkler Systems
- NFPA 14 Standard for Installation of Wet Standpipe and Hose Systems
- NFPA 70 National Electric Code
- NFPA 72 National Fire Alarm Code
- NFPA 101 Life Safety Code
- National Transportation Security Administration Publications
- Occupational Health and Safety Act (OSHA)
- Ordinances of the City of Miami, Miami Dade County, and other Authorities Having Jurisdiction (AHJ)
- Florida Building Code (FBC)

The current version of codes, standards and regulations shall apply, and unless otherwise directed, all addenda, interim supplements, revisions and ordinances by the respective code body shall also apply. Where conflicts exist between these requirements, and unless otherwise directed by MDT, the more stringent requirement shall take precedence.

7.1.2 BASIC GOALS

The design shall include provisions for building, operating and maintaining a safe and secure transportation system as well as to promote uniformity and

standardization in design and equipment. The criteria shall address and comply with all applicable federal and state oversight requirements. These include documentation, hazard management, planned response to varying security levels and threats, procurement, testing, inspection, permitting process and the issuance of certifications of operational readiness.

These criteria shall assist in the development of an integrated approach to systems safety and security. This approach promotes a coordinated team based effort to identify, report, and mitigate safety hazards commencing in the design phase and beyond for MDT projects. Information will be shared, solicited and incorporated into designs as appropriate from internal as well as external sources. These sources shall include as a minimum: the Fire Department, Police Department, Emergency Medical Services, Department of Homeland Security and other related safety and security based organizations.

All elements incorporated into designs shall take into account compatibility with existing and planned Miami Dade Transit facilities, systems, and equipment. This includes stations, guideways, signals, power supplies, communications, vehicles, track and Central Control Facility.

7.1.3 SYSTEM SAFETY AND HAZARD MANAGEMENT

The purpose of System Safety is to identify potential hazards and mitigate or eliminate them as part of the design process or control them to an acceptable level through policies, procedures, programs, warning devices, safety devices, drills and training. This includes applying engineering and management principles, criteria, and analysis techniques to achieve acceptable risk, within the constraints of operational effectiveness, time, and cost throughout all phases of the System's life cycle.

The Systems Safety process for selection of design elements is typically comprised of Hazard Analysis studies such as:

7.1.3.1 Preliminary Hazard Analysis (PHA)

The PHA is performed in the conceptual engineering stage and provides an early assessment of safety hazards. The PHA takes into consideration the potential frequency and severity of forecasted risks and eliminates any issues that could result in a catastrophic condition. The study precludes against loss of operating system and hazards to human life. It further contains generic references and scenarios pertaining to potential hazards, locations, equipment and possible corrective actions.

7.1.3.2 Systems Hazard Analysis (SHA)

The Systems Hazard Analysis deals with specific systems and components as defined in the design criteria, MDT policy statements and other project baseline documents. The SHA investigates how failures in one area could lead to loss of service or diminished performance in other related systems.

Each identified hazard is reviewed with pertinent project personnel and a recommended corrective action formulated. The SHA also investigates incorporation of emerging technologies; interface with existing MDT systems and upgrades; training; drills; plus operations and maintenance concerns. The SHA will be updated during the continuing design process.

7.1.3.3 Operations Hazard Analysis (OHA)

The OHA identifies and evaluates hazards resulting from the implementation of operations or tasks performed by persons; considering: the planned and existent environments, the supporting tools or other equipment; software controlled equipment and systems; biological factors; regulatory or

contractual safety, security and health requirements; and the potential for unplanned events including hazards introduced by operators, maintainers, patrons and incidental occupants at all project locations.

The OHA provides the basis for corrective or preventive measures to be taken to minimize the possibility that human error or procedure will result in injury, death or loss of system capacities. The OHA includes inputs for improvements in design procedures to improve efficiency and safety, development of warning and cautionary notes included in operations and maintenance manuals, and the requirements for drills, training and interfaces for all operations and response personnel.

Human activities and interfaces have been considered as critical and dynamic elements of the total system during the development of the analysis. The OHA identifies the safety requirements, or alternatives, needed to eliminate or control identified hazards or to reduce the associated risk to an acceptable level mandated by contractual specification or by regulatory agencies. The OHA will be updated during the continuing design process.

Corrective actions and counter measures to the above studies will be included in the design drawings, specifications, emergency response procedures, and operations and maintenance manuals.

All hazard management documentation will be utilized in the MDT Safety and Security Certification Plan available under separate cover. This plan shall include Certifiable Elements / Items; Checklists; Test Plans; Variances; Certificates of Conformance and a final Safety and Security Verification Report to attest to operational readiness.

7.1.4 PASSENGER SAFETY

Passenger Safety shall be equal or greater than that of any major rail rapid transit system now operating in the United States.

7.1.5 PUBLIC SAFETY

High safety standards and practices for major public works projects shall be established and administered. The public's exposure to construction shall be minimized. Safety specifications shall be established, as appropriate, for all hardware procurement contracts.

7.1.6 MAINTENANCE AND OPERATIONS SAFETY

Health and safety provisions for maintenance and operational personnel shall at least be equal to those required by local, state and federal regulatory authorities and shall exceed local, state and federal requirements if deemed desirable and cost effective by MDT. This includes pertinent sections of the OSHA standards and regulations.

7.2 SYSTEM PROCEDURES SAFETY CRITERIA

7.2.1 OPERATIONS AND MAINTENANCE

Written directions shall be provided in the form of Rules and Standard Operating Procedures governing a qualified operator aboard the train to monitor its performance during automatic train operations. They shall also provide for manual operation of the train if required or if the operator is directed by proper authority to assume control of the train.

Directions shall be provided to enable the Train Operator to minimize risk to passengers or equipment in the event of an emergency situation.

The skill levels of Train Operators and maintenance personnel shall be maintained at the appropriate qualification level required for their specific responsibilities.

Directions shall be provided by which the Train Operator may bypass specific vehicle subsystems and safely resume revenue operations after a minor malfunction.

The safety of personnel shall be provided during right-of-way maintenance on a scheduled or unscheduled basis. A buddy system shall be used.

A procedure shall be developed whereby a safety critical malfunction occurring on a passenger vehicle which has been annunciated and not corrected shall be reported to Central Control.

Procedures shall be developed for evacuation of patrons from elevated guideways in emergency or abnormal train/operation conditions.

Emergency operating procedures shall be developed for termination of operation of vehicles under excessive wind conditions.

Detailed emergency procedures shall be prepared for emergency assistance response teams.

Procedures shall require that the Train Operator visually verify that all vehicle doors are clear, to the extent possible, before the Train Operator closes the doors and departs the station.

7.2.2 ADDITIONAL SYSTEM SAFETY REQUIREMENTS

System safety requirements will also be identified in a Preliminary Hazard Analysis (PHA), Systems Hazard Analysis (SHA) and the Operations Hazards Analysis (OHA) described above. Elements and items will also be incorporated into designs as part of the continuing process of Safety and Security Certification.

Systems contractors/suppliers (e.g. signals, communications, and traction electrification system etc.) are required to perform hazard analysis down to the detailed subsystem level for their specific equipment.

Acceptance Criteria will be developed for each of the Safety Critical Items with the purpose of providing and insuring the MDT trouble free and safe operation of the new equipment and installations. The criteria will be developed by MDT Engineering, Rail Operations, Facilities Maintenance and Safety and Security. Acceptance Criteria will identify the performance tests, drills, exercises and audits designed to verify the functional capability and readiness of the system and compatibility between system elements.

The Acceptance Criteria is a part of the Safety and Security Certification Plan and provides the available tools to ensure that sub-systems are delivered, tested and validated according to the safety aspects of the specifications and documentation of the project

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7.3 SYSTEM ELEMENT SAFETY DESIGN CRITERIA

7.3.1 STATION FACILITIES

7.3.1.1 General

- A. Adequate electrical grounding and lightning protection shall be provided for structures and facilities. This protection shall be in accordance with the Volume III Section 4.04 and Volume VII Section 1.4.

- B. At least two emergency exits shall be provided in electrical equipment and battery rooms in accordance with OSHA and NFPA regulations. Design shall incorporate self illuminating exit lights. Battery rooms shall have an eyewash station with body spray in close proximity, and positive mechanical ventilation with fire and hydrogen gas monitoring in accordance with Volume II Sections 1.07.5.1 and 5.02.43.

- C. Traction Power Emergency Trip Station (ETS) (Also called Blue Light Stations as defined by NFPA 130) locations shall be provided with appropriate indicator lights and shall include a means whereby the contact rail can be rapidly de-energized.

ETS operation shall provide for quick removal of traction power from established power zones. Activation of ETS shall provide local alarms via panel indicator lights to all impacted Station Attendant Booths and the Central Control Facility (CCF). Re-energization will be controlled from the CCF in accordance with Volume VII Section 3.03.1 requirements for power restoration. At least one form of emergency voice communication will be located with the ETS box or in close proximity.

The ETS (Blue Light Stations) shall (as a minimum) be located at:

- Platform Ends
- Emergency Access Points
- Traction Power Substations
- Station Attendant's and Rail Supervisor Booths
- High Rail Access Points
- Locations provided by Authority Having Jurisdiction

Also refer to Volume VII Section 3.3.3 for more information.

- D. Sufficient structural integrity shall be provided to protect against excessive wind force expected in hurricane and wind squalls. Construction types shall be no less than Type I or Type II or combinations of approved non-combustible materials.
- E. All station entrances/exits shall be immediately recognizable and appropriately marked with signage. Full site access shall be provided for emergency vehicles and fire lanes shall be identified.

Bus, car and taxi access points shall be clearly marked using approved signage.

- F. Vehicles entering the site shall not hold up nor excessively interfere with normal street traffic. This also applies to access to special parking provided as part of the site design.
- G. Patron bus/car and taxi drop-off zones shall be adjacent to the station so patrons can move directly to the station entrance. If, because of the site layout this is not possible, patron movement to the station entrance shall

be as direct as possible while minimizing crossing vehicular traffic lanes. If this occurs, the Designer shall identify the need for traffic signals. This design shall be done by a traffic engineer in coordination with MDT, Department of Public Works Traffic Engineering Department, and Florida Department of Transportation (FDOT).

- H. When public parking is provided, the marked wheelchair designated spaces shall be as close to the station entrance as possible. Patrons in the wheelchair shall not be required to move behind parked cars. Compliance is mandatory for all requirements of the Florida Building Code Chapter 11.
 - I. Bus traffic patterns to and around the station shall take into account the bus route. For example, northbound buses should load/unload on the side most convenient for continuing the route.
 - J. The patron flow patterns in the concourse shall maintain a right-hand orientation where possible and still be simple.
 - K. All station cable raceways shall be grounded. All cables installed shall be in accordance with applicable electrical codes and standards.
 - L. Maps shall be provided showing locations of water, gas or fuel line shutoff valves which are available for emergency use.
- 7.3.1.2 Station Platform and Concourse
- A. Platforms, concourse and other station walking surfaces shall have slip resistant surfaces. Refer to Station Design Criteria.

- B. Adequate lighting of platform and concourse areas accessible by the public shall be provided, free of glare and shadows.
- C. The horizontal gap between the vehicle floor and finished platform shall be no more than 3 inches. The vertical alignment shall be plus or minus 5/8 inches
- D. An adequate platform edge shall be provided with a different color, surface, or other means to identify it from main platform area. The edge areas shall be electrically insulated to minimize touch potential. In accordance with Volume II Section 1.04.6.4 and Volume III Section 4.05.3.1.
- E. A "train approaching" warning method shall be provided.
- F. Signage shall be placed on top of the third rail coverboards, with appropriate high voltage warning for the 750 VDC power. The signage will comply with NFPA 130 requirements.

Also see Volume VII Chapter 2 for additional Coverboard requirements.

7.3.1.3 Station Attendant's Booth

Where booths are provided they shall have:

- Monitoring capabilities for CCTV
- Monitoring capabilities for intrusion detection
- Emergency telephone and radio
- Microphone and keyboard access to the Public Address and VMS System. The System shall have capability for announcements to be

made from Central Control and the Fire Management Panels to the patrons on the concourse and the platform level.

- Monitoring and alarm generation capabilities for fire detection
- Silent Alarms via ACID control panel indicator lights with CCF monitoring
- Refer to Volume VII Chapter 7 for complete list of communication equipment and Volume II Chapter 1 for other equipment.

7.3.1.4 Access Structures

- A. Screening shall be provided on pedestrian bridges to deter any object from being thrown or dropped by pedestrians onto persons, vehicles, or guideway below.
- B. Road and pedestrian approaches to, and exits from, stations and parking lots shall be adequately designed with respect to grade and traffic signal control.

7.3.1.5 Lighting, Emergency Lighting, and Emergency Power

- A. Lighting levels shall be in accordance with the Illumination Engineers Society levels.
- B. Emergency lighting shall automatically activate upon a primary power failure. Emergency lighting shall be at a level to provide adequate illumination for patron safety on platforms, escalators, stairs, and any other potentially hazardous location. Emergency lighting for stairs and escalators shall be designed to emphasize illumination on the top and bottom steps and landings.

- C. Emergency lighting shall be connected to the Emergency Power source and have a minimum duration of 90 minutes.
- D. Emergency lighting fixtures shall be wired to the emergency distribution panels only.
- E. Station lighting shall be shielded and/or located in such a manner as to prevent safety hazards to train operation by glare on guideways or interference with safe operation of adjacent railroad or roadway operations. Refer to Volume II Stations Chapter 4 Electrical Design Criteria.

7.3.2 GUIDEWAY/FACILITIES

7.3.2.1 General

- A. Screening shall be provided on overpasses to deter objects falling or being thrown from overpasses on the guideway below.
- B. There shall be provisions as per NFPA-130 and the AHJ for access and egress by emergency vehicles and crews at elevated below grade and at-grade guideways.

7.3.2.2 Guideway

- A. Handrails or acoustical barriers shall be installed along the outboard edges of guideway elevated more than four feet. Top of handrail shall be at least 3'-6" above the adjacent surface or walkway. Where handrails are installed along center walkways, the 3'-6" height is applicable, and the top of the handrail shall be below the side door threshold height of a "worst-case" passenger vehicle. Stage 1 approach to handrails and acoustical barriers shall also be acceptable. See paragraph B below.

- B. If approved by MDT, guideway fall protection methods, as provided in Stage I Metrorail in non-walkway areas, may be used in the Line Extension in lieu of the requirements of paragraph A. above.

7.3.3 PASSENGER VEHICLE

For safety requirements for Passenger Vehicles refer to Volume VII Section 5.9.1.

7.3.4 TRAIN CONTROL (TC)

7.3.4.1 General (See Volume VII, Chapter 6 Train Control Design Criteria)

The Designer shall insure the TC system addresses the following safety considerations:

- A. Vital circuits on the mainline shall be failsafe, shall operate on closed loop principles, and shall meet the requirements of the Association of American Railroads (AAR) Signal Manual.
- B. Broken rail detection capabilities shall be provided.
- C. All wayside visual signal placements shall be clearly visible to the Train Operator.
- D. Upon interruption of utility supplied power, the transfer to backup power and any associated switching shall not interrupt or effect in any way the computers and Communications Network functions or cause loss of communications and command transmission.
- E. The design of all train control wayside and vehicle equipment shall incorporate electromagnetic compatibility concepts to minimize potential

interference from within the train control system and nearby systems. The considerations shall include conductively coupled interference, interference coupled through common impedance, and interference coupled through radiated electric and magnetic fields.

7.3.4.2 Automatic Train Protection (ATP)

- A. The vital ATP subsystem shall furnish safe train separation considering safe braking distances (SBD), preclude improper positioning or movement of switches, and prevent train overspeed.
- B. By using safe braking distance considerations, the revenue service portion of the system shall be sectioned into individual train control blocks and provide continuous detection within the blocks of stopped or moving trains or maintenance vehicles. Selection of train detection frequencies shall preclude frequency interference and cross talk at an unsafe level.
- C. Any failure of the ATP train detection system shall furnish a block occupied configuration and cause maximum service braking to all trains in affected block zones.
- D. Train direction and route interlocking through crossovers shall be protected by ATP. Occupancy shall be indicated within the blocks on either side of the crossovers, and two-direction operation may be carried out when a section of the track is required to be isolated.
- E. The vehicle ATP subsystem shall not generate a false speed command.

- F. Any aberration in wayside ATP speed commands shall cause automatic braking.
- G. The ATP summary logic shall prevent door opening until the train is stopped, and the train cannot be started until all doors are closed and latched.
- H. All train control vital relays, filters, modules, etc. related to TC/ATP subsystems shall not have an operating frequency within the harmonic spectrum of dc traction power transformer rectifier harmonic output. Selection of track circuit frequencies shall be based on a consideration of the characteristics of the passenger vehicle propulsion system, or AC propulsion system and harmonics produced by any operational or failure of the propulsion system shall not be within the vital train detection or cab signal frequencies.
- I. The propulsion subsystem, brake subsystem and operator control system on the vehicles shall be interlocked to prevent undesired movement of the vehicle under any normal operating conditions.
- J. A means shall be provided to prevent door opening on a moving vehicle or on the side opposite the platform.
- K. A means shall be provided for doors to open under normal conditions only when the train is stopped within the platform limits.
- L. Adequate Safe Braking Distances (SBD) in block system design shall be based upon the "worst case" train. See Train Control Design Criteria.

- M. Command malfunctions from Central Control shall not be capable of overriding the ATP subsystem.

7.3.4.3 Train Operation (TO)

- A. All interlockings shall be capable of being controlled from a manual mimic and switch panel in the local Train Control and Communications (TCC) room.
- B. Provision shall be made in local TCC rooms or Central Control for the reduction of vehicle speed codes in sections of track where an abnormal condition exists or maintenance is being performed on guideway during revenue or pre-revenue service.
- C. The following operations shall be capable of being performed automatically by the train operation system, but shall be subordinate to the ATP subsystem:
 - Regulation of train speed limits which are imposed by the ATP subsystem.
 - Control of train movement with regard to speed, acceleration, deceleration and jerk rate, taking into account all time delay and lags within the TC system.
 - Control of stopping trains at stations and terminal zones within a fixed reference point (dependent upon train length) regardless of variations in approach conditions including grade, curves, train resistance, approach speed or environmental conditions.

- Control enabling of train doors which may only be opened if the ATP system is detecting zero speed and doors are aligned within the station platform limits.

D. In the Yard mode of operation, a speed limiting device shall limit maximum train speed.

7.3.4.4 Train Supervision (TS)

A. The TC system, both wayside and in Central Control, shall have a Uninterruptible Power Supply (UPS) system to support train control for a time period to be established by MDT.

B. The following systems status display shall be provided as a minimum on the Central Control mimic board:

- Train locations by block or group of blocks
- Interlock position and signal status
- Restricted speed command in effect
- Traffic direction
- Operating with ATP cutout in effect

C. There shall be a positive warning system on Yard Control Tower consoles for interlock failure or improper routing.

7.3.5 COMMUNICATIONS

7.3.5.1 General

A dedicated communications system shall be provided for the use of transit system personnel between various fixed facilities and locations of the Rapid Transit System. See Volume VII, Chapter 7 Communications Design Criteria.

The communications system design shall take into account the safety considerations outlined within this criteria.

The objective of the communications system is to provide state of the art, efficient and reliable service between all elements of MDT systems. Voice, data and visual components are required. Communications service will be provided for train operations, passenger station operation and security, emergency responder operations, maintenance operations, and monitoring and alarming of all areas for fire and unauthorized entry.

The design of the communications systems shall be coordinated with the design of train control, traction power, fare collection, support facilities, car equipment, guideway sections, and passenger stations. In areas of interface with existing equipment, the MDT communications system shall be compatible with other systems either currently in service or under design on other portions of the network.

All equipment and systems shall be designed and constructed with consideration given to physical and electrical environment such as temperature and humidity, range of operation, vibration and shock, dust and weather, electric and magnetic fields, electromagnetic coupling of conductors, pairs and cables, transient peaks of electrical grounding, and voltage and current.

Communication and TC consoles in Central Control Facility shall be designed on a site specific basis to provide for efficient and safe operations.

7.3.5.2 Radio

All radio wireless communications for planned expansions must be compatible with present Miami Dade Transit applications. All radio/wireless expansion shall be coordinated with Miami Dade's ESTD Department.

A two-way voice communication capability shall be provided between Central Control and the Train Operator for emergency and other purposes.

The existing mobile radio system for use in emergencies and for other purposes shall be expanded, as needed, for the extensions. System elements will be comprised of:

- Base stations as required in booths
- Multi-couplers, filters and associated equipment racks
- Amplifiers, pre-amplifiers, transmitters, receivers,
- Antennas (smart, directional, slotted cable) and repeaters in locations of poor reception
- Couplers, audio circuits and site control consoles
- Radio chargers in booths with spare battery packs

Communication capabilities shall be provided for the following services:

- Train operations
- Start up and/or test track operations
- Maintenance
- Yard and shops
- Security
- Emergency

Base station transmitters shall be provided with power to support the system for a minimum of 90 minutes upon an electrical power failure, unless otherwise directed by MDT, applicable codes or the AHJ.

All mobile radio support systems, such as transmitters/receivers, shall have dedicated power supplies independent of any other subsystems power.

The radio subsystem between Central Control, trains and transit personnel shall have a priority/emergency channel.

7.3.5.3 Intercom/Public Address System

The system will provide the capacity to distribute audio and visual announcements in station public areas.

The PA audio and visual messages can be generated from remote locations such as the CCF as well as local areas such as Station Attendant's booths and fire management panels.

Each passenger station shall be provided with a public address (PA) system to be used by the Station Attendant or Central Control Facility (CCF) for making voice announcements to the public. The system shall make extensive use of pre-recorded digitally stored announcements for both audio and visual messages. The majority of the non-emergency messages will be real time train arrival messages created automatically. These types of normative messages will be superseded by any emergency announcements. The system shall be addressable for live announcements through selected use of microphone inputs from local and remote sources. Messages shall likewise be addressable to individual and or multiple coverage zones. A separate fire/emergency announcement PA to be used by the emergency response

personnel shall be included and linked to the public system so it will override any lower priority public announcement.

Adequate methods of communication shall be provided between the Station Attendant's booth and the elevator. Push button intercoms shall be provided. All system elements shall comply with ADA requirements and display text as well as graphic information. Refer to Chapter 11 of the Florida Building Code.

7.3.5.4 Emergency Telephone System

A communication system will be provided at stations, guideway, ancillary, parking areas, yards and shops and other transit related locations as required by the AHJ. The system design shall include automatic switch board recall facilities, and party call capacity. The system shall also comply with the following requirements:

A. The local system will be wired into the station communication room and will provide redundant backup. Emergency communications capability shall be provided in the following locations:

- Station Attendant Booth
- Fire Management Panels
- Elevator Rooms or as required by AHJ
- Traction Power Substations
- Train Control Rooms
- Communications Rooms
- Emergency Trip Stations (Blue Light Stations)
- Gap Tie Stations
- Areas of wayside access (in conjunction with ETS/Blue Light Station)

- Central Control Facilities
- Yards and Shops
- Parking Structures
- Select station and platform areas
- Rail Supervisor Booth

Intercom locations shall include:

- Elevator cabs
- Fire Hose cabinets (at stations)
- Areas of rescue
- Select station and platform areas

Also see Volume I Section 9.3.34 and Volume VII Chapter 7 Section 7.05.3 for more information

The emergency telephones or intercoms located at the TC room, station attendant's booth, fire hose cabinets, and the emergency trip stations may be combined into a summary system for transmission to central control.

- B. A call from an emergency position shall generate a priority alarm and telephone location to CCF which will override all non-priority calls
- C. An emergency radio channel shall be designated for use in emergency conditions which may interface with emergency/rescue responding agencies.

- D. A redundant capability, such as handheld radios, shall be provided for emergency transmission in case of base station transmitter failure.
- E. A monitoring and recording capability shall be provided in CCF for all emergency transmissions.
- F. The mobile radio system and Emergency Telephone System (EMT) shall be independent, to prevent fault or failure in one from causing loss of both systems and shall have a minimum 90 minute UPS battery backup.
- G. The Metrorail Communications Network (MCN) shall carry data, voice and video over a high speed, high bandwidth, fault tolerant redundant fiber optic network within the MDT system. The system shall be designed with an open architecture to accommodate multi-vendor equipment and protocol interoperability. Sufficient excess capacity shall be provided to eliminate bandwidth limitations to current and future applications. Designs shall employ physically redundant fiber optic transport media for both primary and secondary applications. This includes dual physically separated paths within the network. An alarm condition with visual and audio annunciation shall be transmitted to local and remote panels when fault or trouble conditions are generated.
- H. All major alarm indications in the station attendant's booth shall also alarm in the CCF and shall be logged in at the CCF.
- I. All train control, communications, and support facilities control functions shall have an alternate/back-up power source. Duration of the alternate/backup power source shall be determined by MDT.

- J. All critical support facilities (such as traction power substations, gap-tie stations, Central Control power, voice and data communications systems) shall have subsystem status indications on the Central Control mimic board or other MDT approved locations within the CCF.
- K. They shall be alarmed when a fault condition occurs. Central Control shall have the capability to isolate power at any faulted area via supervisory controls.
- L. The Yard Control Tower radio communications and emergency telephone system shall be provided with a backup means of communication.

7.3.6 TRACTION POWER EQUIPMENT

7.3.6.1 General

- A. The traction power system design shall conform to the latest edition of the following safety codes, standards, regulations or recommendations as applicable:
 - Urban Mass Transportation Administration (UMTA)
 - National Electrical Code (NEC)
 - National Electric Safety Code (NESC)
 - Electrical Codes of the City of Miami and Miami-Dade County
 - American National Standards Institute (ANSI)
 - National Electrical Manufacturers Association (NEMA)
 - Institute of Electrical and Electronic Engineers (IEEE)
 - Insulated Power Cable Engineers Association (IPCEA)
 - Occupational Safety and Health Act (OSHA)
 - American Society for Testing and Materials (ASTM)
 - South Florida Building Code

- Underwriters' Laboratories Inc. (UL)
 - National Fire Protection Association (NFPA)
- B. Traction Power Emergency Trip Stations shall be provided at strategic locations in the maintenance facility, test track facility, and at specific locations along the guideway sections for rapid isolation of 700V traction power from all contact rail in a power zone.
- C. Remote control of the maintenance yard and shop traction power substation and the test track substation shall be provided at the Yard Control Tower. If "stingers" are used in locations such as the maintenance shop and blowdown pit, they shall be of the failsafe (deadman's switch) type.
- D. Remote control of yard motorized disconnect switches (at transfer zone) shall be provided in the Yard Control Tower.
- E. Adequate electrical grounding and lightning protection shall be provided for the traction power substations and gap-tie stations.
- F. Door key locks shall be provided on all manual AC/DC breaker control cabinets.
- G. Transformer rectifier doors shall be provided with power interlock safety switches.
- H. The capability shall be provided for Central Control to operate and control essential AC and DC switchgear functions including alarms and

visual indication of status changes, faults, or other abnormal conditions associated with traction power substations and gap-tie stations.

- I. Gap-tie stations and traction power substations shall be provided with the provisions outlined in paragraphs 7.03.6.2 and 7.03.6.3 as appropriate.
- J. Warning signs shall be provided at strategic locations on the contact rail protective coverboard throughout the maintenance facility indicating the hazard of the 700 VDC third rail power.

7.3.6.2 Fire Detection, Alarms and Fire Management Panels

Fire detectors and alarms shall provide annunciation (audio and visual) to determine emergency response, evacuation of facilities, activation of suppression equipment, and continued monitoring of developing situations. The fire detection system shall be separately powered, contain a backup UPS and have its various elements red color coded. Separate zones for each floor of no greater than 10,000 square feet shall be established including separate zones for Tie Breakers Stations, Traction Power Substation, Communications Rooms and select ancillary areas. All systems and equipment shall be compatible with MDTs existing Simplex 4100 fiber optic based system.

The fire detection system will be electronically supervised with alarms being generated at the CCF, Station Attendant Booth, and Fire Management Panels. Sensing devices shall include fixed temperature detectors, rate of rise detectors, ionization smoke detectors, pneumatic tube detectors, ember detectors and similar state of the art equipment. These devices will be located in passenger stations, ancillary buildings, parking structures and along the right of way as required.

A manual pull type alarm system shall likewise be provided with local/visual alarms and shall be located in hallways connecting passenger station service rooms to public areas. The design shall include the recording of fire alarms of any type including date, time and location at the Central Control Facility.

Interfaces for the fire detection and alarm system will include:

- The Metrorail Communications Network (MCN) for reporting to the CCF (dedicated fibers in a ring configuration)
- All fire suppression systems and devices
- Commercial telephone system at the CCF for reporting to the fire department
- Elevators to return the cars to street level and or code designated location open doors
- Escalators to slow stop (or possibly reverse direction with CCTV surveillance as per NFPA-130)
- Activation of fire doors and louvers as required
- Plant shut down or reversal
- Fare Gates

The system shall include a Fire Management Panel to provide for alarm monitoring, tamper detection, accessing individual detectors, and providing maintenance status. The panel displays shall show a schematic representation of all detectors, sprinklers, wet stand pipes, gas suppression systems and Heating Ventilation and Air Conditioning Systems (HVAC) activation. This includes fluid and air flow monitoring, tamper alarms and device status. ETS, radios and emergency phones shall also be provided at each panel.

A commercial telephone system at the CCF for reporting to the fire department shall be include in accordance with NFPA 72.

Panel shall be capable of:

- Counting the number of addressable devices in alarm for a particular zone
- Counting the number of addressable devices in alarm for the entire system
- Counting the number of zones in alarm
- Differentiating between alarm types and addressable devices
- Prioritizing devices such as pull stations, flow switches, heat and smoke detectors
- Receiving status reports every three seconds from all devices
- Initiating trouble alarms if addressable devices do not report on time

7.3.6.3 Access Control and Intrusion Detection (ACID) System

An Access Control and Intrusion Detection system shall be provided which consists of intrusion detectors located in passenger station rooms and equipment areas, ancillary buildings or outside areas located along the right of way that are accessible to the public.

Intrusion detectors shall provide alarms to the CCF and Station Attendant/Security booth indicating unauthorized entry for each of the following conditions:

- A broken or open window connected to a public or outside area

- A broken or open air duct cover, louver or grating connected to an outside area
- A protected door when open such as in TPSS, Tie Gap Stations, etc
- Selected areas of the right of way
- A tamper alarm for ticket vending machines

The design will incorporate the latest state of the art intrusion detectors. The latest issue of the following will be used:

- Trip wire and window tape shall be provided across louver openings and windows
- Magnetic switches shall be used on grates and doors
- Contact pads and motion detectors shall be used in hallways and access areas
- Infrared and photoelectric breaks shall be used in guideway areas
- Tamper resistant detectors for flow valves, cameras and TVMs

The ACID shall allow and record authorized access utilizing one or more of the following methods:

- Magnetic Card Readers
- Magnetic Card Strikers
- Voice recognition systems
- Thumb print or palm print scanners
- Key Pad PIN entry
- Cyber Lock or compatible system

Refer to Volume I Sections 8.1.3.3 and 8.1.3.3.1.2 for coordination.

The ACID will use the Metrorail Communications Network (MCN) for interface with CCF.

The ACID will interface to the following:

- UPS backup power system
- Independent primary power –separate circuit breaker
- Self monitoring system for loss of power, etc.
- Provide a hardware status for non communicating devices
- Assignment of priority levels for various alarms

The ACID shall be compatible with MDT's existing system.

7.3.6.4 Closed Circuit Television System (CCTV)

CCTV cameras will be strategically placed at selected locations in the stations and parking structures to facilitate customer and operations safety, security and convenience. Areas monitored may include platforms, mezzanines, equipment rooms, elevator, escalator and access locations. Refer to Volume VII Chapter 7 and Volume I Chapter 8 for further details. The specific number of cameras and their locations shall be determined after coverage zones, field of views and areas requiring surveillance have been determined.

CCTV equipment shall be housed in each station's communications room and be connected to the Metrorail communications network. Existing systems, hardware and software shall be investigated to determine if there is sufficient capacity to accommodate new designs and additional requirements. If beneficial, new Artificial Intelligence Systems shall be proposed to MDT for consideration.

The system shall include but not be limited to the following: workstations at monitoring locations (CCF, Station Attendant and Rail Supervisor booth, fire management panels, etc.); cameras, lenses, housings, mounts, monitors, digital video recording system, switchers and servers, software, power supplies and backup, brackets, connectors and all associated equipment which comprises a modern state of the art system.

Systems requirements include:

- Fixed or variable focal length color camera with low light capacity
- Optional Pan, Tilt, Zoom capacity from monitor's position (select locations to be approved by MDT)
- Weather and vandal resistant cameras mounted at 6' 8" or higher
- Optional Digital motion detector
- A minimum of 90 minute UPS back-up, unless otherwise directed by MDT
- Digital recorder with storage requirements determined by MDT's Office of Safety and Security

See Volume VII Chapter 7 Section 7.05.9 for further CCTV Information.

The CCTV system shall be compatible with MDT's existing system.

7.3.7 TRACTION POWER EQUIPMENT

7.3.7.1 General (See Volume 7 Chapters 1, 2, and 3 – Traction Power Design Criterias)

- A. The traction power system design shall conform to the latest edition of applicable safety codes, standards, and regulations. See Volume VII, Chapter 1, Traction Power Equipment; Volume VII, Chapter 2, Contact

Rail and Protective Coverboard; and Volume VII, Chapter 3, Traction Power Installation Hardware.

- B. Traction Power Emergency Trip Stations shall be provided at strategic locations in the maintenance facility, test track facility, and at specific locations along the guideway sections for rapid isolation of 750V traction power from all contact rail in a power zone.
- C. Remote control of the maintenance yard and shop traction power substation and the test track substation shall be provided at the Yard Control Tower. If "stingers" are used in locations such as the maintenance shop and blowdown pit, they shall be of the failsafe (deadman's switch) type.
- D. Remote control of yard motorized disconnect switches (at transfer zone) shall be provided in the Yard Control Tower.
- E. Adequate electrical grounding and lightning protection shall be provided for the traction power substations and gap-tie stations.
- F. Door key locks shall be provided on all manual ac/dc breaker control cabinets. See Volume VII, Section 1.2.6 for cabinet requirements.
- G. Transformer rectifier doors shall be provided with power interlock safety switches. See Volume VII, Section 1.2.6.16 for further information.
- H. The capability shall be provided for Central Control to operate and control essential ac and dc switchgear functions including alarms and

visual indication of status changes, faults, or other abnormal conditions associated with traction power substations and gap-tie stations.

- I. Gap-tie stations and traction power substations shall be provided with the provisions outlined in paragraphs 7.3.6.2 and 7.3.6.3 as appropriate.
- J. Warning signs shall be provided at strategic locations on the contact rail protective coverboard throughout the maintenance facility indicating the hazard of the 750 Vdc third rail power.

7.3.7.2 Traction Power Substation

- A. The substation battery rooms shall be provided with fan generated positive pressure ventilation system with mechanical exhaust. Also see Volume II Chapter 5.
- B. Power "on" warning lights shall be provided on all main ac/dc circuit breaker control switches.
- C. The primary power to each TPSS shall be capable of being de-energized and isolated without affecting any other TPSS. The traction network shall be capable of maintaining a sufficient train voltage, and minimizing touch potentials.

7.3.7.3 Auxiliary Power

- A. The battery discharge capacity shall be sufficient to provide the necessary power to the ac/dc breaker controls in case of failure of primary ac power. Refer to Volume II Chapter 4 Station Electrical Design Criteria.

- B. Electrical switches and components in battery room shall meet NEC requirements.
- C. Protection shall be provided against overcharging by battery chargers. Also see Volume II Chapter 4 Station Electrical Design Criteria.
- D. Adequate storage facilities shall be provided for battery acid containers.
- E. Eye wash and body spray system shall be provided for personnel decontamination.
- F. Protective clothing shall be provided for use during battery maintenance.
- G. Battery racks shall be provided for maximum protection against battery damage.

7.3.8 MAINTENANCE FACILITY

7.3.8.1 General

- A. Applicable OSHA and local building safety codes shall be incorporated in the design of maintenance facilities.
- B. Illumination levels shall be in accordance with Volume II Chapter 4 Station Electrical Design Criteria. Adequate lighting shall be provided that is free from glare and shadows.
- C. All electrical power distribution facilities shall be located above known 100 year flood levels.

- D. Maintenance facility site road grades, width and visibility shall be in conformance with maintenance vehicles and other special vehicle requirements.
- E. Site road approaches and exits from maintenance facilities shall be adequately controlled by level crossing gates or warning lights, and by traffic signals if warranted where interfacing with main highways.

7.3.8.2 Facilities

- A. Storage rooms and rooms containing combustible materials or high energy sources/equipment shall be provided with emergency exits.
- B. Water spray and eye bath facilities shall be available to personnel working in battery rooms and battery service and storage areas.
- C. Warning lights and signs shall be located at 750 Vdc power distribution and on stingers in the vehicle maintenance facilities if applicable.
- D. Protected or recessed overhead ac/dc power bus systems shall be provided, to prevent their contact with movable maintenance platforms, ladders, or mobile crane control switch cables.
- E. Warning signs and/or barriers shall be provided at vehicle maintenance pit areas in accordance with OSHA regulations.
- F. Slip resistant surfaces shall be provided in all maintenance facilities areas.
- G. First aid facilities shall be provided.

- H. Visibility of the location of the pit area shall not be obscured by installed fixtures.
- I. An emergency power system for emergency lighting and power shall be provided to maintenance facility critical subsystems.
- J. Protective clothing, goggles, hard hats, etc. shall be provided for use in the blowdown pit and other areas requiring special protection of maintenance personnel.

7.3.8.3 Yards

- A. There shall be maximum visibility of the Yard from the Control Tower.
- B. The yard facility final design shall contain adequate provisions for protection of personnel from third rail power (to include gaps for personnel and vehicle access).

7.3.9 MAINTENANCE EQUIPMENT

7.3.9.1 General

- A. Cranes, trucks, and light rail maintenance vehicles shall have adequate lights, warning signals and a communication capability with the Yard Control Tower.
- B. All maintenance vehicles to be used on the running rails shall have positive rail shunt capability for detection purposes; and detection shall be possible on a revenue track, pocket, or crossover.

7.3.10 ESCALATORS AND ELEVATORS

7.3.10.1 General Escalators (See Volume II, Chapter 1 Station Architecture, Section 1.5.2, Escalators)

Escalators are an essential element for both normal and emergency movements and shall be designed per ANSI Standard A 17.1 Safety Code for Elevators and Escalators and be constructed of noncombustible materials.

The following shall be addressed:

- Reversibility (or slow stop requirements in accordance with NFPA 130)
- Visual movement indicators in the handrail
- Safety edge and demarcation markings
- Complete demarcation, heat and light
- Accessibility for maintenance
- Skate/Skateboarding/Skidding deterrent devices
- Emergency Exiting procedures
- Fire suppression for steel truss areas

7.3.10.2 Elevators (See Volume II, Chapter 1 Station Architecture, Section 1.5.3 Elevators)

- A. Elevator designs shall meet Florida Building Code Chapter 11 requirements, and American National Standards Institute (ANSI)
- B. Fire department and maintenance controls are covered in Chapter 9, Fire and Life Safety.
- C. The emergency restart buttons and control indications shall be addressed.

- D. Two-way communication between patrons in the elevator and the CCF shall be provided. CCTV monitoring and recording shall also be provided in elevator cab.

- E. Provisions will be made to return elevators to dwell at street or code designated level and remain with doors open during emergency conditions. Restart will be through key access by Fire Department.

7.4 OTHER REFERENCE MATERIALS

The Designer shall consult the items listed below for additional information on Security issues. Also, in Appendix C is a sample Threat and Vulnerability Analysis Report:

- American National Standards Institute (ANSI) A17.1 Safety Code for Elevators and Escalators
- American Public Transportation Association (APTA), Manual for the Development of Rail Transit System Safety Program Plans
- APTA, Standard for Rail Transit System Emergency Management
- Construction and other applicable Chapters
- Department of Defense, MIL-STD-882 Systems Safety Standard Procedures
- Department of Homeland Security Publications
- Department of Transportation, 49 CFR 659 Rail Fixed Guideway System State
- Department of Transportation, Circular 5800.1 Safety and Security Management
- Department of Transportation, Compliance Guidelines for States with New Start Projects
- Department of Transportation, Handbook for Transit Safety and Security Certification
- Department of Transportation, Hazard Analysis Guidelines for Transit Projects
- Florida Building Code Chapter 11 Florida Accessibility Code for Building
- Florida Fire Protection Code
- Guidelines for Major Capital Projects
- Illumination Engineers Society (IES) Publications
- Insulated Cable Engineers Association (ICEA) Publications

- Institute of Electrical and Electronic Engineers (IEEE) Publications
- Miami Dade County Fire Prevention and Safety Code
- Miami Dade County Florida Fire Prevention and Safety Code
- Miami Dade Transit, Safety and Security Certification Plan
- Miami Dade Transit, Safety and Security Certification Plan
- National Electric Manufacturers Association (NEMA) Publications
- National Electric Safety Code (NESC) Publications
- NFPA 1 01, Life Safety Code
- NFPA 10, Portable Fire Extinguishers
- NFPA 13, Installation of Sprinkler Systems
- NFPA 130, Standard for Fixed Guideway Transit and Passenger Rail Systems
- NFPA 14, Installation of Standpipe, Private Hydrant and Hose Systems
- NFPA 2001, Clean Agent Extinguishing Systems
- NFPA 70, National Electrical Code
- NFPA 72, National Fire Alarm Code
- Occupational Health and Safety Act (OSHA) Regulations
- Ordinances of the City of Miami, Miami Dade County, and other Authorities Having Jurisdiction
- Oversight
- State of Florida, State Fire Marshal's Rules and Regulations
- Transportation Security Administration Publications