Cotton Belt Corridor PE/EIS

Design Criteria Volume 2

02/28/2011

Prepared for Dallas Area Rapid Transit
General Planning Consultant Managed by URS Corporation

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2/28/11

Version 1.1

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SECTION 1 - GENERAL

1.1 GENERAL

Dallas Area Rapid Transit (DART) is preparing preliminary engineering plans for the Cotton Belt Corridor from DFW Airport to its terminus in Plano. When completed, the regional rail within the Cotton Belt Corridor will provide service to DFW Airport, air passengers and other commuters in the North Central Texas region. In addition, it is proposed to provide connection to the DART Red and Green Lines, as well as the future Orange Line.

The Cotton Belt Corridor is an existing east west freight rail corridor that is proposed to have passenger rail. The DART Cotton Belt project corridor is located mostly on DART right of way and runs from just north of DFW Airport to central Plano. It passes through Collin, Dallas and Tarrant Counties including the cities of Grapevine, Coppell, Carrollton, Addison, Dallas, Richardson and Plano.

This two-volume set document describes the design criteria for use in the development of the Preliminary Engineering (PE) Plans for the regional rail in the Cotton Belt Corridor. Volume 1 focuses on design criteria for basic infrastructure, while Volume 2 provides design guidelines for system elements.

1.2 COMMUTER RAIL DESCRIPTION

The Cotton Belt Corridor traverses both DART and the Fort Worth Transportation Authority's (The T) service areas and provides a key, east-west regional connection. The T is currently managing the preparation of PE/EIS for commuter rail on a portion of the Cotton Belt Corridor under its Southwest to Northeast (SW2NE) program for which they anticipate Federal funding for up to 50 percent of the capital cost. The portion of the corridor in DART's service area has been identified for future development for many years. The 26-mile segment, between Dallas-Fort Worth International Airport (DFW Airport) and the Red Line, links growing employment and activities centers. As recently as the DART *2030 Transit System Plan*, DART identified regional rail service for the Cotton Belt Corridor. Regional rail service is associated with 20/60 minute peak/off-peak headways. This corridor has the potential to phase in more frequent service and/or stations over time to further support transit-oriented development and access throughout the corridor.

1.3 SYSTEM CHARACTERISTICS

The Cotton Belt corridor Regional Rail will operate on existing railroad right of way with active freight operations by The Dallas, Garland & Northeastern Shortline (DGNO) and Kansas City Southern (KCS) 26-mile segment, between Dallas-Fort Worth International Airport (DFW Airport) and the Red Line. The Cotton Belt Corridor traverses both DART and the Fort Worth Transportation Authority's service areas and provides a key, east-west regional connection.

1.4 SYSTEM REQUIREMENTS

The system shall be designed utilizing the following common characteristics and criteria. These items shall be used by all designers involved in the design of any system element. Reference should be made to each individual chapter of these criteria to ensure that the characteristics listed hereunder are not superseded by more stringent characteristics in the particular chapter.

1.4.1 Service Requirements

The Commuter Rail System shall be designed using the parameters outlined as follows:

1.4.2 Train Operations

a) Train Headways by Line Section: Trunk Line: TBD Minutes Peak

b) Schedule Speed: Average TBD MPH with a top speed TBD MPH

c) Station Dwell Time: TBD

d) For more detail see Operations, Chapter X.

1.4.3 Environmental Conditions

a) Temperature Minimum Ambient: 4^{o} F Maximum Ambient: 115^{o} F Maximum Daily Range: 50^{o} F

b) Humidity Minimum: 5 % Maximum: 100 %

c) Precipitation Maximum Rainfall Rate: 7 IN per HR

Maximum Snowfall: 8 IN Maximum Ice: Infrequent measurable quantities

d) Wind Average wind speed: 10 MPH Maximum wind gust: 70 MPH

1.4.4 Track Standards

a) See Track Section Vol-1

1.4.6 Vehicle Requirements

a) TBD

1.5 APPLICATION OF DESIGN CRITERIA, VOLUME 2

a) The Cotton Belt Corridor Regional Rail PE/EIS.

SECTION 2 - VEHICLES

2.1 GENERAL

To be developed in the future.

SECTION 3 - POSITIVE TRAIN CONTROL

3.1 GENERAL

Al segments of the Cotton Belt Line shall be planned, designed and implemented in full compliance with the Rail Safety Improvement Act of 2008 as codified in 9 U.S.C § 20157. Detailed requirements for Positive Train Control system are specifically defined by the FRA in 49 CFR §236, subpart I and other sections as amended. The following provides an overview of these requirements.

3.2 REGULATORY REFERENCES

- Rail Safety Improvement Act of 2008, 9 U.S.C. § 20157;
- Federal Railroad Administration (FRA), U.S. Code of Federal Regulations (CFR), Title 49, Parts 229, 234, 235 and 236 as amended.

3.3 ABBREVIATIONS AND DEFINITIONS

The following statutory Abbreviations and Definitions are defined in 49 CFR §236.1003

- **After-arrival mandatory directive**: means an authority to occupy a track which is issued to a train that is not effective and not to be acted upon until after the arrival and passing of a train, or trains, specifically identified in the authority.
- **Associate Administrator:** means the FRA Associate Administrator for Railroad Safety/Chief Safety Officer.
- **Class I railroad:** means a railroad which in the last year for which revenues were reported exceeded the threshold established under regulations of the Surface Transportation Board (49 CFR part 1201.1-1 (2008)).
- **Cleartext:** means the un-encrypted text in its original, human readable, form. It is the input of an encryption or encipher process, and the output of an decryption or decipher process.
- **Controlling locomotive:** means Locomotive, controlling, as defined in § 232.5.
- **Host railroad:** means a railroad that has effective operating control over a segment of track.
- **Interoperability:** means the ability of a controlling locomotive to communicate with and respond to the PTC railroad's positive train control system, including uninterrupted movements over property boundaries.
- **Limited operations:** means operations on main line track that have limited or no freight operations and are approved to be excluded from this subpart's PTC system implementation and operation requirements in accordance with § 236.1019(c).

- **Main line:** means, except as provided in § 236.1019 or where all trains are limited to restricted speed within a yard or terminal area or on auxiliary or industry tracks, a segment or route of railroad tracks:

  (1) Of a Class I railroad, as documented in current timetables filed by the Class I railroad with the FRA under § 217.7 of this title, over which 5,000,000 or more gross tons of railroad traffic is transported annually; or

  (2) Used for regularly scheduled intercity or commuter rail passenger service, as defined in 49 U.S.C. 24102, or both. Tourist, scenic, historic, or excursion operations as defined in part 238 of this chapter are not considered intercity or commuter passenger service for purposes of this part.

- **Main line track exclusion addendum ("MTEA"):** means the document submitted under §§ 236.1011 and 236.1019 requesting to designate track as other than main line.
- **Medium speed:** means, Speed, medium, as defined in subpart G of this part.
- **NPI:** means a Notice of Product Intent ("NPI") as further described in § 236.1013.
- **PTC:** means positive train control as further described in § 236.1005.
- **PTCDP:** means a PTC Development Plan as further described in § 236.1013.
- **PTCIP:** means a PTC Implementation Plan as required under 49 U.S.C. 20157 and further described in § 236.1011.
- **PTCPVL:** means a PTC Product Vendor List as further described in § 236.1023.
- **PTCSP:** means a PTC Safety Plan as further described in § 236.1015.
- **PTC railroad:** means each Class I railroad and each entity providing regularly scheduled intercity or commuter rail passenger transportation required to implement or operate a PTC system.
- **PTC System Certification:** means certification as required under 49 U.S.C. 20157 and further described in §§ 236.1009 and 236.1015.
- **Request for Amendment ("RFA"):** means a request for an amendment of a plan or system made by a PTC railroad in accordance with § 236.1021.
- **Request for Expedited Certification ("REC"):** means, as further described in § 236.1031, a request by a railroad to receive expedited consideration for PTC System Certification.
- **Restricted speed:** means, Speed, restricted, as defined in subpart G of this part.
- **Safe State:** means a system state that, when the system fails, cannot cause death, injury, occupational illness, or damage to or loss of equipment or property, or damage to the environment.
- **Segment of track:** means any part of the railroad where a train operates.

- **Temporal separation:** means that passenger and freight operations do not operate on any segment of shared track during the same period and as further defined under § 236.1019 and the process or processes in place to assure that result.
- **Tenant railroad:** means a railroad, other than a host railroad, operating on track upon which a PTC system is required.
- **Track segment:** means segment of track.
- **Type Approval:** means a number assigned to a particular PTC system indicating FRA agreement that the PTC system could fulfill the requirements of this subpart.
- **Train:** means one or more locomotives, coupled with or without cars.

3.4 PTC REQUIREMENTS SUMMARY

The term "Positive Train Control", is a term of the industry intended to summarize the basic concept of ensuring that trains maintain "positive" separation between each other, or in other words to ensure that collisions are avoided. The PTC terminology also encapsulates various train control systems elements related to ensuring positive train separation and generally improving rail safety. These systems elements are generally agreed to be, but not limited to the following.

- Communications networks and protocols;
- On-board Locomotive equipment;
- Back Office/Dispatch Systems;
- Wayside Signaling Interface;
- Wireless/Radio Communications Systems;
- Track data and management;
- Interoperability Requirements.

The PTC regulations are intended to improve rail safety and reliability by enforcing various train control functions defined in 49 CFR § 236.1005, which are summarized below:

1. Prevention of Train-to Train Collisions.
2. Prevention of over speed derailments (e.g. speed limit enforcement).
3. Prevention of incursion into established work zone limits without proper authority. This is intended to provide improved protection for wayside and track workers.
4. Prevention of movement across misaligned switches.

3.5 FRA SUBMITTAL REQUIREMENTS

The procedural requirements indicated in 49 CFR, § 236.1009 shall be followed. The following is a summary listing of required submittals and documentation to be provided to the FRA for review and approval at various phases of the project. Each of these documents requires analysis, development, resources and coordination with FRA officials to obtain approval.

- PTC Implementation Plan per 49 CFR, § 236.1011;
- PTC Development Plan, Notice of Product Intent and Type Approval Documents per 49 CFR, § 236.1013;
- PTC Safety Plan and System Certification per 49 CFR, § 236.1015.

3.6 OTHER PTC REQUIREMENTS

3.6.1 Communications and Security

The communications systems shall be designed in accordance with 49 CFR, § 236.1033. This states in part that all wireless communications between office, wayside, and onboard components in a PTC system shall provide cryptographic message integrity and authentication.

3.6.2 Field Testing

Provide testing in accordance with 49 CFR, § 236.1035.

3.6.3 Records Retention

Records shall be retained in accordance with 49 CFR, § 236.1037.

3.6.4 Operations and Maintenance Manuals

Operations and Maintenance Manuals shall be provided in accordance with 49 CFR, § 236.1039.

3.6.5 Training

Provide training and qualification programs in accordance with 49 CFR, §§§§ 236.1041, 236.1045, 236.1047, and 236.1049.

SECTION 4 - SIGNAL SYSTEM

4.1 GENERAL

Current state-of-the-art railway signaling techniques and products shall be applied throughout the Transit system to enhance safety in the movement of trains and improve the overall efficiency of train operations. The functions of the Signal System will include the protection and control of track switches; the protection and control of bi-directional train operation where applicable; the protection for following trains operating with the normal current of traffic; and highway-rail grade crossing warning. The signaling needs and the type of signalization to be provided shall be determined by the specific requirements of each line segment. The signal technology to be employed will be for a bi-directional, single track with sidings, Automatic Block Signal (ABS) system.

4.2 STANDARDS AND CODES

4.2.1 Regulatory Documents

The Signal System shall be designed to the latest revision of the following regulatory documents, at the time of Contract award:

- U.S. Code of Federal Regulations (CFR), Title 49, Part 236;
- Rules and Regulations of the Federal Railroad Administration (FRA);
- American Railway Engineering and Maintenance-of-Way Association (AREMA);
- Communications & Signals Manual;
- Rules and Regulations of the Public Utility Commission of Texas (PUCT);
- National Electrical Code (NEC);
- National Electrical Safety Code (NESC);
- Insulated Cable Engineers Association (ICEA);
- American Society for Testing and Materials (ASTM);
- American National Standards Institute, Inc. (ANSI);
- Underwriters' Laboratories, Inc. (UL);
- U.S. Department of Transportation, Federal Highway Administration (FHWA), Manual on Uniform Traffic Control Devices (MUTCD)
- Institution of Electrical and Electronic Engineers (IEEE).

4.2.2 General Standards

In addition to the regulatory documents listed in 4.2.1, the following are general Cotton Belt specific standards that shall be incorporated in the design:

- Orientation
    - Tracks shall be referenced by number. The as East-most track (towards the bottom of the drawing) shall be designated as Track 1 and the West-most track (towards the top of the drawing) shall be designated as Track 2. Any addition tracks, or instances where track designations are inconsistent shall be brought to the attention of the agency for clarification.
- All equipment shall be located in Central Instrument Locations (CIL)
    - All CILs shall be wayside bungalows (walk-in); the use of wayside cases is discouraged and shall only be permitted with approval from the agency on a case-by-case basis.
    - Each CIL shall contain equipment for various systems, such as wayside signaling, highway crossings, or electric locks.
    - Each CIL shall be named CIL%**** where % is the one letter abbreviation for the corridor, and **** is the stationing (rounded to the nearest hundred foot).
- The ID for a signal is determined as follows:
    - Interlocking/Controlled Point Signals
        - Each signal shall be named *# where * is the signal number and # is the controlling direction.
        - All signals are designated with even numbers.
        - Lower numbered signals shall be associated with the lower number track.
        - Signals are designated with an "N" or an "S" for "Northbound" and "Southbound".
- Automatic Signals
    - Each signal shall be named S%****-# where % is the one letter abbreviation for the corridor, **** is the stationing (rounded to the nearest hundred foot), and # is the track number.
    - Northbound signals shall be even numbered (the stationing rounded to the nearest even hundred foot), and Southbound signals shall be odd numbered.
- The track circuit name is determined as follows:
    - Except for OS tracks, the track circuits shall be named as ****-#T, where **** is the stationing of the Receive end of the track circuit and # is the track number.
    - OS track circuits are named from the signals in the interlocking.

- Switches names are determined as follows.
    - Switches are numbered using odd numbers starting at the lowest numbered track on the south end of the interlocking.
    - Where applicable, the ID for a switch shall include a letter to indicate it is working in conjunction with one or more other switches.
    - Examples are:
        - A switch machine on track 1 working independently shall be designated as"1";
        - If two switch machines are working in tandem, the southern-most switch would be designated "1A" and the northern-most switch "1B".

4.3 AUTOMATIC BLOCK SIGNAL SYSTEM

An Automatic Block Signal (ABS) System shall be designed that utilizes a series of consecutive blocks/track circuits governed by wayside signals that are controlled by conditions that affect the use of a block. A complete ABS signal system shall be installed including intermediate wayside signals where required.

At a minimum, the signal system design shall comply with the following:

- U.S. CFR, Title 49, Part 236, Subpart B – Automatic Block Signal System;
- AREMA C&S Manual, Part 2.2.1 – Recommended Functional/Operating Guidelines for Automatic Block Signal Circuits and Systems.

4.4 INTERLOCKING

Interlockings shall be provided at all turnouts and crossovers having power switches. Approach locking, time locking, route locking, and traffic locking shall be provided. Detector locking shall incorporate loss of shunt protection of not less than 10 seconds, and shall be provided on each route within interlocking limits. All non-conflicting train movements shall be permitted simultaneously. If applicable, sectional releasing shall be permitted.

At a minimum, the interlocking design shall comply with the following:

- U.S. CFR, Title 49, Part 236, Subpart C – Interlocking;
- AREMA C&S Manual Part 2.2.10 – Recommended Functional/Operating Guidelines for Interlockings;
- AREMA C&S Manual Part 2.2.1 – Recommended Functional/Operating Guidelines for Automatic Block Signal Circuits and Systems;
- AREMA C&S Manual Part 2.4.3 – Recommended Instructions for Automatic Block Signal Systems.

4.5 CONTROLLED POINTS

In addition to interlockings which include power operated switches, additional Controlled Points may be utilized where necessary to facilitate operational requirements. All controlled points shall include wayside signals.

4.6 HIGHWAY-RAIL GRADE CROSSINGS

The Contractor shall design, furnish, install and test the highway-rail grade crossing warning systems at all locations where the railroad alignment and streets/highways intersect.

Highway-rail grade crossing warning systems shall be designed to operate with train movements in both directions on all tracks

4.6.1 Warning systems

Grade crossing warning systems shall be designed to comply with recommended practices of the most current edition of the following:

- MUTCD;
- FHWA Railroad-Highway Grade Crossing Handbook;
- AREMA Communications and Signals Manual Part 3.1.10 – Recommended Functional/Operating Guidelines for Interconnection Between Highway Traffic Signals and Highway-Rail Grade Crossing Warning Systems;
- AREMA Communications and Signals Manual Part 3.3.10 – Recommended Instructions for Determining Warning Time and Calculating Minimum Approach Distance for Highway- Rail Grade Crossing Warning Systems;
- U.S. Department of Transportation Highway-Railroad Grade Crossing Technical Working Group.

Warning devices for highway-rail grade crossings shall be installed, and at a minimum shall include gate arms and mechanisms, gate arm lights, LED flashing light units, electronic bells, signs, microprocessor grade crossing predictors, standby/backup battery, and associated control circuitry as required. High wind guards and gate keepers shall also be provided.

4.6.2 Design Requirements

The design of each highway-rail grade crossing shall be determined based upon site specific requirements. The total warning time shall be 20 seconds, plus any additional warning time that may be required for clearance and/or traffic preemption. The Contractor shall perform an engineering analysis using a qualified traffic engineer to ensure that the Clearance Time and Exit Gate Clearance Time, where existing, are adequate for the conditions at each crossing. The Contractor shall submit a report of the engineering analysis to the agency for review.

4.6.2.1 Warning Times

In order to minimize the instances of gates beginning to rise, only to go down again for a second train, all crossing starts for crossings not in single track territory shall have a 2nd train phase of 10 seconds preceding the normal start location for the crossing. During this 2nd train phase, if the first train clears the crossing, and there is a second train within 10 seconds of the crossing, the gates shall not rise. A second train sign shall illuminate on each gate to indicate to the public that a second train is coming and the gates shall remain down until the second train clears the island circuit at the crossing. If the gates are not down during the entire 2nd train phase, the crossing shall start normally at the end of the 2nd train phase. The second train sign shall be a blank out sign so that the wording cannot be read when the sign in not energized. There shall also be a flashing element associated with the border of the sign to draw attention to the sign.

Preemption Warning Time (PWT) shall run concurrently with the 2nd train phase. The effect of this is that if the crossing where PWT is in effect is already activated, the traffic light preemption shall remain in effect until the second train clears the crossing.

After an initial layout of gates, cantilevers and flashers at the crossings, a Crossing Diagnostic Team Meeting shall be conducted with the following members at a minimum.

- agency representative;
- Civil and Traffic Engineer;
- Signal Engineer;
- TxDOT representative;
- Local Traffic Engineer;
- Others as deemed appropriate.

The Crossing Diagnostic Team Meeting shall make recommendations for changes to the initial layout based upon the local conditions of the crossings, as well as local knowledge regarding traffic conditions that may not be apparent from just a site visit.

4.6.2.2 Failures

In the event that the highway-rail grade crossing warning system does not activate or is activated but one or more crossing gates are not horizontal, the crossing signal bungalow shall interface with the appropriate signal relay bungalow(s) to ensure that the wayside signal is downgraded to the most restrictive aspect.

If the crossing remains down for more than 2 minutes, an alarm shall be sent back to the Rail Operations Center (ROC).

The exit gates shall not be the fail-up type, but rather normal fail-down gates.

4.7 SAFETY DESIGN

Train safety shall be the prime consideration in the design of the signal system and in the selection of its components, including relays and other devices with moving parts, insulated wire, wire terminals, binding posts, housings, conduits, resistors, capacitors, transformers, inductors and other similar items. The signal circuit design shall conform to the regulatory standards and codes listed in Section 4.2.1

The following requirements shall govern the design of the portions of the system or subsystem which affect train safety:

- Only components which have high reliability, predictable failure modes and rates, and which have been proven in conditions similar to the projected service shall be used.
- Components shall be combined in a manner that ensures that a restrictive rather than a permissive condition results from any component failure.
- All circuits which are not confined to one housing and which affect safety shall be doublewire, double-break, except signal and switch indicator light circuits.
- The design shall be based on closed circuit principles.
- Component or system failures shall cause a more restrictive signal indication than that permitted with no failure. The built-in fault detection and alarm generation capability are preferred.
- System safety design shall be such that any single independent component or subsystem failure results in a safe condition. Failures that are not independent (those failures which in turn always cause other failures) shall be considered in combination as a single failure and shall not cause an unsafe condition.
- Any latent failure of the equipment, that is a failure, which by itself does not result in an unsafe condition, but which in combination with a second or subsequent failure could result in an unsafe condition, must be detected and negated within a stipulated time period.
- Electronic circuit design shall insure that the following types of component failures have a restrictive rather than a permissive effect:
    - Two terminal devices – open, short, partial open or short;
    - Multi-terminal devices – combination of opens, shorts, partial opens and/or partial shorts.
- Wherever possible, built-in checks shall be included that impose a restriction and/or actuate an alarm whenever a device fails to assume its most restrictive position when conditions require that it should.
- Redundant design by itself shall not be considered an acceptable method of achieving design safety.

4.8 HEADWAYS AND BLOCK LAYOUT

Headway is defined as the length of time taken for a given signal block to upgrade to a permissive aspect after a leading train has passed that boundary at normal track speed.

Signal system design headways are calculated without regard for variations in vehicles, weather conditions, or train operators. Headway calculations shall assume that stops are made at all stations, and a dwell time of 30 seconds maximum.

The signal system shall be design to support the operational requirements of the railroad.

The anticipated levels of service are summarized below:

Weekday Operating Plan		
Period	**Time**	**Headway**
AM Peak	**TBD**	**TBD**
Mid-Day	**TBD**	**TBD**
PM Peak	**TBD**	**TBD**
Evening	**TBD**	**TBD**

Weekend & Holiday Operating Plan		
Period	**Time**	**Headway**
Mid-Day	**TBD**	**TBD**
Evening	**TBD**	**TBD**

The actual design headways have not yet been determined however the signal system shall be designed to support optimal operational requirements of the railroad.

4.9 SAFE BRAKING DISTANCE

Safe braking distances shall be calculated based on standard industry practices, the Vehicle characteristics as described in the Vehicle Technical Specifications and Freight characteristics and speed limits. The assumed deceleration rate shall be reduced on downhill grades to compensate for the effects of gravity.

In addition, all safe braking distance calculations shall be based upon the vehicle characteristics and a Maximum Authorized Design Speed (DMAS) of 79 MPH and a max operating speed (MAS) of 65 MPH for passenger trains. The safe braking distances for freight traffic will differ due to differences in the freight vehicle characteristics and MAS for freight traffic. In areas designated to allow for both commuter and freight traffic, the signal system shall be designed to conform to the vehicle with the longest safe breaking distance.

An overspeed of 5 MPH shall be added to all MASs for safe braking calculations. Formulas used to calculate safe braking distance shall be submitted to for review.

4.10 ENVIRONMENTAL CONSIDERATIONS

All signal equipment to be housed in wayside signal bungalows shall be designed for a minimum operating temperature of negative 40 degrees Fahrenheit and a maximum operating temperature of positive 160 degrees Fahrenheit; and a minimum storage temperature of negative 67 degrees Fahrenheit and a maximum storage temperature of positive 185 degrees Fahrenheit.

All CILs and wayside cases shall be provided with heating and air conditioning equipment designed to maintain an interior temperature between 50 and 90 degrees Fahrenheit.

4.11 SERVICE PROVEN EQUIPMENT AND DESIGN

All signal equipment shall be proven in similar North American railroad or transit service. The Signal System shall have an expected service life of 40 years at the specified level of service. Achievement of this useful life shall be through the use of off-the-shelf proven hardware. Each major component shall incorporate provisions to allow for functional and physical interchangeability of replacement/spare parts.

4.12 TRAIN DETECTION

Train detection in the blocks outside of the interlockings shall be accomplished by using microprocessor-based coded track circuits, such as Electro Code 5 (EC5). Genradcode or approved equivalent.. Train detection within interlocking limits shall be via vital DC track circuits. Since this alignment is non-electrified and may not receive adequate train tonnage each day, shunt enhancing technology shall be utilized in order to ensure proper detection of commuter trains.

A shunt with 0.06 Ohm resistance or less at any point between the two rails of any track circuit shall cause the track circuit to indicate train occupancy. Shunt fouling shall not be allowed, and multiple track relays or series fouling shall be used for all turnouts. All track circuits and associated bonding shall be designed to provide broken rail protection.

4.13 SIGNALS

4.13.1 Color Light Signals

Standard railroad LED or incandescent color light signals, including backgrounds and hoods, and split junction box bases shall be provided at all interlockings. The final design shall determine which type of color light signal shall be provided.

4.13.2 Signal Aspects

Each type of signal (Interlocking/Controlled Point, and Automatic/Intermediate) shall have aspects which provide indications (meaning/operating instructions), which are the same wherever they are displayed throughout the system. The Contractor shall determine and provide, signal aspects that achieve the safe braking and headway requirements and are in accordance with standard industry practices.

4.13.3 Light-Out Protection

Not applicable – signal design shall utilize LED Signal Technology.

4.13.4 Signal Locations

Signals shall be located to the right of the track governed. There may be locations where space constraints do not permit right-hand signals. However, every effort shall be made to adjust clearances so that the signals can be located on the right. Signals should be located to provide a non-obstructed view from the operator's cab, and should be viewable from a distance not less than 1,000 feet in approach to the signal.

4.13.5 Signal Height

All wayside signals governing normal movements shall be close to the Train Operator's eye level depending upon possible interferences and constraints.

4.13.6 Signal Lighting

Approach lighting shall be used and signal lamp(s) shall be extinguished when the track circuits in approach to a signal are unoccupied. Approach lighting shall be activated two blocks in advance of a signal. Exceptions to this will include the first signal approached when leaving non-signaled territory and entering signaled territory (these signals shall be lit continuously, and must use LED signals).

4.13.7 Signal Numbering

All signals shall have number plates attached to facilitate identification and simplify record keeping. Signals shall be assigned numbers as specified in Section 4.2.2 above.

4.13.8 Red Signal Violation

Where applicable, signals shall be equipped with a positive means of detecting a red signal violation. Red signal violations shall be recorded at the local data recorder, as well as being sent to the ROC.

4.14 MAINLINE TRACK SWITCHES AND TURNOUTS

All mainline switch machines shall be US&S M23E or approved equal. Switches shall be dual control (motor driven/manual) switch machines. Power for the dual control switch machines shall be from the signal power line or from commercial 120 V AC power source with rectifiers and 110 V DC batteries. Manual operation of switch machines shall be via a hand-throw lever/bar. Switch machines shall be equipped with operating rods, lock rods and point detectors. In addition to the vital point detector function, the switch machine shall also provide an indication for "maintenance required" to the ROC indicating the need for adjustment when point detector adjustment approaches tolerance limits.

Limiting speeds through turnouts can be found in the Design Criteria Section on Trackwork. A helper rod assembly shall be provided for all #15 turnouts or greater.

4.15 CONTROL CIRCUITRY

All safety circuits or logic shall be designed using vital microprocessors of proven design and successful operating record with the aim of minimizing the use of vital relays.

Non-vital logic circuits shall be controlled either by non-vital logic controllers or emulators with the aim of minimizing the use of relays.

All relays shall plug into separate relay bases. All non-vital relays shall be identical. All relays shall be furnished with at least one spare independent front-back contact.

The use of diodes, capacitors, or resistors to change the timing characteristics of a vital relay shall not be allowed. All such timing characteristics shall be accomplished magnetically.

4.16 VITAL MICROPROCESSOR INTERLOCKING SYSTEMS (VMIS)

A Vital Microprocessor Interlocking System (VMIS) shall be employed to execute all vital signal system safety functions.

The microprocessor shall be capable of operating in a rail transit environment including exposure to temperatures, humidify, and vibration. The microprocessor shall be capable of operating at a temperature range of -40 degrees Fahrenheit to +160 degrees Fahrenheit at 90% noncondensing.

The VMIS software systems shall be segregated into two independent software levels as follows:

- Executive Software shall consist of the coding that performs the input, internal and output operations that is defined within the individual interlocking application logic. The executive software shall be configured on a closed loop principle to ensure that the individual vital microprocessors operate in a fail-safe manner. The executive software shall reside in a read-only memory.

- Application Software shall be segregated from the executive software and consists of the vital signal logic defining a specific interlocking configuration. The application software shall derive its safety from signal circuit design practices similar to that used for relay logic.
- The Contractor shall furnish the application program for each programmable microprocessor based unit they supply. The intent is that in the event of a failure, CTA maintenance will be able to reload the program furnished by the Contractor.
- All programs shall be turned over to the agency. The method used to identify the programs shall be submitted for Approval.

Individual microprocessor units shall interface with the ROC and other microprocessor units via the Signals Code System communications link and approved vital protocol. Vital relays shall be permitted to provide interface between locations/wayside signal equipment only when necessary due the absence of a microprocessor at a location.

The VMIS shall be equipped with a data recorder and diagnostic system capable of being accessed on-site at the VMIS location, or remotely via the Signals Code System communications link using a diagnostic terminal or standard laptop personal computer. Data shall be capable of being accessed remotely from the data recorder and in real time on-site directly from the microprocessor equipment. The diagnostic system shall be capable of identifying a failure, the nature of the failure and failure location. In addition to the diagnostic system, individual cards including; input/output boards, central processor cards and internal power supply boards shall be equipped with indicator lights that illuminate when respective input/output devices or ports are active.

The VMIS system shall be configured to operate from local available signal system power supply sources. Individual microprocessor units shall be equipped with protection against unwarranted power surges at the power supply input terminals. The microprocessor units shall also be protected against high levels of EMC/EMI or electric noise transmitted from external sources such as radio, vehicle propulsion systems and hi-tension commercial power lines. Lightning protection including appropriate lightning arresters and equalizers shall be provided at all input terminals interfacing with wayside signal apparatus.

Microprocessor units shall be modular and consist of standalone card files capable of being mounted in standard instrument racks. Included in the instrument rack shall be all signal equipment required to provide a complete stand alone system.

4.17 SIGNAL POWER

4.17.1 Power Line

Primary power should be provided to the various signal locations by individual power drops provided by the local utility.

4.17.2 Batteries

All highway-rail grade crossing warning equipment shall be provided with standby/backup battery. Nickel-cadmium or sealed lead-acid batteries, with a minimum capacity of 240 Ampere-hours shall be provided. Separate battery banks provided for equipment located outside of the bungalow, and the equipment contained entirely within the bungalow. Battery backup shall provide sufficient power during a power off condition to allow the crossing to operate for a minimum of 8 hours under normal operating conditions. Batteries are to recover to full charge within 48 hours after return of AC power.

4.17.3 Redundant Signal Power

Redundant signal power shall be provided only at the Master Signal Location (MSL).

4.18 SIGNAL CODE SYSTEM

Each CIL shall interface with the Signal Code System to provide the following controls and indications between the CIL and the ROC:

4.18.1 Controls (from the ROC)

- Switch Control – Allows the ROC to take control of a switch. Each power switch shall have two associated controls. One shall be used to request the switch normal and the other shall be used to request the switch reverse. Requesting both positions simultaneously shall generate no new switch request.
- Route Request – Allows the ROC to request a route (requests the switch or switches that are associated within the requested route and requests the entering signal for the associated route). Each operative signal shall have one or more associated route request, depending on whether there are one or more routes associated with the signal. At a minimum, each operative signal shall have a “normal” or “reverse” route request, or both. Additional controls may be required if there are several “normal” or “reverse” routes.
- Route Cancel – Allows the ROC to cancel a cleared signal. Each signal shall have an associated Route Cancel.
- Fleet – Allows the ROC to fleet a cleared signal. Fleeting shall be initiated by first clearing a signal and then selecting the associated Fleet control. Fleeting shall be canceled by operating the Fleet Cancel for the fleeted signal. Each signal shall have the capability of being fleeted. The Fleet control shall be disabled until such time as a second track is constructed.
- Fleet Cancel – Allows the ROC to cancel a fleeted signal without canceling the Route Request. Each operative signal shall have an associated Fleet Cancel.

4.18.2 Indications (to the ROC)

- Track Circuit – Each track circuit shall indicate occupancy.
- Switch Position – Each power switch shall have three associated indications.

  - Switch is in correspondence in the normal position;
  - Switch is in correspondence in the reverse position;
  - Switch is electrically locked.
- Signal Aspect – Each signal aspect shall have an associated indication.
- Signal In Time – Each signal shall have an indication that shall indicate when the signal/route has been canceled and the ASR is de-energized.
- Lamp Out – Each signal shall have an associated indication that shall indicate whenever a lamp is burned out.
- Overrun – If applicable, each signal shall have an associated indication that shall indicate whenever a train has passed a red signal.
- Mode of Operation – Each controlled location shall provide two indications which shall indicate the current mode of operation: ROC, or Local.
- Fleet – Each signal shall have an indication which shall indicate whenever the associated signal is fleeted.
- Faults/Warnings – There shall be a series of indications to indicate fault/warning conditions. These indications shall not be under the control of the mode of operation and shall indicate whenever the fault/warning is present. These indications shall include:
  - C Power Off – Indicates whenever an AC power source is lost. This indicates that the interlocking is operating on the alternate AC power source. At locations where duel AC power sources are utilized, this indication shall monitor both sources and indicate which source is lost.
  - DC Power Off – Indicates whenever one or more of the DC power supplies is not producing DC power. At locations with standby power supplies, this indication shall monitor both the on-line and standby power supplies.
  - DC Ground – Indicates whenever one or more ground detectors indicates a positive or negative ground fault greater than 50% of the drop away current of any vital relay used in the system. This shall monitor all of the DC power supplies in the associated relay bungalow.
  - Link Fail – Indicates whenever TCP/IP communications between redundant processors (if applicable), and/or remote signal locations is lost. There shall be a separate indication for each link used.
  - Blown Fuse – Indicates whenever one or more of the indicating fuses or breakers are in the blown or tripped position.
- Redundant Processor Statuses – There shall be a series of indications to indicate the health status of redundant processors (if applicable) and the Vital Transfer Panel (VTP). These

indications shall not be under the control of the mode of operation and shall indicate whenever a status change is present. These indications shall include:

- Health Status (Main) – Indicates whenever the "Main" or "A Unit" has experienced a failure and is not in control or not able to take control.
- Health Status (Standby) – Indicates whenever the "Standby" or "B Unit" has experienced a failure and is not in control or not able to take control.
- VTP Status – Indicates whenever the VTP selector switch is not in the "auto" position.

- Highway-Rail Grade Crossing indications:
  - Gate Down – Indicates whenever the crossing gates are in the horizontal position.
  - Crossing Active – Indicates whenever the XR is de-energized.
  - Crossing Alarm – Indicates whenever the crossing gates have been in the horizontal position for greater than 2 minutes.
  - Gate Alarm – Indicates whenever the XR is energized and the crossing gate(s) are not in the vertical position.
  - Exit Gate Alarm – Indicates whenever an exit gate is down, but the entrance gates are not down.

4.19 LIGHTNING AND TRANSIENT PROTECTION

Track circuits shall be protected from lightning. Grounding electrode rods shall be provided and installed in the signal relay bungalow. Connections between arresters, other signal equipment, and grounding electrodes shall be protected, except that all connections to grounding electrodes shall be by exothermic welding. All protection provided shall be per AREMA C&S Manual, Section 11 – Circuit Protection.

All electronic and solid-state devices shall have effective internal and separate external surge protection. High-voltage lightning arresters shall be applied to commercial power connections.

4.20 WIRE AND CABLE

Location-to-location and CIL-to-field equipment signal wires in the signaled areas shall not be combined in the same cable or conduit with signal power or communication circuits. In general, conduit located in an underground conduit shall be provided in locations to be specified.

Location-to-location and CIL-to-field equipment signal conductors shall be No. 14 AWG or larger conductors. Multi-conductor cables shall have an outer jacket of extruded, black, low density, high-molecular weight polyethylene.

CIL wiring shall be No. 16 AWG or larger (TEFZEL).

Wire, cable, and the installation of both shall comply with the applicable requirements of the AREMA C&S Manual, Section 10 – Wire and Cable. A minimum of 10%, but not less than two spare conductors, shall be required in each cable.

4.21 LOCATION OF SIGNAL EQUIPMENT

Signal System equipment shall be located in a CIL.

- CILs shall be located as close to their controlling function as possible.
- The location of CILs shall not impede the installation of additional (future) tracks as noted in the Contract Documents.

All ROW mounted signal equipment, including signals, gates, cantilevers, flashers, and CILs shall clear the dynamic outline by a minimum of 4 feet.

All signal equipment mounted on the track, including switch machines shall clear the dynamic outline by a minimum of 6 inches.

Doors of the CILs shall be restrained from opening to a position less than 6 feet from the dynamic outline.

CILs shall be located in such a way as to not obstruct a train operators' or motorists' (in the case of highway-rail grade crossing warning equipment) view of the governing signal.

SECTION 5 - COMMUNICATIONS SYSTEM

5.1 GENERAL

The Communications System shall consist of the following subsystems: communications transmission; data communications, radio; public address; visual message board; telephone; fire detection and/or suppression system as required by the local jurisdiction; and intrusion detection and security. The communications system shall also be designed with provisions for a future closed circuit television (CCTV) subsystem. Additional supervisory control and control center operational communications subsystems are described in the Design Criteria.

5.2 COMMUNICATIONS SUBSYSTEMS SCOPE

5.2.1 Communication Transmission Subsystem

The Communications Transmission Subsystem (CTS) provides the medium for point-to-point, shared voice, and data transmission. It consists of transmission, multiplexing and inter-connect equipment and provides interfaces for all terminal equipment requiring connectivity from field communicating sites to the Rail Operations Control Center (ROCC).

The CTS shall utilize a single-mode fiber optic backbone with OC-12 (or OC-48) drop and insert nodes, Optical T-1 drops, and integrated Ethernet services. The CTS backbone network shall be based on the Synchronous Optical Network (SONET) standard and shall comply, at a minimum, with Telcordia Technologies GR-253-CORE, SONET Generic Criteria requirements. The SONET ring structure shall consist of two (2) separate UPSR rings, both terminated at the ROCC node Physical CTS interfaces within the communications house or facility consist of: two-wire or four-wire audio frequency channels; EIA Standard Interfaces RS-232, RS-422 or RS-485; high speed optical or wireless technologies; and Ethernet 10/100/1000 Base T.

The CTS backbone shall be a private network owned and operated by Cotton Belt. There are existing fiber cables laid along sections of the Cotton Belt corridor ROW that could be leased or shared with the existing owners. Spare dark fibers along the ROW acquired by Cotton Belt Rail shall be lit to support the CTS.

All optical multiplexers shall employ redundant, east-west optical interfaces for high-speed sections. Low speed multiplexer sections shall employ 1:1 or 1:N protection switching on circuits determined operationally critical by DART. CTS common control card equipment such as CPU's, switch matrices, timing reference cards, shelf controllers, power supplies and all other critical system resources shall be deployed with fully redundant active and standby

modules. Operational signals shall share transmission media with fire and security signals such that the following requirements shall be met:

a) The transmission media shall conform to the requirements of Installation, Maintenance and Use of Proprietary Protective Signaling Systems (NFPA 72).

b) Common transmission media shall not impair the fire alarm function.

Fire alarms, security trouble alarm, and supervisory signal transmission from transit facilities to the appropriate central supervising station may be accomplished primarily via the Communications Transmission Subsystem.

5.2.3 Central Control Communications Subsystem

There shall be a Central Control Communications and Dispatch Office subsystem (DOS). The DOS will be used to support supervision of Cotton Belt Rail operation from the Dispatch Office located at the DART Control Center. The DOS shall interface with Signal Systems and interoperate with the Back Office Equipment (BOS) as specified. There shall be proper implementation and integration of all field indications, controls, and monitoring functions as described in the signal specifications and drawings. The DOS shall include separate display monitor and terminals from those existing for Cotton Belt operations. It shall be fully integrated with the existing DRT Dispatch Center hardware and software, and shall also be integrated to the Communications and Signal System. The Dispatch Control Subsystem shall monitor and control remote equipment on the Cotton Belt Rail System as one fully integrated system.

A communications workstation shall be provided at each Dispatch Station and Yard Operations Controller console. Communications workstation equipment shall not interact with the supervisory control equipment in the console, although all equipment shall be fully integrated within the console.

The console communications equipment shall include: a touch screen LCD; keyboard; mouse; processor; and audio equipment, i.e., headset, speaker, and footswitch. The processor shall be a commercially available type state-of-the-art unit to allow for ease of upgrades and expansion to the system. Each console processor shall communicate with a central Communications Controller via an industry standard interface. The Communications Controller shall provide all audio switching, line level adjustment and line signaling functions.

The communications workstation LCD display shall provide a menu-based man-machine software interface that can provide notification and pre-assigned priority call selection for the following channel types:

a) Radio;

b) Wayside Telephone;

c) Elevator Emergency Telephone;

d) Administrative Telephone;

e) Passenger Emergency Call (PEC);

f) Public Address / Visual Message Boards (VMB).

Utilizing a combination of function keys and menu windows, it shall be possible to select incoming calls or initiate calls and also to make public address and VMB announcements to equipped station(s). The communications channels available at each workstation shall be assigned in pre-programmed groups to allow for flexible peak and off-peak personnel assignments.

5.2.4 Data Communications Subsystem

There shall be a Data Communications Subsystem (DCS) to support transmission of data between field devices and Central or Vehicle-mounted equipment such as Positive Train Control (PTC). The DCS shall be compatible with the PTC equipment and meet the performance level requirements of the PTC system.

5.2.5 Voice Radio Subsystem Rail

The Voice Radio Communications Subsystem shall provide voice radio communications between the Cotton Belt Rail Dispatch Office and Rail Vehicles, Maintenance, Police and other field personnel. The Voice Radio Subsystem shall consist of:

a) Two-way communications to support rail operations, maintenance and public safety shall be carried on a 900 MHz network that covers all above grade, underpass, and depressed Right-of-Way (ROW) sections.

b) Build-Out expanded coverage shall be part of the radio subsystem planning. This includes software-based coverage prediction and simulation tools for RF propagation studies and the performance of field coverage studies that shall give indication of the need for system expansion based on geographic factors.

c) Radio system coverage shall be provided in underpasses and depressed sections of ROW, in accordance with NFPA 130. Portable radio coverage shall be a design parameter.

The 900 MHz radio network shall utilize existing DART system and newly acquired (additional) FCC channels, base stations and/or remote receiver equipment. Radio channels shall be allocated as follows, per DART/TRE FCC licensed frequencies (the allocation may change based on operational requirement):

a) Train Operations – Primary;

b) Train Operations – Secondary;

c) Yard Operations;

d) Maintenance;

e) Police.

The implementation of additional channels shall be contingent upon business need, light rail system expansion, budget allocation, and availability of frequency licenses (as a result of any frequency use and allocation changes mandated by the Federal Communications Commission [FCC]). Each channel shall be an open channel, such that all radios operating on a channel shall hear all communications on that channel. The design shall anticipate that radio equipment will employ a form of Coded Squelch (CS) in the future.

New equipment shall be capable of operating with 12.5 kHz bandwidth capabilities, and, 6.25 kHz if available. New remote receivers shall be added as needed.

5.2.5.1 Cab Radio Channel Designators

5.2.5.2 Railroad Radio Services VHF Frequency Channels

5.2.5.3 Listing of Allocated Frequencies in the Railroad Radio Service

5.2.5.4 Interface of Radio Communications Module

5.2.5.5 Frequency Modulated Transceiver

5.2.6 Closed Circuit Television Subsystem

CCTV conduits shall be provided at all passenger stations for future CCTV equipment installation. Conduits shall be sized to allow for camera power and control cabling that includes pan/tilt/zoom (PTZ) functions. Conduits shall connect individual station camera

locations to the Communications Interface Cabinet (CIC) serving that station. The design shall adequately accommodate signal, power and control cabling. Camera power shall be provided by a UPS, with a backup time equal to that required by PA, VMB, and other station equipment located within the CIC.

Camera locations shall be defined and sites properly surveyed prior to implementation. Cameras shall be mounted to limit access to vandals, but shall be conspicuous to patrons. Aerial and at-grade stations platform level camera locations shall provide a full view of all patron accessible areas. Enclosed stations will have CCTV installed in accordance with NFPA 130.

5.2.7 Fare Collection Subsystem

The Fare Collection System shall consist of three (3) types of fare collection machines, namely Ticket Vending Machines (TVM), Parking Permit Machines (PPM), and regional smart card system currently being planned by DART in cooperation with TRE and other regional agencies. TVMs are located on the platforms and the PPMs are located on the parking lot. The machines shall be located in a well lighted area during hours of darkness.

5.2.7.1 Ticket Vending Machines (TVM) and Stand Alone Validators (SAV)

There shall be a minimum of two (2) TVMs and one SAV per platform area. Two (2)TVMs shall be accompanied with one (1) SAV and they shall comprise a set (TVM/SAV). The location of the TVMs and validator shall be spaced so as not to cause congestion from passengers using the equipment. One (1) TVM/SAV set shall be located and housed approximately XX feet from the northern edge of the platform. If more than one (1) set of TVM/SAV are provided per platform, then the second TVM/SAV set shall be located not more than XXX feet apart from the other set.

5.2.7.2 Parking Permit Machines (PPMs)

Parking Permit Machines are pay by the space number. A minimum of two (2) PPMs shall be provided per parking area for passengers' convenience and redundancy. The two (2) PPMs shall be located adjacent to each other near the entrance to the platform and on the pathway from the parking lot to the station. At some stations, parking permit purchase may be available on the platform as an integrated purchase of parking and train ticket with automatic validation through the TVM. PPMs are only applicable to station parking lots designated as paid parking only.

5.2.7.3 Public Address/Visual Message Board Subsystem

Each station shall have a Public Address/Visual Message Board (PA/VMB) to allow communication with patrons or employees as appropriate during emergency or interruptions of train service. Equipment shall be designed to comply with ADA accessibility guidelines. The Public Address (PA) system provides clear, audible communication to commuters waiting at a station. The PAS consists

of speakers located along boarding platforms. A pair of PAS speakers will be mounted on every other light pole beginning at the second light pole on the north end of the platforms.

The Visual Message Board (VMB) is required by ADA to augment and complement audio public address messaging for the benefit of hearing impaired commuters. Each unit has two (2) identical sides to display identical messages. A minimum of two (2) VMS boards per boarding platform shall be required for passenger viewing convenience and for redundancy. The VMS board shall be located approximately one third of the platform distance from each platform end.

At any station, the system shall be capable of originating announcements from: the Train Control Center (TCC); station fire management panel (if installed); security room; or at least one locally designated area, such as the Communications Interface Cabinet. The local announcement panel shall have line of site station platform and concourse visibility, where practical. Announcements from the fire management panel shall automatically override other announcements. TCC announcements shall have second priority to any local announcement. The station VMB design shall include a local keyboard access feature for ad hoc station messaging. The system shall be capable of storing multiple canned voice and visual messages. TCC Controllers and supervisors shall have the capability to select any combination of stations to receive PA/VMB announcements utilizing the communications workstation consoles.

5.2.8 Telephone Subsystem

There shall be a telephone subsystem including Administrative Telephone, Passenger Emergency Call, Elevator Emergency Telephone, Elevator Emergency Telephone, Wayside Telephone.

5.2.8.1 Administrative Telephone

One telephone per platform shall be provided to improve the sense of security and convenience. Administrative telephones shall be provided at signal and communications equipment facilities, substations, crew rooms and other areas as determined by Cotton Belt Rail. Standard desk or wall mount, 12-digit dial pad telephone equipment shall be compatible with analog PABX extensions delivered from either existing or new Cotton Belt Rail owned and operated switches.

5.2.8.2 Passenger Emergency Call

There shall be a Passenger Emergency Call (PEC) telephones at station platforms as well as in the Dispatch Office. The PEC telephones are intended for patron use. There shall be two (2) PEC telephone units per passenger station. The PEC shall be ADA compliant, and shall consist of a two push buttons unit, one Red EMERGENCY button will call for 911 emergency services and a black CALL button that will call the Dispatch Office telephone for passenger information. The PEC unit shall use a leased TELECO circuit. The PEC enclosure shall be a vandal resistant phone tower type. The PEC phone tower shall include a blue light strobe mounted atop unit,

continuously lit, and the strobe shall be activated when EMERGENCY button is pressed and flashes for duration of call.

5.2.8.3 Elevator Emergency Telephone

There shall be Elevator Emergency Telephones (EET) at stations with elevators. Elevator emergency telephones shall be integrated into each elevator cab installed in stations to provide a direct means of emergency communications from a station patron, located inside the elevator, to the operations control center. The design shall conform to ASME A17.1 latest edition, Safety Code for Elevators and Escalators, and ADA design guidelines. The instrument shall be hands-free and have only a single push button to initiate an emergency call. The instrument shall not have a dial pad or a corded handset. The instrument shall be flush mounted and integrated into the elevator control panel. Each telephone shall be served by a single PABX with no local parallel or 'party-line' wiring between instruments allowed. The instrument shall be capable of storing and auto-dialing at least a primary and secondary telephone extension of designated TCC operator console stations when a patron initiates a call.

5.2.8.4 Wayside Telephone

There shall be Wayside Telephones at the ROW to support rail operations. Wayside telephones shall be installed in normally non-public areas such as grade-separated guideway, bridges, tunnels, freight or heavy rail crossings, and at designated fire management panels. Wayside telephones and enclosures shall be NEMA 4X rated, with a 12-digit dial pad and a non-modular armored cord with handset. Between any two communications facilities, wayside telephones may be paralleled into line groups with a maximum of four telephones per line. No two adjacent wayside telephones shall be wired to a pair from the same communications facility. Telephones in northbound and southbound tunnels shall be independently wired. Drops for wayside telephones shall be in a parallel-through configuration with the cable enclosed in conduit from the cable trough, through a protected entrance terminal, to the telephone wiring terminal.

5.2.9 Fire Detection Subsystem

There shall be fire detection sensors triggered by both heat and smoke detectors arranged for cross-zone verification with class-A wiring. Communications facilities shall be configured for a minimum of two detection zones. Each zone shall consist of at least one smoke and one rate-of-rise heat detector. If more than one detector zone is activated, a fire alarm shall be annunciated from the fire detection panel and shall be indicated to the local RTU for TCC logging. Fire supervisory indications shall be allocated for future use in the event that a facility requires this monitoring function. Local alarm annunciation shall be accomplished with horn and strobe lights.

The fire detection control panel shall provide a CTS interface via an RTU so that a single alarm for each location can be indicated to the TCC. Alarm processing is described in the Train Control Center and Supervisory Control System. Primary reporting shall be

accomplished by using an Underwriter's Laboratory (UL) approved Digital Alarm Communication Transmitter (DACT). DACT's are installed at each field location with connection to the local fire detection systems that shall communicate with the existing TCC Digital Alarm Communication Receiver (DACR). This alarm reporting scheme is subject to approval by the fire marshal who represents an authority having jurisdiction.

All fire detection equipment shall conform to the latest requirements of NFPA Codes Section XXXX.

5.2.10 Intrusion Detection Subsystem

The Communications Contractor shall provide intrusion detection and alarming equipment in the Communications houses, interface cabinets, facilities and rooms. In addition, intrusion detection equipment monitoring via SCADA indication over the CTS shall be provided for Fare Collection equipment, emergency exits, equipment rooms, and other secure locations. An ROCC interface shall be provided via the CTS described in the Operations Control Center and Supervisory Control System. Communication house or room intrusion detection circuits shall be supervised by a separate intrusion detection panel or by an intrusion detection module within the fire alarm control panel. The ability at TCC to read/write numeric identification numbers and log ingress and egress shall be provided. Alarm activation shall be time delayed to allow deactivation with a key or control code from inside the house or room. An intrusion alert occurs when the Communications Room door is opened. It shall be annunciated with a low-level buzzer and indicated to the RTU for logging at the TCC. An intrusion alarm occurs if the alert is not deactivated within a selectable time period. Alarms shall be annunciated locally with a 105 dBA bell and indicated to the control center via an RTU interface. Communications equipment intrusion shall be indicated by a log entry and a visual or audio notification to controller via the Supervisory Computer System (SCS). Local annunciation is not required.

5.3 DESIGN REQUIREMENTS

- Electromagnetic Compatibility;
- Requirements;
- Communication Houses, Cabinets and other Facilities;
- Communications House.

The communications networking equipment shall be housed within the station and in the equipment house only accessible by authorized personnel. The equipment house shall be a prefabricated steel construction structure. All construction shall be applicable NFPA 70 (NEC) and Texas Building Code.

Network electronics, termination panels, UPS, and other communications equipment shall be mounted in cabinets.

Equipment room lighting, environmental controls, floor loading, space planning, service entrances, and other design criteria will be in accordance to ANSI/TIA/EIA 569-B. For security, a means to control access to any equipment room shall be provided. A state-of-the-art card reader/access system utilizing a 56Kbps service channel via the station/CTS carrier network shall be the preferred method of choice.

- Cabinets;
- Other Facilities;
- Yard Control;
- Maintenance, Service and Inspection Yard;
- Connection to Other Systems;
- DART Communications Control Center at S&I Facility;
- TRE Control Center at Irving Yard;
- Communications Cable.

Station platforms and facilities shall contain power and communications conduits and pull boxes required to support all Cotton Belt equipment, including ticket vending machines (TVMs), parking permit machines (PPMs), ticket validators, public address (PA) speakers, visual message signs (VMSs), and closed circuit televisions (CCTVs). All conduit systems (electrical, communications, and signals) shall be located within the utility corridor located by the platform to prevent platform closure in the event that there is a failure in the conduit system requiring excavation within the platform area.

5.3.1 Power Systems and Grounding

5.3.2 Uninterruptible Power Systems

5.3.3 Grounding

5.3.4 Bonding

5.3.5 Lightning Protection

5.3.6 Station Communications Equipment

5.3.7 Prohibited Materials and Methods

5.3.8 Environmental

5.3.9 Climatic Conditions

5.3.10 Air Contaminants

5.3.11 Outdoor Locations

5.3.12 Indoor Locations

5.3.13 Cooling Devices

5.3.14 Heater Devices

5.3.15 Vibration Limits

5.4 INTERFACING REQUIREMENTS

5.4.1 Station Demarcation Panel

5.4.2 General Interface Coordination

5.5 ABBREVIATIONS AND DEFINITIONS

5.6 REFERENCE AND STANDARD

5.6.1 Industry Standards

1. 28 CFR Part 36, ADA Standards for Accessible Design
2. National Fire Protection Association (NFPA)
    a. NFPA 130 - Standards for Fixed Guideway Transit Systems
    b. NFPA 70 - National Electric Code (NEC)
3. Underwriters Laboratories, Inc. (UL)
    a. UL1459 - UL Standard for Safety Telephone Equipment
    b. UL/CSA 60960 - Safety of Information Technology Equipment
    c. UL 50, Type 3R - Enclosures for Electrical Equipment
4. American National Standards Institute (ANSI)
5. Building Industry Consulting Services International (BICSI)
6. Telecommunications Industries Association (TIA)

SECTION 6 - TRAIN CONTROL CENTER AND SUPERVISORY CONTROL SYSTEM

6.1 GENERAL

To be developed in the future.

SECTION 7 - FARE COLLECTION

7.1 GENERAL

To be developed in the future.

SECTION 8 - SYSTEM GROUNDING AND RACEWAYS

8.1 GENERAL

To be developed in the future.

SECTION 9 - RELIABILITY AND ITY

9.1 GENERAL

To be developed in the future.

SECTION 10 - SYSTEMS SAFETY

10.1 GENERAL

To be developed in the future.

Alliance Transportation Group

Arredondo, Zepeda & Brunz

Bowman Engineering

Connetics Transportation Group

Cox|McLain Environmental Consulting

CP&Y

Criado & Associates

Dunbar Transportation Consulting

HMMH

KAI Texas

K Strategies Group

Legacy Resource Group

Mas-Tek Engineering & Associates

Nathan D. Maier Consulting Engineers

Pacheco Koch Consulting Engineers

Parsons

Schrader & Cline

Spartan Solutions

Stantec