Design Criteria - Phase 2 South RFP

For the
Central Florida Commuter Rail Transit Project

In preparation for

Florida Department of Transportation
District 5

Revision Log

Draft Revision #	Revised By	Date	Issue / Revision Description
--	--	3/6/13	Original Draft P2S RFP Document
1		3/17/15	CEI comments/revisions merged into document.
2		5/29/15	PMT comments/revisions incorporated for RFP

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1 INTRODUCTION

Florida Department of Transportation (FDOT), in cooperation with the Central Florida Regional Transportation Authority (LYNX), METROPLAN Orlando, The City of Orlando, and Volusia, Seminole, Orange, and Osceola Counties is proposing to extend regional commuter rail service from the CFCRT Phase 1 Sand Lake Road station to an additional station in Orange County, as well as to provide service into Osceola County.

The CFCRT project uses an active Class IV mixed freight and passenger railroad right of way (ROW) acquired from CSXT in November, 2011 for rail operations. The 61-mile corridor received the Federal Railroad Administration (FRA) alpha designation Central Florida Rail Corridor or CFRC and SunRail is the name of the commuter rail service that currently operates on the 32mile initial operating segment (IOS). The IOS service plan provides 30-minute bi-directional SunRail service during morning and evening peak periods and 120-minute service in the midday, Monday through Friday using locomotives, cab cars and passenger coaches. The SunRail service operates entirely at grade, sharing tracks owned by FDOT with freight service provided by CSXT and Florida Central Railroad (FCEN) and Amtrak intercity passenger rail service.

The CFCRT Phase 2 South Project is to extend operations within the corridor 17.2 miles south from the Sand Lake Road Station to the Poinciana Blvd Station. Phase 2 South includes construction of four stations at Meadow Woods in Orange County; and Osceola Parkway, Kissimmee Amtrak and Poinciana in Osceola County. The Opening Year operating plan is consistent with current SunRail Phase 1 operations. There are approximately 3.7 miles of existing double track with approximately 11.8 miles of additional second track being added. Work also includes adding a new railway operations signal system. End of the line storage at a Vehicle Storage and Light Maintenance Facility (VSLMF) is proposed adjacent to the Poinciana Station.

Design and construction of track and signals shall be in conformance with CFRC Operating Rules, Roadway Worker Protection Safety Plan and Safety Transportation And Responsibility (S.T.A.R.) Manual as specified in the Design Criteria.

This Project shall be constructed entirely within the limits of the right of way owned by FDOT, also referred to herein as “the Department.”

2 SAFETY AND SECURITY DESIGN

The current editions of the following codes, manuals, specifications and agreements for the applicable technical subject shall be used with this document as a basis for design, unless otherwise specified.

A

- ADA Standards for Accessible Design (2010)
- American Conference of Government Industrial Hygienists (ACGIH)
- AISC "Code of Standard Practice for Steel Buildings and Bridges." Paragraph 4.2.1 of the above code is hereby modified by deletion of the following sentence: "This

approval constitutes the owner's acceptance of all responsibility for the design adequacy of any connections designed by the fabricator as a part of his preparation of these shop drawings."

- AISC "Specifications for Structural Steel Buildings," including "Commentary" and Supplements.
- AISC "Specifications for Architecturally Exposed Structural Steel."
- AISC "Specifications for Structural Joints using ASTM A325 or A490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.
- American Iron and Steel Institute (AISI), "Specifications for the Design of Cold-Formed Steel Structural Members."
- American National Standards Institute (ANSI)
- American Railway Engineering and Maintenance of Way Association (AREMA)
    - Manual for Railway Engineering and “Portfolio of Trackwork Plans”
    - Signal Manual of Recommended Practice
- American Society of Civil Engineers (ASCE) Minimum Design Loads for Buildings and Other Structures
- American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) Handbooks
- American Society for Testing and Materials (ASTM)
- American Welding Society (AWS), Structural Welding Code and the Bridge Welding Code
- American Welding Society (AWS) D1.1 "Structural Welding Code - Steel."
- American Welding Society (AWS), D1.3 "Structural Welding Code-sheet Steel."
- ASTM A6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural use.

B

- Building Industry Society Consulting International (BICSI)

C

- Central Florida Operating and Management Agreement (CFOMA)
- Central Florida Rail Corridor (CFRC) Operating Rules
- CFRC Air Brake and Train Handling Rulebook
- CFRC Equipment Handling Rulebook and CFRC General Bulletins and Notices and CFRC Timetable and Special Instructions.
- CFRC Roadway Worker Protection Safety Plan

- CFRC Safety, Transportation and Responsibility (STAR) Manual
- CFRC Standards – Maintenance of Way Instructions (MWIs), Standard Drawings, Continuously Welded Rail (CWR)Plan and Field Manual

E

- Electronic Industry Association/ Telecommunications Industry Association (EIA/ TIA)

F

- FDOT, Facilities and Design Manual
- FDOT, Manual of Uniform Minimal Standards for Design, Construction and Maintenance for Streets and Highways (aka Florida Greenbook)
- FDOT, Plans Preparation Manual
- FDOT, Design Standards
- FDOT, Soils and Foundation Handbook
- FDOT, Standard Specifications for Road and Bridge Construction
- FDOT, Structures Manual
- Florida Accessibility Code for Building Construction
- Florida Building Code
- Florida Energy Code
- Florida Fire Prevention Code, with supplements
- Florida Fuel and Gas Code, with supplements
- Florida Mechanical Code, with supplements
- Florida Plumbing Code, with supplements
- Florida and Osceola County environmental regulations
- Florida Statutes

H

- Highway Capacity Manual, Transportation Research Board

I

- Insulated Power Cable Engineers Association (IPCEA)
- Illuminating Engineering Society of North America
- Insulated Cable Engineers Association (ICEA)

M

- Manual on Uniform Traffic Control Devices for Streets and Highways, US DOT FHA (MUTCD)

N

- National Electrical Code (NEC)
- National Electrical Safety Code (NESC)
- National Electrical Manufacturers Association (NEMA)
- NFPA 1 – Uniform Fire Code, Florida amended
- NFPA 101 – Life Safety Code

O

- Occupation Safety and Health Administration (OSHA)

S

- State of Florida Model Energy Efficiency
- Steel Deck Institute (SDI), "Design Manual for Composite Decks, Form Decks and Roof Decks."

U

- Uniform Fire Code, Florida amended
- Underwriters' Laboratories, Inc. (UL)
- U.S Department of Transportation, Transit Security Design Considerations
- U.S. Code of Federal Regulation (CFR), Title 49 as applicable
- Other applicable federal and state statutes

The CFCRT Project Phase 2 South safety and security process shall address system safety and security elements according to the requirements of the applicable standards listed in the current CFRC System Safety Program Plan (SSPP) and System Security Plan (SSP), Phase 2 South Safety and Security Management Plan (SSMP), FTA's guidance on Crime Prevention through Environmental Design (CPTED) Concepts[1], FRA's Guidance on Pedestrian Crossing Safety At or Near Passenger Stations[2], and this

[1] U.S Department of Transportation, Transit Security Design Considerations , http://transit-safety.fta.dot.gov/Security/SecurityInitiatives/DesignConsiderations/CD/sec6.htm

[2] U.S Department of Transportation, Federal Railroad Administration, Office of Railroad Safety. Guidance on Pedestrian Crossing Safety At or Near Passenger Stations, April 2012

document. Should any standard or requirement conflict, the most stringent standard shall apply.

Standards, specifications, regulations, design handbooks, safety design checklists and other sources of design guidance shall be reviewed for pertinent safety design requirements applicable to the Phase 2 South Project system. General system safety design guidelines include, but are not limited to:

- Identified hazards shall be eliminated or their associated risks shall be reduced to an acceptable level by the Department through design, including material selection or substitution.
- Hazardous substances, components and operations shall be isolated from other activities, areas, personnel and incompatible materials.
- Equipment shall be located so that access during operations, servicing, maintenance, repair or adjustment minimizes personnel exposure to hazards (e.g. hazardous chemicals, high voltage, electromagnetic radiation, cutting edges or sharp points).
- Risk resulting from excessive environmental conditions (e.g. temperature, pressure, noise, toxicity, acceleration and vibration) shall be minimized.
- Risk resulting from human error in system operation and support shall be minimized as part of the design effort.
- In the case of risk from hazards that cannot be eliminated, alternatives that shall minimize such risk shall be considered. (E.g. interlocks, redundancy, fail safe design, system protection, fire suppression and other protective measures, such as clothing, equipment, devices and procedures.)
- Power sources, controls and critical components of redundant subsystems shall be protected by physical separation or shielding, or by other suitable methods mutually agreeable to the design and the Department.
- Changes to design, configuration, production, or Project requirements (including any resulting system modifications and upgrades, retrofits, insertions of new technologies or materials, or use of new production or test techniques) shall be accomplished in a manner that maintains an acceptable level, as determined by the Department.
- When alternate design approaches cannot eliminate the hazard, safety and warning devices and warning and cautionary notes shall be provided in assembly, operations, maintenance and repair instructions, and distinctive markings shall be provided on hazardous components, equipment and facilities to ensure personnel and equipment protection. These shall be standardized in accordance with commonly accepted commercial practice or, if none exists, normal procedures. Where no such common practice exists, the design shall propose the method or methods to be used for review and approval by the Department. The design shall provide all warnings, cautions and distinctive markings proposed for review and comment.
- Design criteria shall not include inadequate or overly restrictive requirements regarding safety. Where there is appropriate supporting information, the designer shall recommend new safety criteria as required.

3 TRACK AND ROADWAY

The existing track operating speeds are between FRA Class III and IV Track Safety Standards. New track shall be built to exceed FRA Class IV Standards. Upgraded track shall also exceed Class IV Track Safety Standards.

The definition of "exceed Class IV Track Safety Standards" is: "A track structure that not only complies with the FRA Class IV Track Safety Standards, but also is strong and durable, so that it can continue to meet FRA Class IV Track Safety Standards with a maximum of reliability and a minimum of maintenance. Track upgraded to Class IV Track Safety Standards should not need major programmed maintenance or partial component replacement for several (5+) years under the anticipated traffic.

4 TRACK CLEARANCES

4.1 General

Required clearances for this project have been developed based on CFOMA and AREMA guidelines and Florida Statutes.

Standard clearances are to be used for all new construction where there are no legal requirements that dictate greater clearances. Clearances for reconstruction, rehabilitation, and alteration work are dependent on existing conditions. For dimensions at station platforms, see Section 17 *Station Geometry*.

4.2 Horizontal Clearances – Track Centers

4.2.1 Tangent Section of Track

The horizontal distance between main track centerlines shall be 15 ft 0 in. Field conditions or right of way constraints may require the main track centers to less than 15 ft 0 in, but in no case shall the horizontal main track spacing be less than 13 ft 6 in for tangent track. All deviations from the 15 ft. 0 in track spacing shall be approved by the Department.

4.2.2 Curved Sections of Track

The minimum horizontal distance between track centers shall be increased by 2 inches per degree of curvature where track centers are less than 15 ft 0 in. In curved multiple track sections, the tracks shall be concentric unless the curve is being used to modify the track location for a bridge pier, other obstructions located between the tracks, or to tie into existing track.

4.2.3 Yard tracks and Freight Sidings

The desired distance from main tracks to adjacent subsidiary tracks is 15 ft 0 in. The minimum distance from main tracks to subsidiary tracks is 13 ft 6 in (FS).

4.3 Horizontal Clearances – Obstructions

The horizontal clearance from the track centerline to a permanent obstruction shall be 18 ft 0 in. The minimum horizontal clearance from the track centerline to a permanent obstruction shall be in accordance with CFOMA. Any deviation from the 18 ft 0 in clearance to a permanent obstruction shall be approved by the Department.

For signals greater than 3 ft 0 in above the top of rail, the minimum horizontal clearance from the track centerline shall be 8 ft 6 in.

For signals and switch machines 3 ft 0 in or less above the top of rail and located between tracks, the minimum horizontal clearance from the track centerline shall be 6 ft 0 in (FS).

For horizontal clearance dimensions at station platforms, see Section 17 *Station Geometry*.

4.3.1 Curved Track Alignment

On curves, both the desired and minimum horizontal clearances to obstructions shall be increased by 1 inch per 30 minutes of curvature, for obstructions on the inside of curve, plus 1 inch per inch of Superelevation for every 5 ft of height of the obstruction above the top of rail to a maximum of 3½ inches per inch of Superelevation.

Whenever the outside track has the greater Superelevation, increase the track centers 3 ½ inches per 1 inch of Superelevation difference.

4.3.2 Passenger Platforms

The horizontal clearance from the tangent track centerline to a platform edge shall be 5 ft 1 in.

The horizontal clearance for platforms located within a horizontal curve shall be increased as described in *4.3.1 Curved Track Alignment*

Refer to Sections *17.3 Platform Heights and Offsets and 17.4 Mini-High Platforms.*

4.4 Vertical Clearances

Vertical clearances shall be maintained according to the CFOMA. Refer to Sections *17.3 Platform Heights and Offsets and 17.4 Mini-High Platforms.*

4.4.1 Intertrack Fence Outside of Passenger Platforms

A fence centered between the two tracks outside the station platform areas shall provide a barrier to deter unauthorized persons from crossing the tracks where designated by the Department. The top of the fence shall be 3 ft 6 inches higher than the top of the lowest rail. The fence shall be black vinyl coated steel chain link and posts with steel top and bottom rails. The fence shall be constructed in interlocking, removable sections to facilitate track maintenance. Supporting posts shall be removable from sleeves placed in

a concrete foundation embedded a minimum of 2 ft. The top of the concrete shall be no higher than the top of the lowest tie.

4.4.2 Wayside (ROW) Fence

Wayside fencing shall be placed, as determined by the Department, to provide a barrier to deter unauthorized persons from trespass into the CFRC ROW. The fence shall be a minimum of 6 ft in height and conform to FDOT Standards. Clearance from the track shall be in accordance with Section 4.3 of this document.

5 GEOMETRIC DESIGN

5.1 General

The desire is:

- Maintain existing alignment and grade to the maximum extent possible.
- Maintain the existing degree of curve in accordance with the CFOMA. CSXT has right of approval for any change.
- Follow existing alignment and grade with proposed 2nd track
- Minimize realignments in order to stay within the right of way
- Match Main Line track elevations at crossovers and at-grade crossings
- Vertical variations between tangent mainline tracks elevations shall be no more than 4 inches
- Vertical variation between superelevated tracks shall be minimized.
- Standard typical sections shall be proposed for the corridor to match the IOS typical sections.

5.2 Horizontal and Vertical Survey Control Requirements

Engineering stationing shall be used to reference all geometric control points.

Alignment information shown on the plans refers to the centerline of track. Alignment shall be based on the centerline of track, equidistant between gauge side of running rails. Profile refers to top of the lower rail in final position.

Track to be constructed conforming to the alignment and profile data shown on the signed and sealed plans.

5.3 Design Speeds

The design speed along horizontal curves shall be determined by considering factors such as degree of curvature, actual and unbalanced superelevation and other conditions such as proximity to station stops, interlockings, operational criteria and other more restrictive curves and gradients. The design speed shall be greater than or equal to the timetable speed at the time of the contract execution.

5.4 Alignment – Horizontal

Any increase in the degree of curve on the existing alignment requires the approval of the Department and CSXT in accordance with the CFOMA.

5.4.1 Track Layout

Station platforms shall be located in accordance with *Section 17, Station Geometry* and the attachments to the RFP.

Universal crossovers on double track main lines shall be located as shown in the RFP.

5.4.2 Layover Facilities

One storage track with a run-a-round track shall be located at the VSLMF as per Section 29.

5.4.3 Tangent Length

- The minimum tangent length in main tracks and sidings is 100 ft with zero cross level.
- The minimum desired tangent length in terminals or yard areas where the design speed is 20 mph or less is 65 ft with zero cross level.

5.4.4 Horizontal Curves

- Along main tracks, the desired maximum degree of curvature allowed shall be 2°-0' based on a design speed of 79 mph.
- The maximum degree of curvature for yards and terminals is 12°-00’.
- The minimum length of circular curve excluding spirals shall be 100 ft.

5.4.5 Concentric Curves on Multiple Tracks

Multiple tracks shall be concentric along curves when they follow the same alignment.

5.4.6 Superelevation

Curves shall be superelevated using 1 ½” unbalance based on the assigned freight train speed for each curve. Upon determining the superelevation based on freight train speed, check for the proper maximum allowable operating speed for passenger trains based on the degree of curvature and the new superelevation. If all passenger train vehicles in

scheduled service in the CFRC comply with the requirements in FRA Track Safety Standards, Paragraph 213.57(c), use *FRA Table A2 Maximum Allowable Operating Speeds – 4" Unbalance* which shall determine the sole passenger train speed for the curve. If all passenger train vehicles in scheduled service in the CFRC do not comply with the FRA Track Safety Standards, Paragraph 213.57(c), then use *FRA Table A1 Maximum Allowable Operating Speeds – 3" Unbalance* which shall determine the sole passenger train speed for the curve. Superelevation should not be reduced on existing or proposed future parallel curves of substantially the same track structure/geometry such that passenger speed has to be lowered unless a lower passenger speed has already been agreed upon by all passenger operators in the CFRC.

- Maximum actual Superelevation (E_a) shall be 5 inches.
- E_e = Equilibrium Elevation (inches) = $0.0007V^2D_c$, where

  V = Speed in miles per hour

  D_c = Degree of curve
- E_a = Actual Superelevation [in]; Difference in elevation between high and low rails.
- E_u = Unbalanced Elevation = E_e-E_a
- Allowable E_u:
  - Freight trains: 0.00" ≤ E_u ≤ 1.50"
  - Passenger trains that comply with FRA Track Safety Standards, Paragraph 231.57 (c): 0.00" ≤ E_u ≤ 4.00"
  - Passenger trains that do not comply with above: 0.00" ≤ E_u ≤ 3.00"

5.4.7 Spirals

Spirals shall be used on main tracks to transition from tangents to curves with superelevation and between compound curves with different superelevation.

- Desired minimum spiral length Ls_{min} = 100 ft or 62 Ea or 1.63 E_uV (whichever is greatest)
- Minimum spiral length Ls_{min}= 100 ft or 62 E_a or 1.22 E_uV (whichever is greatest)

5.5 Alignment – Vertical

The vertical alignment of the tracks shall consist of tangent grades connected by parabolic vertical curves meeting the criteria defined herein. The ideal surface is a uniform profile consisting of constant grades connected by vertical curves with zero cross level on tangents.

5.5.1 Grades

The profile grade is defined as the top of low rail and shall conform to the following:

- The desired maximum grade is 0.7 percent.

- The absolute maximum grade is 1.5 percent.
- The required grade at stations or where trains stop on a regular basis is 0.0 percent.
- The desired minimum length of constant grade is 200 ft.
- The absolute minimum constant grade length is 75 ft.

5.5.2 Vertical Curves

Grades shall be connected by parabolic vertical curves, which shall be defined by the following equation:

$E_x = E_1 + g_1x + 1/2rx^2$, where:

E_x	=	Elevation at point × distance from PVC, in ft.
E_1	=	Elevation at PVC, in ft.
g_l	=	Grade at PVC, in %.
x	=	Horizontal distance from PVC, in 100 ft stations.
g_2	=	Grade at PVT, in %.
L_{vc}	=	Length of vertical curve in ft
PVC	=	Beginning point of vertical curve
PVT	=	End point of vertical curve
PVI	=	Point of intersection of vertical tangents.
VE	=	External - distance from PVI to curve = $((g_2-g_1)/8)L$
r	=	Rate of change of vertical curvature = (g_2-g_1/L)
Sag	=	Concave vertical curve ($g_1-g_2<0$)
Summit	=	Convex vertical curve ($g_1-g_2>0$)
X_{LP}	=	Horizontal distance along track from PVC to low point on sag vertical curve, in ft
	=	$-g_1L/(g_2-g_1)$
X_{HP}	=	Distance along track from PVC to high point on crest vertical curve, in ft
	=	$-g_1L/(g_2-g_1)$

Turnouts shall not be located on vertical curves. In locations where a vertical curve is located adjacent to a turnout, the vertical curve shall be a minimum of 25 feet from the point of switch.

5.5.3 Minimum Length of Vertical Curve

The minimum length of the vertical curve for both sags and summits is determined by the following formula (in no case should the length of the vertical curve be less than 100 ft):

$L_{vc} = D\ V^2\ K / A$ where:

A = vertical acceleration

For freight operations: $A = 0.10\ ft/s^2$

Passenger operations: $A = 0.60\ ft/s^2$

D = absolute value of the difference in gradients expressed as a decimal

K = 2.15 conversion factor to give L_{vc} in ft

V = speed of train in miles per hour

5.5.4 Minimum Length of Tangent

Minimum length of tangents between vertical curves is 100 ft.

6 TRACKWORK DESIGN

6.1 General

Ballasted track construction shall be used at all locations.

6.2 Track Material

6.2.1 Rail

All new rail shall be 115 RE section and continuous welded rail (CWR). Standard control cooled rail shall be used except for curves of greater than 2 degrees and at SunRail stations (for a length = platform plus 200 ft beyond each end of platform) where fully heat-treated carbon steel rail shall be used. Rail shall be shop welded into a minimum of 1,400 ft strings to minimize the number of field welds. Electric flash butt welding shall be used wherever possible for field welds. CWR fabrication and electric-flash butt welding of rail, including quality assurance, shall be in accordance with AREMA Guidelines and CFRC Standards. CWR strings shall be field cut for insertion of special trackwork and insulated joints.

Relay rail shall only be used in yards, maintenance of way tracks and layover facilities. The use of relay rail requires Department concurrence.

- Only certified repair rail shall be used.

- A tag near the center of the rail shall identify certified repair rails from an approved supplier's facility. The information on the tag indicates the rail section, class, source, test date and identifier of the technician who performed the nondestructive test on the rail. Certified repair rails identified by a rail test vehicle operator are identified by a white paint stick marking on the gage face of the web of the rail.

- Certified repair rail shall be compatible with the adjacent rail and shall be the class that best matches.

- The rail webs must be in alignment.

- The base offset of rail ends to be thermite welded is recommended not to exceed ⅛ inch but in any case shall not exceed ¼ inch.

6.2.2 Ties

Provide ties in accordance with AREMA Guidelines and CFRC Standards. Dual-treated (boron/creosote) hardwood crossties shall be used in all applications. Main track and passing siding ties shall be 7" grade x 8 ft 6 in. Highway grade crossing ties and pedestrian crossing ties shall be 7" grade x 10 feet. Other track ties shall be 6" grade x 8 ft 6 in. The use of white oak ties is not permitted.

Tie spacing shall be as follows:

- On main tracks including passing sidings, wood ties shall not be spaced in excess of 19.5 inches on center.

- At grade crossings, the ties shall be 18.5 inches supporting crossing panels, 19.5 inches within the 20 foot track panel extension.

- For freight sidings and yards, maintenance of way tracks and layover facilities, the spacing shall not exceed 19.5 inches on center.

- Turnouts, crossings, switches and special trackwork shall have ties (minimum 7" x 9") spaced in accordance with AREMA Guidelines and CFRC Standards.

- At bridge approaches, ten bridge approach ties (10 ft long) are required at 19.5 inches on center (or matching existing tie spacing if less than 19.5 inches on center) at each end of the structure in accordance with CFRC MWI 1404-03

Transition ties and spacing shall be provided where changes in the track modulus occur.

6.2.3 Ballast

The Contractor shall provide ballast in accordance with AREMA Guidelines and CFRC Standards. Use Granite Type 4A gradation for main lines; Type 5 gradations for yard areas.

Minimum ballast depth below bottom of ties at the rail shall be 12 inches on tangent sections of track or below the bottom of the tie at the low rail on curved sections of track. The ballast is to be level within the tie crib and 1 inch below the base of rail. The ballast shoulder shall extend 12 inches from the ends of ties to the edge of slope on tangent sections and the inside of curves and 18 inches on the outside of curves. The 18 inch width is to extend onto the tangent at each end of the curve for 100 ft then taper to 12 inches over the next 50 ft. Ballast shoulder to be sloped at 2H:1V. On ballast deck bridges, walkways will be constructed in accordance with AREMA Section 8.5.2.2. In general, walkways shall not have less than a 2′-0″ clear width.

In areas where track is to be upgraded or realigned, the existing ballast should be cleaned to provide a minimum thickness of 8 inches of clean ballast under ties.

The CFRC CWR Plan shall be used to address FRA safety requirements. Ballast compaction/consolidation equipment (track stabilizer) shall be utilized to avoid and minimize speed restrictions for new track construction and/or track disturbance.

Ballast shall be washed prior to loading in railcars. The Department reserves the right to reject any load of ballast arriving at the site for unloading that does not conform to the gradation as determined by methods of test.

6.2.4 Sub-Ballast

Sub-ballast shall be composed of crusher run granite or limestone in accordance with AREMA Guidelines and acceptable to the Department. Sub-ballast material shall conform to the gradation requirements as follows:

Sub-ballast Gradation Requirements		
Screen Size [inches]	Percent by Weight Passing	
	Graded Aggregate [%]	Crusher Run [%]
1 ½	100	100
¾	60-100	
No. 10	30-55	15-45
No. 60	8-35	
No. 200	5 - 20	5-12

Sub-ballast shall be placed in a compacted 6-inch lifts and graded to provide a cross slope of 4% away from the center of the right of way. The minimum sub-ballast cross slope shall be no less than 2%. Sub-ballast shoulder shall be sloped at 2H:1V.

6.2.5 Sub-Grade

The Contractor shall follow the practices, standards and specifications described in the following:

- CFRC MWIs
- AREMA Guidelines
    - Manual for Railway Engineering
    - Portfolio of Trackwork Plans
- FDOT Standard Specifications for Road and Bridge Construction

The sub-grade material shall be composed of suitable excavation material as far as practical before borrow materials are obtained from outside sources. The Contractor must obtain approval in advance for any off-site borrow sources and allow sufficient time so that the suitability of the material for use as fill can be investigated. “Fill Material” should be homogenous and composed of “Common Material” or “Rock”. Materials such as topsoil, loam, uniform fine sand, silt and clay are not acceptable.

Sub-grade materials shall be placed in compacted layers over the full width of the embankment not exceeding 6 inches using approved mechanical compacting equipment before the next layer is placed with a minimum density in accordance with the Department’s standard specifications. Compaction equipment must be capable of achieving the minimum compaction requirement. Material approved for fill shall have a natural water content close to the optimum water content for compaction. When required, the Contractor shall add water uniformly be means of an approved distributor to any fill material, which is deficient in water content for compaction. If the fill material is too wet, it shall be scarified or disked and aerated until the proper water content is attained. If before acceptance of the work, the specified compaction density is not attained or softening of the subgrade surface occurs under construction traffic to a degree unsatisfactory to the Engineer, the soft material shall be reworked or removed and replaced at the Contractor’s expense.

Sub-grade shoulder to be sloped at 2H:1V. The sub-grade must be maintained in a well-drained condition at all time. Surfaces should be shaped and compacted during placement to facilitate positive drainage and minimize absorption of water. The subgrade and subballast side slopes shall be protected to control erosion in accordance with AREMA Guidelines, Ch. 1 Roadway and Ballast, Part 1 Roadway. Erosion protection includes seeding and sodding, the use of coarser materials and vegetative matting.

Temporary shoring will be provided as required to maintain the existing track grade at 2H:1V.

6.3 Special Trackwork

All special trackwork shall be located on horizontal and vertical tangents.

- All turnouts and crossovers shall be selected based on operating speeds provided in Section 14 - *Safety and Headway Criteria for Signal Block Layout Design, Design Speeds* for movements through the diverging routes.

- Derails shall be located on all freight sidings and yard lead tracks that slope downward to a main track or as freight operations dictate. Derails are installed to derail equipment away from the track to be protected and allow the equipment to stop at an adequate distance from the fouling point between tracks.

Proposed derail locations shall be reviewed and accepted by the Department prior to installation. Whenever possible, the derail should be installed on the gage side of the outside or high rail of a curve.

All derails shall be equipped with either switch locks, or if used to protect personnel or equipment of a craft or group of workmen, a lock used only by that craft or group.

- Bumping posts shall be located at the ends of all stub-ended yard tracks, the Poinciana Station track and layover facility tracks.

- Rail lubricators shall be evaluated for all curves of 2 degrees or greater for *both newly constructed and existing main line tracks and sidings*. The location site of all rail lubricators shall be directed by the Department and constructed by the Design-Build Firm.

6.3.1 Crash Walls

Refer to Section 23, *Structures*.

6.3.2 Track Gage

All track shall be Standard Gage (4'-8 ½").

6.3.3 Railroad Signs

Mileposts, whistle and speed restriction signs shall be consistent with AREMA Guidelines and CFRC Operating Rules and installed by the Contractor. Speed restriction signs shall be placed in accordance with freight train service braking distance back from the start of the restriction. Split speeds (e.g. 60/30: 60 mph for passenger and 30 mph for freight) shall be used in the signage. Railroad warning signs shall be placed at all public grade crossings in accordance with the current MUTCD.

6.3.4 Crossing Surfaces

For new mainline track construction, crossings shall be constructed according to MWIs.

Grade Crossing Panels shall be shunt resistant and intended for signalized territory.

The panel manufacturer's recommendations for installation shall be adhered to, unless otherwise specified in the MWIs.

Both the existing crossing (where it is to remain) and the new second track grade crossing shall be evaluated in consultation with the Department to determine if precast concrete panels should be used. When a new second track is added to a location where the existing crossing surface is determined by the Department to be in good condition and can remain, the new second track crossing shall also be constructed using the same or equivalent materials as the existing crossing surface. (see MWIs).

Where a new second track is added to a location and it is determined by the Department that the existing main crossing surface needs to be replaced the existing track panel shall also be replaced.

The vertical alignment of the roadway over a crossing shall coincide with the grade established by the tracks and comply with the vertical profile requirements of the Florida Greenbook.

Track panel shall be extended 20 ft beyond last crossing panel in each direction.

Tie spacing shall be 18.5 inches supporting crossing panels, 19.5 inches within the 20 foot track panel extension.

The crossing surface width shall be a minimum of 2 ft wider than the adjacent travel way of the roadway including sidewalks and/or shoulders on both sides of the roadway. Roadway widths across the railroad crossing area shall at a minimum provide a typical section matching the existing roadway section with the same number and width of traffic lanes. Crossing surfaces shall be ADA compliant.

6.3.5 Insulation Joints

Provide insulation joints in accordance with AREMA Manual, CFRC Standards and the Route and Aspect Chart.

7 ROADS AND PAVING

7.1 General

The roadway approach to the crossing shall coincide with the grade established by the track. This profile grade, preferable zero, should be extended a reasonable distance (at least two times the design speed in feet) on each side of the crossing. Where vertical curves are required to approach this section, they shall meet the requirements of the Florida Greenbook.

The full width of all travel lanes shall be continued through grade crossings. The crown of the pavement shall be removed gradually to meet the grade of the tracks. This pavement cross slope shall be removed in conformance with the requirements for superelevation runoff. The lateral and longitudinal pavement slopes should normally be designed to direct drainage away from the tracks.

Roads and paving are required to be in compliance with the applicable standards and the Florida Greenbook.

8 RAILROAD SIGNALS – GENERAL

8.1 Description

The grade crossing warning system design includes, but is not limited to, existing traffic signal modifications (including pre-emption or interconnect) and grade crossing control

systems and warning equipment (gates, flashers, etc.). The improvements required at the grade crossings are documented in the RFP.

The wayside signal system shall be a Traffic Control System (TCS) consisting of bi-directional, 4-Aspect Wayside signaling using the signal aspects provided in the current CFRC Operating Rules. Block layout shall support 79 mph passenger train and 60 mph freight train operations. Intermediate signals shall be installed between control points per the block layout. All track circuits not with in control point limits will be electronic-coded track circuits. Solid-State microprocessor-based systems shall be used for new control points and control points shall use typical DC track circuits with in the control point limits. Control points shall use fiber optic for communication to the Operations Control Center and a 900 MHz radio-based backup communication system shall be provided. The wayside signal system shall provide protection for all hand throw switches to prevent unauthorized access until expiration of a pre-determined time interval. The Traffic Control System shall be compliant with all applicable FRA regulations.

8.2 Design References, Codes and Standards

Design criteria for Signals shall be in accordance with this document and all applicable standards, instructions, specifications, and operating practices for railroad signaling. The design and construction of the system shall conform to the latest revision of applicable codes, but not limited to the recommended practices, and standards listed in Section 2.

8.3 Abbreviations and Definitions

8.3.1 Definitions

All Definitions shall be as described by AREMA in Section 1.1.1 of the Communications and Signal Manual of Recommended Practices. The definitions for terms used in the Signal Section of this document are represented by the following:

Alarm Condition - Any abnormal condition that requires the attention of an operator, supervisor or maintainer.

CIH – Central Instrument House, main control housing at an interlocking.

Pedestrian Crossing (Pedestrian Pathway) – Crossing designed across the rail for pedestrian access to platforms at stations. Pedestrian crossings shall have flashing LED lights, gates and bells for warning systems and flangeway fillers for safe pedestrian movement .

Primary Gate - A mechanism, complete with flashing lights and a standard fiberglass highway crossing gate whose color is red/white stripes. Its failure mode is in the lowered or down position. The primary gate is used to inhibit highway motor vehicle traffic for the normal direction of highway traffic.

Preemption Circuit - An electrical circuit that transmits information from a Railroad crossing location to a traffic signal control box to initiate a predetermined traffic cycle.

Right-of-Way (ROW) – Represents FDOT property lines.

Signal House - A walk-in weatherproof shelter where vital hardware is located.

Signal Case - A weatherproof enclosure where vital hardware is located.

8.4 Design Requirements

8.4.1 General

The following provisions shall govern the design of the system or a subsystem that affect public safety:

- All components shall be current, proven technology and the same or previous product models shall have been in service on a minimum of two Class 1 railroads or a minimum of two major commuter rail systems and is currently accepted by the Class 1 railroads or commuter rail systems for new installations. These components shall include an MTBF report to support reliability.
- Components shall be combined in such a manner that component failure shall result in a more restrictive condition.
- All vital circuits shall be based on closed circuit principles. Broken wires, broken rails, dirty contacts, a relay failing to respond when energized or a loss of power supply energy shall not result in unsafe conditions.
- 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 and conditions require that it should.
- All circuits, or portions of circuits, whose direct operation is required for the safety of train movements in order to protect life and property are to be considered vital.
- All relays that are to be energized by a vital circuit shall be vital relays or vital solid state electronic devices. All contacts that are used within any vital circuit shall be contacts of a vital relay, or driven by a vital output solid-state device.
- The design shall be based upon vital processor technology with plug-in type relays as required. Every effort shall be made to standardize on contact configurations.
- The wayside signal and highway-rail grade crossing design shall utilize the Phase 1 design as a basis for the signal systems for the CFRC.
- The wayside signal and highway-rail grade crossing design shall follow all manufacturer recommended practices. All designers shall be familiar with equipment being designed on this project. It will be the contractor’s responsibility to train their employees on all equipment being used on this project.

8.4.2 Fail-safe Design Criteria

Fail-safe design shall be achieved by using the closed-loop principle on vital circuitry, and shall protect against unsafe operation in the instance of a single open circuits or short circuits. All such vital circuits shall consist of two-wire, double-break circuits or vital serial data link in any instance where the controlled element (relay or vital microprocessor input) and any portion of the control circuit are not within the same instrument housing.

8.4.3 Physical – Signal Equipment Housings and Wayside Cases

All equipment within Signal Houses or Wayside Cases shall function in accordance with the environmental requirements as defined in the AREMA Guidelines Section 11.5.

Signal equipment installed outside of the Signal House or Wayside Case shall be designed to operate in all weather conditions including rain, dirt, temperature and humidity variations.

8.5 Traffic Control System (TCS) Wayside Signals

8.5.1 General

The vital signaling system shall be a Traffic Control System (TCS) permitting train movements on the double main track and passing sidings in both directions under vital signal protection. The system shall be designed with wayside signals to support the planned mixed-use corridor operation. The system shall comprise non-controlled automatic signals and controlled Interlocking and holding signals. The number of signal heads necessary for each signal shall be determined by the Route and Aspect chart. The signal heads of the non-controlled and controlled signals shall, where required by the signal block design, support flashing display. Interlocking signals controlling movement out of yard areas shall be Low Home Signals. The number of signal heads necessary for each signal shall be determined by the Route and Aspect Chart.

The signal system shall provide the functions of train detection, broken rail detection and protection, signaling for safe train operation and route security through the interlocking. All portions of the signal system shall be designed to use current proven technologies and components in accordance with industries best-practices.

All portions of the communications and signal system and its components shall be designed to operate in the electromagnetic environment that exists today or is introduced by this project. The signaling system components and operation shall be immune to any harmful effects of electromagnetic interference - conducted, radiated or inducted. The Signal system components shall comply with FCC regulations for EMI not causing adverse effects on other non-signaling systems.

The vital system logic shall be configured as a contiguous fault tolerant system of high reliability of a type that has been proven to have a high Mean Time Between Failures (MTBF). Equipment used shall be standard products produced by industry-recognized manufacturers regularly engaged in the production of such equipment or material.

8.5.2 Control Facility

Traffic Control System (Bi-Directional) – The TCS system shall be designed to be controlled from the existing Operations Control Center located at the Vehicle Storage and Maintenance Facility at Sanford near MP 766.

Refer to Section 13 describing the Operations Control Center.

8.5.3 Microprocessor-Based System

Vital processors shall be used at all interlockings and wayside signal locations to perform the signal logic required for that specific application. Vital processors shall be capable of exchanging information using vital data communication processes.

8.6 Housings

8.6.1 General

Cable trays shall be used within all houses. An open ladder-type wireway shall be supplied at ceiling level and where required to adequately support all house wiring. The use of plastic wire guide-way shall be used on walls and terminal boards.

Standard racks shall be provided within instrument houses for mounting of relays, code equipment, test and maintenance panels, and other items designed for rack mounting. A Faraday Cage shall be provided for entrance terminal boards.

Racks shall be clearly identified by number from left to right as seen from the front of the rack. Equipment spaces shall be clearly identified with rows by letter from top to bottom and equipment by number in the row from left to right. Equipment shall be arranged in rows of racks such that related functions (by signal and switch) and similar functions are grouped together in numerical order where practicable. Equipment on the racks shall not be placed less than 12 inches and not higher than 72 inches above the floor.

Standard type arrangements and layouts are required within these housings.

Instrument houses shall be sized to provide a minimum of twenty percent spare space for equipment mounting and capacity for future expansion potential.

Cables entering the house in the same cable consists shall be terminated in sequence including all spare conductors.

8.6.2 Electrical

Commercial power (60 Hz) shall be distributed through the instrument houses as needed. Houses shall be provided with fluorescent lighting, sufficient to illuminate all accessible areas to a 30 foot-candle minimum. Fluorescent lighting to be industrial type, double tube enclosed by unbreakable clear polycarbonate safety shields, four feet in length mounted in the ceiling above free floor space.

The equipment supplied under this contract shall be protected against transient surges of the commercial power line. Apparatus furnished for the power source shall include all necessary protection devices.

The circuit breaker panel shall be provided inside the Signal House. This panel shall consist of at least one Ground Fault Circuit Interrupter (GFCI) breaker. This GFCI breaker shall be used for all lighting and convenience outlets. Standard type breakers shall be provided to allow for equipment disconnects and shall be appropriately sized for the circuit load to be connected to the circuit breaker.

Each Signal House shall be equipped with an emergency generator termination plug that shall allow for external use of a generator during a long-term power outage. External power off indication lights shall be provided for each house.

8.6.3 Not Used

8.6.4 HVAC and Ventilation

Any Signal Houses containing electronic equipment shall have a climate control HVAC system of sufficient capacity to maintain a consistent temperature 20 degree F less than exterior. In the event that the ventilation or air conditioning system fails in Control Point houses, high heat alarms shall be activated at 120 degree F and sent to the CFRC Operations and Control Center (OCC) located in Sanford, Florida.

8.6.5 Grounding

Each Signal House or Wayside Case shall be supplied with all necessary lugs, terminals and grounding rods. A grounding bus shall be installed within each house or case. This shall be a copper bar, minimum 1/4 inch thick by 2 inches wide around the entire perimeter of each house, with the exception of the entrance doors. A minimum of 4 ground rods shall be installed for instrument houses, and 2 ground rods at instrument cases. Ground rods shall be 5/8 inches diameter copper covered steel, and a minimum of 8 ft in length. The grounding system shall have a resistance to earth of not more than 5 ohms.

8.6.6 Smoke Alarms and Fire Extinguishers

One smoke alarm and one fire extinguisher shall be provided at all Central Instrument Houses (CIH) houses. Smoke alarms shall be remotely indicated to the Operations Control Center.

8.6.7 Highway / Rail Grade Crossing Houses

Crossing locations requiring new houses shall be a minimum 8 ft x 8 ft climate controlled aluminum house with two points of egress. The house shall contain a minimum of one cable entrance rack/terminal board and two racks dedicated for signaling equipment. Intrusion alarms and a means to secure the house from intrusion (such as a lockable door) shall be provided in all new crossing houses and alarms shall be recorded on the local event recorder.

A power-off indicator light shall be mounted on each side of the instrument housing. The lights shall be visible to train crews approaching the crossing from either direction.

The crossing houses shall be installed a minimum of 30 feet from the crossing surface and 25 feet from the centerline of the nearest track. Crossing houses shall be installed to minimize impairing public visibility of trains approaching the crossing. Crossing house locations where a deviation shall occur shall be identified and submitted to the Department for acceptance but in no case shall the crossing house be installed less than 12 feet from the centerline of the nearest track.

Each crossing house shall be stenciled with identifying information that can be read from the roadway it is associated with. The information shall include the name of the crossing, the mile post and the crossing DOT number.

8.6.8 Central Instrument Houses

Central Instrument Houses (CIH) shall be a minimum 8 ft x 10 ft, climate controlled aluminum house as required to support the vital signal equipment. Auxiliary houses at each control point shall be a minimum 8 ft x 8 ft and sized to support the vital equipment installed.

Intrusion detection and a means to secure the house from intrusion shall be provided on all signal houses within each interlocking. Each CIH shall have a door alarm system feeding to a non-vital input (a vital input is acceptable but not required). The system shall report any entrance into the housings to the Operations Control Center (OCC). Intrusion detection cutout switches shall be mounted in the same area as the local control panel. A maintainer call light (vandal resistant design) shall be mounted on an exterior wall and an internal call light shall be provided within the CIH. The internal call light can be mounted on the Local Control Panel.

Each CIH shall be stenciled with identifying information that can be read from the front door. The information shall include the name of the location and the mile post.

8.6.9 Automatic (Intermediate) Signal Houses

Automatic Signal Houses shall be a minimum 6 ft x 6 ft climate controlled aluminum house or as required to support the vital signal equipment. A means to secure the house from intrusion shall be provided.

Each automatic signal house shall be stenciled with identifying information that can be read from the front door. The information shall include the name of the location and the mile post.

8.6.10 Wayside Cases

Signal cases shall be provided along the ROW to support track circuits, hand-thrown switch locations and miscellaneous other signal facilities. The size of the case shall be based upon engineering requirements and local field conditions. Any locations requiring more than a high single case (41”x24”x73.75”) shall be wired into a 6 ft x 6 ft or larger house. No electronic equipment shall be designed to be installed in a wayside case

without prior acceptance by the Department. A means to secure the case from intrusion shall be provided.

Each wayside case shall be stenciled with identifying information that can be read from the front door. The information shall include the name of the location and the mile post.

8.6.11 Foundations

Crossing and wayside houses shall use foundations as recommended by the house manufacturer and in all cases shall be designed to support the load of the house and all equipment installed in addition to hurricane wind loads. Galvanized steel foundations may be used for wayside cases.

9 TRAFFIC CONTROL SYSTEM (TCS) – WAYSIDE SIGNALS

9.1.1 General

Instrument houses and equipment shall be new and complete to include all internal wiring, power components, equipment apparatus, shelves, relay bars and wire ties, wall mounting brackets and all other accessories for a complete operating facility.

All material to be incorporated in the work shall be new, except where noted, and be manufactured by recognized suppliers to the railway industry and shall meet or exceed the AREMA Signal Manual Guidelines.

Wayside Signal designs shall meet or exceed current AREMA guidelines and shall comply with all current FRA regulations published in the CFR 49 Part 236.

9.2 Electronic Train Detection

The train detection system shall be predominately based upon an electronic track circuit in the form of DC current pulses and shall be compatible with train detection systems used in the IOS. This vital train detection shall be set to detecting a 0.06 ohm shunt across the running rails with an assumed ballast resistance of 2 ohms per 1000 ft of track. The system shall support a minimum of seven vital codes that can be used in combination to provide train detection as well as intermediate signal control. This system shall support the wayside block signaling vital controls and status over rails. The selected manufacturer shall be required to demonstrate reliable shunting characteristics for the equipment that shall be operated under the new commuter rail operations, without affecting or having any impacts upon safety or reliability of the freight operation.

9.3 Interlocking Train Detection

The train detection system within the interlocking shall be based upon DC track circuit. This vital train detection shall be set to detection a 0.06 ohm shunt across the running rails with an assumed ballast resistance of 2 ohms per 1000 ft of track. The circuit shall be used to support vital train detection within the interlocking with regards to all vital safety circuits and systems. Switch shunt fouling shall be used for all turnouts with a second relay added for #15 or greater turnouts. The function of this circuit shall be for

detection purposes only. This circuit shall be supported by storage-batteries located within a close proximity to the insulated joint locations defining the boundary points of the interlocking. Each Interlocking train detection shall also be supplied with a minimum 10 second loss of shunt circuit. Conditions may exist where the use of these track circuits shall be required for highway/rail grade crossing circuits or other location specific circuits and the loss of shunt delay shall not be implemented on these circuits.

9.4 Shunt Audio Frequency Overlay Circuits

Series shunt overlay circuits shall be used on electric lock locations to release the electric lock when a train is occupying the main track.

9.5 AC/DC Style Track Circuits

AC/DC Style track circuits shall be used within the layover track at VSLMF to indicate the approach of a train from the yard tracks to CP 813.

This circuit may also be used as an approach indication to main line interlockings as a method to detect trains approaching from dark territory.

9.6 Power-operated Switch Machines

All powered machines shall be equipped with internal lock, point detector rods and throw rods. The machines shall be laid out 42 inches from gauge of rail. The switch control and indication cabling shall be terminated in a junction box alongside the switch machine, with flexible loose wiring installed in flexible conduit between the switch junction box and the switch machine. All number 20 turnouts shall be equipped with a midpoint helper rod with a pipeline connection.

All switches located within the boundaries of an interlocking and having an electric switch and lock movement shall be dual controlled switch machines (24 V DC). The machine shall be consistent with the switch machines used in the IOS to reduce the quantity of spare equipment required to be maintained. The switch machine shall be supported by storage batteries in the event of a power outage.

9.7 Hand-throw Switches and Electric Locks

All hand-thrown mainline switch locations where a train can clear the mainline into a siding track shall have electric locks provided. The lock shall prevent accidental operation of the switch points unless a specified amount of time permitting an approaching train to arrive at the switch has expired or the train is detected by the shunt overlay track circuit within 75 ft of the switch points. Electronic timers shall be used for the timing circuit. Derail detection in the form of a circuit controller rod, shall be provided wherever a permanent derail is placed, which allows access to and from a mainline track. Both the mainline switch and derail shall have a target sign (Red/Green) that shall indicate the position of the switch points or derail.

Switch fouling shall be based upon shunting of the mainline track circuit the train or engine is obstructing. This detection shall be provided in the form of two separate fouling wires run between the crossover rails of a switch to the two main line rails.

Trains or engines occupying the crossover rails, fouling either of the main tracks shall be detected by the mainline track circuit.

Each electric lock layout shall consist of a manual handthrow switch mechanism, an electric lock mechanism, junction box, insulated front rod, screws, nuts, washers, pins, grease fittings and all other hardware to mount the electric lock mechanisms on the ties and connect it to the switch points. Each electric lock layout shall have a switch circuit controller and rod. The switch circuit controller shall be operated by a separate detector rod connected to a point lug for each switch point that has a signal governing movement over the switch.

9.8 Helper Rods

Helper rod assemblies (external connecting pipe) shall be provided on all number 20 turnouts per AREMA.

9.9 Switch Circuit Controller and Rod

Switch circuit controller shall be furnished complete with connecting rod, switch point lug, cable entrance, and all bolts, nuts, washers, and fastenings.

9.10 Junction Boxes

Junction boxes complete with pedestal, cable entrance, and all bolts, nuts, washers, and fastenings shall be furnished to terminate underground cables. This junction box shall be provided complete with a sufficient quantity of AAR type double post terminals to terminate all cable wires, including spares.

9.11 Home Signals (Interlocking High Signals)

All home signals shall be LED color light signals capable of displaying the required Signal Aspect for that particular location, shall be compatible with CFRC Operating Rules, and the aspect chart. Signals shall be LED color light type, installed adjacent to the tracks, in accordance with standard clearances. Ground masts shall be used for all main line signals except under special circumstances. Split base junction boxes shall be provided for all high wayside signals. Solid welded bases with mast mounted junction boxes shall be used for all signal bridges and cantilever signals. The Designer shall be responsible for verifying the signals shall comply with CFRC Operating Rules.

Signals shall be mounted on a Signal Bridge or Cantilever if located within 500 feet of a station platform.

9.12 Low Home Signals (Interlocking Low Signals)

Dwarf signals shall be used for slow speed non-mainline train movements onto the mainline. Signals shall be LED color light signals capable of displaying the required Signal Aspect for that particular location, shall be compatible with CFRC Signal Aspects and Indication Rules and the aspect chart and shall be determined by the Designer. All signals shall be installed on all yard or siding tracks (other than main line tracks) at the clearance point with the mainline at the interlocking.

9.13 Automatic Signals (Intermediate Signals)

Automatic signals shall be high signals capable of displaying the required Signal Aspect for that particular location shall be compatible with CFRC Signal Aspects and Indication Rules and the aspect chart and shall be determined by the Designer. Signals shall be LED color light type, installed adjacent to the tracks, in accordance with standard clearances. Ground masts shall be used for all main line signals except under special circumstances. Split base junction boxes shall be provided for all high wayside signals. Solid welded bases with mast mounted junction boxes shall be used for all signal bridges and cantilever signals. The Designer shall be responsible for verifying the signals shall comply with CFRC Operating Rules.

Signals shall be mounted on a Signal Bridge or Cantilever if located within 500 feet of a station platform.

9.14 Microprocessor-Based Interlockings

9.14.1 General

The design of the interlockings shall be based upon a vital microprocessor.

9.14.2 Vital Processor

The design of the new system shall be based upon a fault tolerant vital processor supported by vital plug-in type relays, as required. Should a failure occur and lead to a reset, the processor shall attempt to reset itself two times with a minimum of 3 minutes between attempts. After the third failed attempt, the processor shall be considered failed and proper alarms sent.

Vital processors shall be used at all interlockings to perform the signal logic required for that specific application. Vital processors shall be capable of exchanging information between other vital processor based railroad signal systems using dedicated vital data communication processes. Each microprocessor-based unit shall receive inputs from vital track circuits, signals, switches, grade crossings, traffic controllers, etc. and process them accordingly.

9.14.3 Microprocessor-Based Control Points

A list of the major functions the Microprocessor shall manage follows. This list is not intended to be all inclusive of every microprocessor application required by the Phase 2 South project.

9.14.3.1 Track blocking

Track blocking shall be provided for each track section to prevent a route from becoming established into an out of service track.

9.14.3.2 Indication Circuits

All indication circuits shall be non-vital in purpose. Indication circuits shall be provided for use with all Local Control Panels for indicating the availability of the functions of the associated controls. Each individual signal block shall be indicated to the CFRC Operations Control Center and interconnections specified herein.

9.14.3.3 Line Circuits

The use of line circuits shall be kept to a minimum where possible. Each track circuit shall be indicated by the nearest Control Point and reported to the CFRC Operations Control Center. All line circuits that require a physical connection shall be accomplished through hard wired underground vital cable installations. All vital circuits shall be double break, except within a signal house or wayside case, after the entering or leaving circuits are double broke.

9.14.3.4 Route Selection Circuits

Route selection shall determine the proper route for movement through an interlocking and initiate traffic reversal on the exiting track, if applicable. No over and back movements within the same interlocking are currently planned.

9.14.3.5 Route Locking Circuits

Route locking shall be provided for all interlocking moves, with sectional releasing to the rear of the train movement when and where a safe routine exists to the rear of such move.

9.14.3.6 Traffic Locking Circuits

Traffic locking shall be in effect to prevent changing the direction of traffic if any route is lined or locked to enter the TCS territory or any track circuit within the block is occupied.

9.14.3.7 Approach and Time Locking Circuits

Approach locking shall not be provided except at Electric Lock Switches.

The method of changing specified time (if not external to the microprocessor) shall be submitted for acceptance.

The ASR circuitry shall be designed such that two track circuits must be de-energized simultaneously to allow the ASR relay to energize after the relay has been de-energized with the first of the two track circuits being the circuit directly after passing the absolute signal.

Time locking shall be provided for each signal that will prevent the route from being changed or a signal being cleared into the route for a predetermined time interval if a signal is put to stop without the movement of a train. The time interval will be calculated by the Designer based on AREMA Section 2.4.20

9.14.4 Software Design

The system shall be designed such that no single component failure can result in unsafe operation. Also, any component failure which could result in unsafe operation because of successive component failures shall revert to the fallback mode.

All executive and vital system software, including all self-checks, shall be installed in the system in a manner that shall prevent unintentional changes by the user.

Location specific vital and non-vital software shall be programmable by the user and shall be stored in non-volatile memory. Field adjustable items shall not be locked by the program and shall be available for field adjustment. Programmable field adjustments shall be password protected, capable of adjustment after entry of the correct password.

The system shall automatically reset and should attempt a restart after a condition causing system shutdown is eliminated.

The system shall remain in fallback mode until self-initialization software and hardware tests have been completed to determine that the system is operating properly.

The system shall contain internal diagnostics to permit troubleshooting.

9.14.5 Signal Control (Vital)

All vital signals shall be LED colorlight signals. Current limiting resistors shall be mounted in the head of the signal to allow for proper voltage adjustments to be made at the signal head by maintenance personnel. Light out detection shall be accomplished by means of determining if 80% of the normal current to light the circuit is present. Current falling below this 80% level shall result in notification that the signal's light is out, and the signal shall display a more restrictive aspect and downgrade the approach signal to an appropriate aspect. .

9.14.5.1 Switch Control

Vital relays shall be provided for the control and indication of the dual controlled switch machines. The switch correspondence shall be a vital software expression, determined by vital switch requests and switch point detection relays. The switch overload protection shall be accomplished by the means of "timed" base output of the control circuit, in that a specified amount of time shall be programmed in which the switch machine must come into correspondence. Once this time has expired, the vital processor outputs for the normal switch and reverse switch control relays shall be removed and the switch shall be considered to be "overloaded". The Designer shall be responsible for determining the length of time this circuit is applied based on the switch manufacturer recommendations.

9.14.5.2 Interlocking Track Circuits

Interlocking Track relays shall require a 10 second Loss of Shunt (LOS) device. The LOS together with the actual Track Relay shall produce the logic for the Track Repeater Stick Relay (TPSR). The vital logic for that particular Track Circuit shall use this TPSR. No additional vital wayside signal circuit shall be driven off the actual track relay without written acceptance from the Department.

9.14.5.3 Code System Interface

The bit and code chart shall logically group together controls and indications on a unit and application basis and shall be consistent with charts defined in the IOS.

The non-vital control and indication of the system shall be handled via the fiber optic network. A 900 MHz data radio communications system shall be installed at the control points to provide Control Point (CP) to OCC communications in the event of a fiber optic failure. The communications shall automatically transfer to the backup system upon a fiber optic failure and transfer back to the fiber when communications are restored. A visual indication shall be provided to the CFRC Train Dispatcher in the OCC that a CP has transferred to the backup system.

9.14.6 Vital Wayside Signal Circuits

9.14.6.1 Interlocking Aspects

The Aspects shall be based upon CFRC Operating Rules. Each interlocking shall be capable of displaying all aspects related to the CFCRT project. Each interlocking shall have a route and aspect chart pertaining to that specific interlocking showing as a minimum three signal blocks to the rear of the interlocking home signals. The individual Route and Aspect chart for each interlocking shall provide “Actual” and “Equated” distances of each signal block represented on the interlocking drawing.

9.14.6.2 Lights Out

All Home signals shall include the function of “Light Out” detection. Should a signal head detect a light out condition, the light shall be considered burned out and the signal shall display a more restrictive aspect and downgrade the approach signal to an appropriate aspect. Light out indications shall be transmitted to the OCC.

9.14.6.3 Fleeting

Fleeting shall be provided for all interlocking signals on straight through main track movements. Fleeting shall only be established once the signal has been cleared, but may be cancelled at any time.

9.14.6.4 Local Control Panel (LCP)

The LCP shall be provided inside the Signal House.

9.14.7 Vital / Non-Vital Direct Current Power

Each interlocking shall have a minimum of four Direct Current (DC) power supplies with standby storage batteries. These DC power buses shall be standard from interlocking to interlocking and shall be placed in approximately the same location within each Central Instrument House. The batteries shall be in parallel with the chargers so as not to require a transfer device of any kind. Failure of the Commercial AC power source shall result in the storage batteries automatically assuming the load of the vital buses.

Power supplies and DC buses shall be required by the system design and shall be shown on the Design Plans. Battery power calculations shall be provided to indicate proper sizing of the battery capacity.

9.14.8 Maintenance Requirements

Vital / Non-Vital software expressions shall provide relay logic printout and shall provide a tabulation of all of the software expressions used in the application portion of the microprocessor based system. This tabulation shall indicate where the expressions are used along with the number of times each expression is used within the software.

The Microprocessor shall provide a means for maintenance personnel to view a stored memory location and determine its current status through a maintenance laptop computer. Software/hardware shall be provided to allow maintenance personnel to simply “click” on a particular interlocking, get a listing of all of the vital and non-vital expressions used at the interlocking and check the status of the vital and non-vital expressions without interrupting or compromising the integrity of the vital system.

9.14.9 Local Control Panels (LCP)

The LCP shall be equipped with toggle switches that shall allow “indication only” viewing for the maintenance personnel. To gain control over the interlocking it is anticipated that maintenance personnel shall “request” manual control from the Operations Control Center via telephone or the system wide radio maintenance channel. If approved, the Operation Control Center shall send a control to the interlocking releasing the control remotely and allow personnel located within the CIH to assume control over the signal apparatuses. This control shall be limited to the locally controlled switches and signals relating to that particular interlocking.

In addition to this method of transferring control a “keyed” (software and hardware) based security system shall also be deployed for failures that may occur to the remote radio based CTC control system. The means and procedure of this security shall be submitted to the Department for acceptance.

Once the LCP assumes control the unit shall clearly display to the user that the panel is actively controlling the signal apparatuses associated with the particular interlocking. The event recorder shall record and time stamp this transfer of control between the remote dispatcher and the LCP.

9.15 Signal Bridges/Signal Cantilevers

Where clearances are insufficient for signal masts or in the case of interlockings with more than two tracks, a pre-fabricated signal (either bridge or cantilever) structure shall be used. Signal bridges shall be furnished complete with all ladders (including lockouts), junction boxes, foundations, etc.

Signal bridges or cantilevered signals shall be used at station exiting signals where a minimum of 15 seconds of preview distance is not provided or if any portion of the signal aspect is obstructed from view due to the station canopies. Signals shall be mounted on a Signal Bridge or Cantilever if located within 500 feet of a station platform.

9.16 Event Recording System

Event Recording shall be internal to the vital and/or non-vital processors at each interlocking. Inputs provided to the processor shall be recorded by the event recorder so that failure of the microprocessor system does not compromise the data being recorded by the event recorder.

The event recorders shall be capable of allowing remote queries as to the status of the vital and non-vital systems in the event a vital processor should fail. The events recorded shall provide maintenance personnel with sufficient data to quickly assess the failure and respond accordingly.

The digital event recorder shall be a microprocessor based device. The unit memory shall be cyclical. When memory storage capacity is reached, the oldest data shall be erased and replaced with the data containing the newer information. The unit to be furnished and installed shall be capable of storing all of the data needed for 30 days with 40 train movements per day per track before recycling.

As a minimum, the events to be recorded shall consist of all controls and indications that the LCP depicts including but not limited to:

- Microprocessor Failures
- Track circuits
- Switch Positions
- Signal Clear Indication
- Crossing Positions
- Use of LCP
- Entrance Alarms
- Smoke Alarm
- Power off
- Other functions as required by the Engineer

A standard interface shall be provided on the recorder unit to download event data to a printer or laptop computer. All available event data shall be available to be downloaded, through the use of user options specific selections can be made that include but not necessarily limited to, specific times and data points.

This power supply shall support the main internal clock, and protect data in random access memory or printed circuit board memory.

Event logs shall record the following:

- Occurrence of alarm conditions
- Time/date event change
- Date of latest revision

The system shall allow retrieving, printing and viewing of data both locally and remotely in the English language and with a time stamp. Data shall be retrievable, viewable, and

printable both remotely and locally in real time or in time definable blocks down to one second increments.

9.17 Peripheral Locations

None identified

9.17.1 Defect Detectors

A Defect Detector is located at MP 801.00 on the west side of the existing track. A second track is being added on the east side of the existing track at this location and the Defect Detector house shall not be required to be relocated. A new dragging equipment detector and new hot journal detector shall be added to the second track and connected to the existing detector.

Voice announcements shall be made for each train that passes over the Defect Detector and shall include, at a minimum, detector location identification, train wheels count and defects noted. Announcement shall be consistent with current system and other defect detectors within the CFRC.

10 HIGHWAY-RAIL GRADE CROSSING SYSTEMS

10.1 General

Instrument houses and equipment shall be new and complete to include all internal wiring, power components, equipment apparatus, shelves, relay bars and wire ties, wall mounting brackets and all other accessories for a complete operating facility ready for outside power and hook up.

All material to be incorporated in the work shall be new, except where noted, and be manufactured by recognized suppliers to the railway industry and shall meet or exceed the AREMA Signal Manual Guidelines.

Highway-Rail Grade Crossing design shall meet or exceed current AREMA and MUTCD standards and shall comply with all current FRA regulations published in the CFR 49 Part 234.

At each crossing where traffic preemption is required, a vital No. 9 AWG cable shall be provided from the new housings to a pull/termination box located at the nearest ROW property point to the highway traffic controller. The Contractor shall be responsible to coordinate with the local, county, city or state agency, with jurisdiction of the traffic light system that traffic preemption is included in the design and construction.

All grade crossings with track work involved or where roadway surface is being renewed or as shown in the RFP shall receive the following:

- All flashers (Gate and pole mounted) shall be based upon LED technology and in accordance with the current AREMA guidelines. Pole and Cantilever flashers shall be 12 inch LED's while the gate arms shall receive 4 inch LED's.
    - Sidewalks outside the railroad ROW that do not continue within the RR ROW shall have the end-of-sidewalk in accordance with MUTCD, as determined by the Department.
- All crossings with defined sidewalks shall be equipped with either a standalone pedestrian gate, shall have the sidewalk pass to the roadway side of a main gate assembly or shall have a roadway gate with an auxiliary sidewalk arm.
- All gate mechanisms shall use solid state control technology located within the gate mechanism.
- All crossing arms shall be fiberglass with highly reflective red and white striping and included 4 inch LED flashers
- All gate mechanism, flasher, and cantilever foundations shall be pre-cast concrete in accordance with concept drawings. Helical foundations are an acceptable alternative to precast foundations for flashers and gate mechanisms.
- The internal design of each house shall be standardized. The Designer shall determine the house size required for each location.
- Cables passing underneath the track structure or roadway shall be installed in a minimum two 4 inch ID Schedule 80 PVC pipes under the track and two 4 inch ID RGS pipes under the roadway. Directional boring of HDP conduits is an acceptable alternative to PVC and RGS conduits.
- Existing local utility power shall be maintained with new vital cabling provided from the new control housing.

10.2 Highway / Rail Grade Crossing Summary

The RFP identifies the minimum required changes at each crossing.

The assemblies provided shall constitute a complete working assembly. It should be noted that supporting hardware, brackets, cable hoses, and all other hardware required to install and make operational shall be provided by the Contractor. All metallic hardware supplied shall either be a galvanized steel or aluminum in accordance with AREMA and the signal manufacturer's recommendations.

The RFP table uses acronyms to indicate the minimum improvements. Below are the acronyms used in the table:

- **No Changes Identified**

At these locations the existing control housings and technology shall remain.

- **Gate Complete (FL & G)**

Complete gate assembly consists of:

- A 16 ft mast schedule 40 aluminum pole 5 inches diameter with the FDOT crossing identification sign attached to the crossing pole. Placement shall be in accordance with AREMA 3.1.35.
- Split base cable termination junction box with a minimum of two rows of eight AAR terminals (as specified by AREMA) along with all terminating hardware and test links.
- A pre-cast concrete or helical foundation
- A gate mechanism with a Direct Current (DC) gate motor in accordance with AREMA 3.2.15, capable of raising and lowering a 36 ft fiberglass gate within the time specified within these documents. This shall include two weight support arms along with any special tooling required for maintenance and proper adjustment.
- The maximum gate arm shall be 36 ft., unless accepted by the Department.
- A fiberglass arm as specified in AREMA Section 3 with 4 in LED flashing lights. The reflectorized arms shall be in accordance with AREMA 15.2.20. The gate arm LED's shall be in accordance with AREMA 3.2.40.
- Wind brackets shall be provided for all applications in accordance with AREMA 3.2.22
- Pole mounted 12 inch LED flashing light units in accordance with AREMA 3.2.35.
- A Railroad crossbuck sign in accordance with AREMA 3.2.70 and as shown in the current version of the MUTCD signs as R-15-1
- Multiple Track Signs (when required) in accordance AREMA 3.2.76 as shown in the current version of the MUTCD as sign R-15-2
- An Emergency Notification Sign in accordance with MUTCD Section 8B.18 and CFRC SDI 1202.01
- A pinnacle mounted electronic bell in accordance with the AREMA.

A minimum of two pinnacle mounted electronic bells shall be provided at each crossing in accordance with the AREMA. (If reusing warning gate the existing bell can remain if in good working order).

- **Cantilever (Cant)**

A complete assembly with flashing units provided for each traveled lane and back lights. Each Cantilever unit shall contain an external Junction Box with a minimum of 12 multiunit AAR terminals and test links as per AREMA 3.2.5

The complete assembly shall include

- A pre-cast concrete foundation

- Pole mounted 12 inch LED flashing light units in accordance with AREMA 3.2.35.
- A Railroad crossbuck sign in accordance with AREMA 3.2.70 and as shown in the current version of the MUTCD signs as R-15-1
- Multiple Track Signs (when required) in accordance AREMA 3.2.76 as shown in the current version of the MUTCD as sign R-15-2
- A pinnacle mounted electronic bell in accordance with the AREMA.

- **Gate/Cantilever Combination (GC Combo)**

A complete assembly with flashing units provided for each traveled lane and back lights. Each Cantilever unit shall contain an external Junction Box with 12 multiunit AAR terminals and test links as per AREMA 3.2.5

- A pre-cast concrete foundation
- A gate mechanism with a Direct Current (DC) gate motor in accordance with AREMA 3.2.15, capable of raising and lowering a 40 ft fiberglass gate within the time specified within these documents. This shall include two weight support arms along with any special tooling required for maintenance and proper adjustment.
- A fiberglass arm as specified in AREMA Section 3 with 4 in LED flashing lights (in conjunction with the gate schedule shown on the crossing layout plans). The reflectorized arms shall be in accordance with AREMA 15.2.20. The gate arm LED's shall be in accordance with AREMA 3.2.40.
- Wind brackets shall be provided for all applications in accordance with AREMA 3.2.22
- Pole mounted 12 inch LED flashing light units in accordance with AREMA 3.2.35.
- A Railroad crossbuck sign in accordance with AREMA 3.2.70 and as shown in the current version of the MUTCD signs as R-15-1
- Multiple Track Signs (when required) in accordance AREMA 3.2.76 as shown in the current version of the MUTCD as sign R-15-2
- An Emergency Notification Sign in accordance with MUTCD Section 8B.18 and CFRC SDI 1202.01
- A pinnacle mounted electronic bell in accordance with the AREMA.

- **Station Pedestrian Gate (PEDFL)**

A complete pedestrian gate assembly consists of:

- A mast of schedule 40 aluminum pole 5 inches in diameter. Mast shall be of a sufficient length to support the gate mechanism installed.
- A gate mechanism with a Direct Current (DC) gate motor in accordance with AREMA 3.2.15, capable of raising and lowering a 16 foot fiberglass

gate within the time specified within these documents. This shall include two weight support arms along with any special tooling required for maintenance and proper adjustment.

- Split base cable termination junction box with a minimum of two rows of eight AAR terminals (as specified by AREMA) along with all terminating hardware and test links.

- A pre-cast concrete or helicial foundation

A fiberglass arm as specified in AREMA Section 3. The reflectorized arms shall extend across the sidewalk to a point at least 3 inches from the end of the swing gate and shall include two 4 in. LED gate arm light. The gate LED lights shall be one foot within each edge of the sidewalk.

- Pole mounted 12 inch LED flashing light units in accordance with AREMA 3.2.35.
    - If the station's canopy is blocking the proper placement of the flasher on the gate mast, then a short mast (see PEDSM below), flashing lights and second train warning signs will be mounted between tracks on each side the pedestrian walkway.

- A Railroad crossbuck sign in accordance with AREMA 3.2.70 and as shown in the current version of the MUTCD signs as R-15-1
- Multiple Track Signs (when required) in accordance AREMA 3.2.76 as shown in the current version of the MUTCD as sign R-15-2
- An Emergency Notification Sign in accordance with MUTCD Section 8B.18 and CFRC SDI 1202.01
- A swing gate to be used to ensure pedestrians are not trapped in the right of way by the pedestrian gates. The gates shall be mounted in a way to swing out away from the tracks and in alignment with the crossing gate. (swing gates shall comply with SDI 0202-01)

- **Standalone Sidewalk Pedestrian Gate (PEDSA)**

A standalone pedestrian gate is a pedestrian gate in a quadrant with no other warning gate. A complete standalone pedestrian gate assembly consists of:

- A mast of schedule 40 aluminum pole 5 inches in diameter. Mast shall be of a sufficient length to support the gate mechanism installed.

- A gate mechanism with a Direct Current (DC) gate motor in accordance with AREMA 3.2.15, capable of raising and lowering a 24 foot fiberglass gate within the time specified within these documents. This shall include two weight support arms along with any special tooling required for maintenance and proper adjustment.

- A fiberglass arm as specified in AREMA Section 3. The reflectorized arms shall extend across the sidewalk to a point at least 6 inches beyond the end of the sidewalk and shall include two 4 in. LED gate arm lights for gate arms ten feet or less. The gate LED lights shall be one foot within each edge of the sidewalk.

- If gate arm is over ten feet then the gate arm shall include three 4 in. LED gate arm lights. The gate LED lights shall be one foot from edge of tip, one within one foot of the edge of the sidewalk closer to the gate mast and one at the center of sidewalk.

- Split base cable termination junction box with a minimum of two rows of eight AAR terminals (as specified by AREMA) along with all terminating hardware and test links.

- Pole mounted 12 inch LED flashing light units in accordance with AREMA 3.2.35.

- A pre-cast concrete foundation

- **Sidewalk Pedestrian Gate (PEDSM) Associated with grade crossing gate**

A pedestrian gate that is associated with a grade crossing gate is a pedestrian gate in a quadrant with a grade crossing gate exists. A complete pedestrian gate associated with a grade crossing gate assembly consists of:

- A mast of schedule 40 aluminum pole 5 inches in diameter. Mast shall be of a sufficient length to support the gate mechanism installed.

- A gate mechanism with a Direct Current (DC) gate motor in accordance with AREMA 3.2.15, capable of raising and lowering a 16 foot fiberglass gate within the time specified within these documents. This shall include two weight support arms along with any special tooling required for maintenance and proper adjustment.

- A fiberglass arm as specified in AREMA Section 3. The reflectorized arms shall extend across the sidewalk to a point at least 6 inches short the end of the grade crossing gate assembly and shall include two 4 in. LED gate arm lights for gate arms ten feet or less. If gate arm is over ten feet then the gate arm shall include three 4 in. LED gate arm lights. The gate LED lights shall be one foot within each edge of the sidewalk.

- Split base cable termination junction box with a minimum of two rows of eight AAR terminals (as specified by AREMA) along with all terminating hardware and test links.

- A pre-cast concrete foundation

10.3 Vital Train Detection

Vital train detection shall include electronic track circuits that sense the shunt of the oncoming train toward the crossing calculates the train speed as it approaches the crossing and predict how much time shall be required to warn motorists. Grade crossing train detection shall be overlaid on the wayside vital train detection. The Contractor shall be required to demonstrate reliable shunting characteristics for the equipment that shall be operated by the new commuter rail operations without affecting or having any impact on reliability or safety of freight operations.

Component or system failures which are not self-detecting shall not cause unsafe conditions, even if added to other failures. Any number of simultaneous component or system failures attributable to the same cause or related causes shall not cause unsafe conditions. Any component or wire becoming grounded or any combination of such grounds shall not cause unsafe conditions.

All vital circuits shall be double-break, except within a signal instrument house (shelter) or wayside case, after the entering or leaving circuits are double-broke.

Highway Crossing Warning start circuits shall provide initiation of the warning equipment from both sides of the crossing and shall also include separate island circuits.

A minimum of 30 seconds of warning time shall be required prior to the arrival of a train at crossing. Additional start time shall be provided for multiple track crossings with wide travel surfaces, simultaneous or advance pre-emption, or locations where additional time is required. Vital train detection shall be designed to detecting a 0.06 ohm shunt across the running rails with an assumed ballast resistance of 2 ohms per 1000 ft of track.

10.4 Constant Warning Systems

Constant Warning devices shall be used at all crossings.

10.5 Warning System Control

Where means are provided for cutting out the warning devices during intervals when trains make regular operating stops or perform switching operations on approach circuits:

- Controls shall be designed to provide that warning devices are operating before train enters crossing.
- Automatic control of the warning devices actuated by approaching trains other than the train that has stopped or is performing switch operations shall take precedence over any cutout features.
- Hand-throw switches equipped with circuit controllers shall not cause the warning devices to operate without trains within the approach circuits when the switch is reverse.

Warning devices shall operate until the rear of the train clears the crossing for trains operating in either direction; pedestrian bells at crossings equipped with automatic gates shall only operate until the gate arm has reached the horizontal position.

10.6 Solid State Control Devices

10.6.1 Software Design

The system shall be designed such that no single component failure can result in unsafe operation. Also, any component failure which could result in unsafe operation because of successive component failures shall revert to the fallback mode as described therein.

All executive and vital system software, including all self-checks, shall be installed in the system in a manner that shall prevent unintentional changes by the user.

Location specific vital and non-vital software shall be programmable by the user and shall be stored in non-volatile memory. Field adjustable items shall not be locked by the program and shall be available for field adjustment. Programmable field adjustments shall be password protected, capable of adjustment after entry of the correct password.

The system shall be designed to automatically reset and should attempt a restart after a condition causing system shutdown is eliminated.

The system shall remain in fallback mode until self-initialization software and hardware tests have been completed to determine that the system is operating properly.

The system shall contain internal diagnostics to permit troubleshooting.

10.6.2 Operation

Alternating flashing 12 in LED and bell outputs shall energize no more than 1.0 second after control or GP inputs are de-energized.

Alternate lamp flashing rate should be adjustable over the range of 45 to 60 Flashes per Minute (FPM).

Gate control output shall de-energize a minimum of 3.0 seconds after control input is de-energized. Gate control output de-energization delay should be field adjustable from 3 to 5 seconds.

Where gate control is provided, gate control output shall energize no more than 1.0 second after control input is energized. Where gate control is not provided, flashing lamp and bell outputs shall de-energize no more than 1.0 second after control unit is energized.

System power supply shall provide all system operating power from the AC line, independent of standby battery, when AC power is present and within the range specified herein.

System shall operate from standby battery, independent of AC power, when AC power is off or inadequate to provide normal system operation.

System power supply should float charge battery to manufacturer’s specifications.

Flashing and steady flasher voltages should remain within 2% of preset levels under normal conditions.

Means shall be provided to manually energize either side of the flashing lamp circuit continuously, with the other side off, for lamp voltage adjustment under actual operating conditions. If provided de-energizing control input (on approach of a train) shall flash one or both sets of lamps to provide warning indication and override manual control.

10.6.3 Control Inputs

Control inputs shall require 12 V DC into a load resistance of 500 ohms to maintain warning device drive in a clear condition. Control input resistance shall be 250 to 1000 ohms. Control input voltage less than 4.0 V shall result in activation of the crossing warning devices. Multiple vital and gated control inputs shall be provided integrally or as an accessory.

10.6.4 Control Outputs

The system shall be provided complete with all the required power supplies and accessories and shall provide the following outputs to drive the crossing warning devices:

- Three-wire alternately flashing lamp drives, which shall provide a minimum of 12.0 V to operate the nominal 10 V signal lamps with load rating as specified by the Manufacturer.
- Steady energy lamp drives from two wires of the three wire flashing lamp circuit, which shall provide a minimum of 12.0 V to operate the nominal 10 V gate arm tip lamps with load rating specified by the Manufacturer.
- Highway crossing gate controls, which shall provide 4.0 amps at a minimum of 11.0 V DC to raise the gates and maintain them in a clear position and fall to 1.0 V maximum to lower the gates.
- Warning bell drives shall provide 4.0 amps at a minimum 11.0 V DC to operate the existing mechanical type crossing warning bells and a minimum of 0.25 amps at a minimum of 11.0 V DC to operate the existing electronic type bells.

10.6.5 Gate Position

When equipped for gate control, the system shall have a gate position (GP) input for a nominal 13.5 V DC and a minimum of 25 ohms resistance. When the GP circuit voltage falls below 4.0 V DC, the flashing LED, gate arm tip LED and bell circuits shall be energized.

10.6.6 Fallback Mode

In the event of a failure which would impair the system from operating, the highway crossing warning device properly in response to control and GP input signals, the controller shall have a fallback mode which shall assure the following minimum operating capabilities when the control input signal is de-energized:

- Flashing LED power is applied at 12 V to at least one of each lamp pair, with either flashing or steady energy.
- Gate control output is de-energized
- Bell control output is energized at 11 V DC
- Operation meets the operating criteria specified for the primary controller operating system.

During failure of the crossing warning system any traffic signal interconnection shall be in its most restrictive state.

10.6.7 DTMF Remote Activation

All crossings shall be provided with Dual Tone Multi-Frequency (DTMF) Remote Activation. Activation of the crossing active warning system shall be provided by a Dual Tone Multi-Frequency Input/output (DTMF I/O) Remote Activation System. The system shall provide a DTMF activation code to enable maintenance forces to activate the crossing warning system and the crossing warning system to be returned to a normal state by using an estimated 30 second reset timer. Operating the warning system with the DTMF system shall not interfere with the normal operation of the warning system upon detection of a train or OTE approaching the crossing. After a field adjustable time interval, the DTMF system will return the crossing to normal operation if activated. The DTMF System shall provide an output to control the crossing warning system and shall record activation using the DTMF code on the event recorder. The DTMF System shall operate at 12 VDC. The activation code shall be the last three digits of the DOT number for the crossing to be controlled followed by the "#" for activation. Instances where adjacent crossing may be affected by duplication of the DTMF code shall be identified by the Designer and alternative code identification shall be used to activate individual crossings in the vicinity. The Designer shall provide the CFRC with the DTMF codes.

10.6.8 Pedestrian Crossings Operations at Stations

DTMF Remote Activation as described in Section 10.6.7 shall be provided at all pedestrian crossings. Where directed by the Department, pedestrian gates are to be installed at pedestrian crossings per Section 10.3. They will utilize flashing lights, bells and gates. Where directed by the Department swing gates are also to be provided to allow pedestrians to clear the tracks after the gates are down.

10.6.9 Highway-Rail Grade Crossings Operations at Stations

The preferred operation for grade crossings adjacent to stations is for the crossing devices to clear after initial operation so that vehicles and pedestrians can cross while SunRail dwells in the station. The distance the crossing is from the station and the volume of pedestrians/vehicles using the crossing are factors that need to be considered in making the final determination. The preferred operation is:

- The crossing(s) activate as a SunRail train approaches the station. If there are crossings next to the station, both on the north and south side, then the crossings are to function independent of the other
- Both crossing devices shall clear after it has been determined that a SunRail train has stopped at the station, allowing pedestrians/vehicles to use the crossing
- The crossing in front of a SunRail train will activate upon movement of the train out of the station toward the crossing and/or the use of the DTMF remote activation code is keyed in by the train.

10.6.10 Traffic Signal Interconnection

Traffic signal interconnection shall be provided per MUTCD and Florida Statue requirements.

All crossings which have a traffic signal within 200 feet are required to have preemption installed. If there is a traffic signal within 500 feet of the grade crossing, pre-emption shall also be installed unless a traffic study determines that preemption is not required. The requirements for preemption shall follow MUTCD and the Florida Statues.

Preemption shall not be removed from any crossing without prior written approval by the Department.

All existing preemption locations shall be provided with new preemption cable in accordance with AREMA closed circuit recommendations. The work shall consist of providing a cable and terminating junction box in the crossing quadrant closest to the traffic controller or to a different location coordinated with the controlling traffic operations agency. Final connection is to be made by the Contractor in coordination with the local traffic operations personnel responsible for the traffic systems.

10.7 Warning System Devices

10.7.1 General

Warning system devices shall be installed based on the information provided in the RFP. Pedestrian gates are required on both sides of a Highway-Rail Grade Crossing where there is a sidewalk on both sides of the rail and the roadway gate does not also cover the sidewalk.

10.7.2 Gate Mechanisms and Gate Arms

Gate arm lights shall be of LED type technology.. Gates shall have 4 inch LED flashers. The gate flashers shall operate in conjunction with the highway grade crossing signal as follows:

- Lights shall operate at all times when the gate is in position to obstruct highway traffic.
- Light nearest the tip of arm shall be steadily lit.
- Two lights shall flash alternately and in unison with the lights on the highway crossing warning signal.
- Gate arms shall start in downward motion not less than 3 seconds or greater than 5 seconds after the flashing lights start to operate.
- Gate arms shall reach the full horizontal position five seconds before arrival of any train and shall remain in that position until the rear of the train has cleared the crossing.

- Circuits shall be so arranged that a failure of the gate mechanism to operate as intended shall not prevent the lights on the gate arm and signal from operating on the approach of a train.
- Where bell(s) are used with gates, a warning shall sound from the time the signal lights start to operate until the gate arm has descended to within 10 degrees of the horizontal position. The bells shall also operate when the gate is being raised.
- Voltage adjusting resistors shall be provided to field adjust individual lamp and bell voltage levels.
- Gates shall not be located more than 15 ft from center line of track.

10.7.3 Cantilevers

Cantilevers shall not be more than 20 ft from center line of track. If, at any crossing, the cantilever is required to be located outside of FDOT ROW or more than 20 ft from the centerline of track, the Contractor shall document and notify the Department for resolution prior to starting work.

10.7.4 Flashing Light Signals

All flashers (gate and pole mounted) shall be based upon LED technology in accordance with current AREMA guidelines. Pole and cantilever flashers shall be 12 inch LED's.

10.7.5 Crossing Bell

Electronic bells shall be used at all highway/rail grade crossings and new pedestrian crosswalks. There shall be a minimum of two crossing bells per highway grade crossing.

10.7.6 Second Train Warning Signs

Second Train warning signs shall be installed at each pedestrian crossing on the pedestrian gate such that the sign is visible to pedestrians prior to entering the pedestrian crossing surface. Second Train warning signs shall be installed at each roadway grade crossing directly adjacent to the station platforms. Second Train warning signs shall be mounted on the crossing gate or pedestrian gate mechanism masts at these crossings, unless an alternate location has been accepted by the Department. Second Train Warning Signs installed on crossing mast shall be placed to provide a visible and audible warning prior to the pedestrian entering the crosswalk. Placing the Second Train Warning signs to display across the tracks to the opposite platform should be considered as an effective means of displaying the warning to pedestrians prior to entering the crosswalk area. Location of the Second Train Warning signs must be verified by the Department prior to installation.

Second Train Warning signs shall be approximately 30 in x 30 in and operate on 12 VDC. Lettering on the signs shall consist of white LED's for the "Second Train Coming" text and red LED's for the "Warning" text with a minimum text size of 3.25 inches. Warning text shall be capable of flashing 50 to 60 times per minute. The text message

shall “blank out” when not activated and sign face shall be constructed of a vandal resistant material.

Second Train warning signs shall include an audible voice warning feature with a minimum of 90 dB measured 3 ft from the speaker and shall be field adjustable. Voice message shall be pre-recorded and capable of repetition from 0 – 15 second intervals. Voice warning shall be activated simultaneously with the visual warning message.

10.7.7 Second Train Warning Signs Control Circuits

Second Train warning sign control circuits shall be designed and wired into the control locations for the pedestrian crosswalks and the highway-rail grade crossing warning systems and shall be terminated on lightning arrestors. Circuitry and lightning arrestors shall be provided for a positive / negative 12VDC operating output and a two-wire, 12VDC Second Train sign control output to the Second Train warning sign. A 7 conductor # 14 AWG cable shall be installed from these lightning arrestors and terminated in the pedestrian flasher junction box base at the pedestrian crosswalks.

Second Train warning sign shall be activated when one train is in the station with the active warning system activated and a second train is approaching and shall continue while both trains are within the station. The departure of either train shall deactivate the Second Train warning sign. Circuit shall be designed such that with a train on either track stopped in the station, the Second Train system shall operate by the approach of a train in either direction on the adjacent track.

10.8 Event Recorder System

An Event Recorder System (ERS) crossing analyzer shall be provided for each new automatic highway crossing house location as shown in the RFP. The crossing analyzer shall be capable of recording events at highway crossings to monitor and report activities associated with signal equipment operation. Crossing Analyzers shall also provide data analysis capabilities internal to the crossing analyzer, which through user defined application logic can interpret the stored information.

The ERS shall be capable of reporting:

- Digital information such as relay contact closures.
- Analog information such as relay battery voltage, gate battery voltage, and AC lamp voltage.
- Have a GPS Clock to ensure accurate time is kept on the data recorder.

The ERS shall utilize solid state microprocessor technology and shall not require any off-line storage devices for operation or start-up. This application logic shall be programmed in solid state EPROM memory.

The ERS shall receive inputs from voltage sources and shall process outputs to battery packed up memory for storage with a date and time stamp.

The ERS shall also be capable of receiving inputs and process controlled outputs to the control center.

ERS shall conform to AREMA Manual Part 3.1.29 for event recorder design and operation.

ERS remote units shall be installed in accordance with standard AREMA temperature ranges for field installed equipment.

Each input and output port shall be equipped with an illuminated status indicator. The indicator shall light when the respective port is energized.

Each unit shall be equipped with built-in interface for connection of a laptop computer to download recorded events, errors and alarm occurrences from memory.

Communication and software utility shall provide communication interface between event recorder and a Contractor supplied laptop personal computer (PC). Communications software utility shall allow for direct connection to laptop PC or dial-up modem and provide error checking during download of information.

ERS operating voltages shall be 12 V DC nominal capable of 9-16 V DC operation.

Units shall be configured for 19 in rack mounting, wall mounting and shelf mounting. Unit shall be bound in a secure enclosure with wiring connections protected from accidental contact when passing by mounted unit.

ERS shall be provided to record 16 event inputs and store up to 5000 events.

Visual indications of system functions such as self-tests, battery ok (for memory), communication flags and system running shall be provided.

A software mod-implementing package shall be provided.

The ERS shall be capable of and include all hardware necessary to support installation of data communication via a land-based communication or a cellular compatible communication system.

10.9 Standby Battery

The system power supply shall be designed in accordance with FRA 234 and provide eight hours of standby back-up battery for 40 train moves. Battery power calculations shall be provided to indicate proper sizing of the battery capacity.

11 MISCELLANEOUS SIGNAL MATERIAL

11.1 General

All portions of the signal system shall meet the requirements set forth in this document. All equipment used shall be standard products produced by manufacturer regularly engaged in the production of such equipment or material, conform to all applicable codes and standards, include current AREMA recommended practices and be compatible with existing signal equipment in the CFRC.

11.2 Vital Relays

All vital relays shall be of the plug-in, biased neutral type with a minimum of 6 independent contacts, except in case of special application requirements. A minimum of one spare front-heel-back contact set shall be provided within each relay group. The relay group is defined to mean a relay and all subsequent repeaters that are designed to energize and de-energize together with that relay without additional delay.

Vital relays, other than those used as track relays, shall operate on 12 V DC.

All relays shall be configured so as to be able to ascertain the state, energized or de-energized, by visual inspection while in use.

All furnished relays shall conform to all applicable Manual portions of the AREMA Signal Manual.

The relays shall be magnetically biased where practical. Relays shall be provided with a means to permit de-energizing from the front.

Relays shall not be mounted more than 6 ft from the floor and shall be secured from vibration in racks. Relays shall not be mounted on the bottom row of the relay racks (a minimum of one relay base height from floor or 12 inches).

Relays shall have indexing pins to prevent insertion of an improper relay in relay plugboards. The fastening of relay to plugboard shall be so arranged as to securely hold the relay in place and yet be readily removable.

11.3 Non-Vital Relays

Non-vital relays shall be of the plug-in, rack-mounted type and hermetically sealed. They shall have an operating voltage range of 12 to 24 VDC, except special application relays such as Power Off relays. Non-vital relays shall conform to AREMA Signal Manual, Part 6.3.1.

11.4 Cable

All cabling shall comply with the AREMA Recommended Signal Practices for Direct Burial solid conductor cabling and in accordance with Part 10.4.1 (Wire and Cable) and Part 10.4.30 (Wiring) and have the following characteristics:

- Insulation shall be rated for 600 V
- Cable shall be direct burial cable installed at a depth of 30 inches outside of the end of the ties and at 36 inches below the top of tie when crossing the track.
- Cabling shall be solid annealed copper.
- Cables crossing track(s) shall be installed in high impact Schedule 80 PVC conduit or an approved equivalent, 36 inches below the top of railroad tie.

- Aerial cable installation shall not be used without special permission from the Department.
- Cables shall have 20% spare capacity.

Express and local signal cables shall be supplied and installed. It shall be the responsibility of the Contractor to determine the cable requirements. Cable types shall be defined consistent with the application, and all cables used for like purpose shall be of identical type.

Cable splices shall not be allowed without prior written acceptance by the Department.

All cable shall run through protective conduit where exiting or entering any housing or junction box.

Each switch machine shall be provided with independent cable terminating at the switch and at the equipment house controlling the switch. “Loop” cables, terminating at two switch machines without entry to an equipment house, shall not be permitted.

11.5 Case Wiring

The signal designer shall size all wire in order to assure proper operation of the apparatus on the basis of equipment loads and the operating parameters for the systems described in this specification.

Wire for interconnection of apparatus involved in vital signal circuits shall not be less than No. 16 AWG, 19 strand wire. For all lighting circuits and local buss feeds, the wire shall not be less than No. 10 AWG, 27 strand wire. For track circuits inside the signal location, wire shall be two conductors #10 AWG twisted pair, nominal 10 twists per ft.

All local wiring shall be routed through cable ways or dressed with cable ties following a regular vertical and horizontal pattern consistent with the wiring required.

Vital circuit rack wiring shall be accomplished with solderless connections using stranded wire, minimum size No. 16 AWG and shall use closed end energy loops where practicable. Non-vital circuit wiring shall be accomplished with solderless connections using stranded wire, minimum size No. 20 AWG, and shall include non-vital relay connections. All wires not inside plastic wireways shall be neatly laced using plastic wire ties.

11.6 Tagging

All apparatus, cable wires and wires shall be tagged. For vital circuits, tags shall be furnished on every wire at each termination point showing termination designation. Nomenclature used shall be consistent with AREMA.

All cable terminations shall be clearly tagged to identify the circuit associated with each conductor used. Each individual wire of all local wiring shall be clearly tagged near each termination with the circuit identification.

Every relay, device, and electronic component shall be clearly marked with an identification clearly describing its function by tagging with embossed label or approved equal. Stenciled markings shall be provided within equipment houses or cases.

11.7 AC Power Supply (Commercial Power)

The power system shall be fed directly from local utilities located along the corridor. Each house shall receive local service from the power utility company that serves the local area.

- Highway/rail grade crossings: Provide a minimum 100 Amp 240 V AC power source as the normal power feed.

- Interlockings: Provide a minimum 100 Amp 240 V AC power source.

Power requirements shall be calculated for the equipment installed at each location with sufficient service being provided.

At locations where a service pole is required, it shall meet the requirements of the local Power Company and ANSI 05.1-1979 except when modified.

Transformers shall be single phase, air-cooled dry type, capable of operating in 60 Hz environment and shall conform to the AREMA Signal Manual, Section 14. All commercial items not stated within shall be in accordance with applicable rulings or standards of the Institute of Electrical and Electronic Engineers, Underwriter's Laboratories, Inc. or the National Electrical Manufacturers Association.

11.8 Batteries and Charging

Vital signal equipment operates nominally on 12 or 24 VDC. All power sources shall be supported by maintenance-free storage batteries. The storage batteries shall be sized to provide 8 hours of standby service at maximum load after a power failure. Maximum load is defined as 40 activations over this 8 hour period.

Batteries shall be used to back up all vital signal circuit power sources including switch batteries. Battery chargers shall be placed in parallel with the batteries so that they are constantly under load and charge and do not require a device to perform a transfer.

The battery chargers shall be temperature compensated, constant potential type operating on 60 Hz. Chargers shall be current limiting to prevent damage during overload conditions. The charger shall be compatible with maintenance-free batteries as per specification.

All storage batteries shall be housed within the confines of the wayside signal cases and houses. The Department shall consider applications whereby a separate battery box is required to maintain the size of the overall signal house.

11.9 Pipe and Conduits

At highway/rail grade crossings being renewed or replaced the Contractor shall install new cables in RGS conduit or an approved equivalent under roadways and PVC conduits or an approved equivalent under tracks. Additionally, one unused spare conduit of the appropriate type shall be installed. One additional conduit shall be provided under roadways and tracks for future cable replacement. Spare conduits shall be documented and shown on the final as-built drawings with dimensions provided to fixed objects.

11.10 Precast Foundations

Buried precast foundations shall be used for wayside signal foundations, highway/rail grade crossing gates and cantilevers, and signal bridges. Helical foundations are an acceptable alternative to precast foundations for flashers and gate mechanisms where geotechnical conditions provide the capability to support the structure attached.

11.11 Grounding

Grounds shall be provided for transformer cases and other metal housing for transformers and associated apparatus. The grounding system shall have a resistance to earth of not more than 5 ohms. Ground wire shall be in accordance with the AREMA Manual, Parts 11.1.2 and 11.1.3. The ground wire shall be base copper wire not smaller than No. 6 AWG with a continuous below ground length not less than 12 ft.

11.12 Signal Support Hardware

Signal hardware shall be a rust-proof low-maintenance material, such as galvanized steel or aluminum.

11.13 Additional Equipment

11.13.1 Terminals and Binding Posts

Solderless-type insulated wire terminals shall be used at the end of each wire. The terminals shall be attached to the conductor with a tool recommended by the terminal manufacturer in such a manner that the flexibility of the conductor shall not be destroyed, and the possibility of breakage at the terminal shall be reduced to a minimum.

Terminal posts shall be provided for all cable conductors including spares. All cable terminals shall consist of a double column of vertical terminals equipped with insulated test links. An additional 10% spare terminal posts shall be provided on all entrance racks.

All relays and cable terminations shall be provided with a method of quickly opening and closing electrical connections at points required for test purposes, without removal of wiring.

11.13.2 Lightning and Surge Protection

The Contractor shall provide all surge protection, lightning protection and related equipment necessary for installation. Low voltage and high voltage lightning protection shall be provided as specified by the manufacturer's requirements for all circuits that are directly susceptible to such influence. All track wires, line cables, signal lighting cables, power cables, and communication cables shall be protected by lightning arrestors and/or surge protection as required. All direct current buses shall have surge protection. A Faraday cage shall be provided for entrance terminal boards.

Lightning and surge protection shall be designed in accordance with the industry standards.

11.13.3 Components Not Listed

Any components not specifically described in this document shall meet or exceed the requirements of the AREMA Signal Manual and shall be suitable for the intended purpose and approved by the Department. These components shall be designed for use in the environment necessary for rail operations and shall be proven technology in current use within the railroad industry.

12 SIGNAL CONSTRUCTION STANDARDS

This section not used.

13 OPERATIONS CONTROL CENTER

The Operations Control Center (OCC) was constructed within the IOS. This section describes the requirements for integrating the Phase 2 South Control Points and station systems into the existing OCC at Sanford Fl.

13.1 System Overview

The OCC constructed in Sanford, Florida during Phase 1 houses the Centralized Traffic Control (CTC), Supervisory Control and Data Acquisition (SCADA) and communications equipment for the operation of the CFRC between Milepost (MP) 749.61 and MP 813.82

The OCC is equipped with two train dispatcher workstations, a maintenance/trouble desk workstation, a supervisor workstation, CCTV monitor bank, and a separate equipment room containing a technician workstation.

The OCC performs all control functions required for the operation of all trains using the CFRC , including dispatching SunRail, CSXT, Amtrak, and Florida Central Railroad (FCEN) trains. The OCC also acts as the central point of contact for passenger assistance, maintenance, security, and incident response

13.1.1 Overview of OCC System Functions

The existing OCC Systems provide the following functions:

1. Train Dispatching

The main purpose of the OCC is to provide complete dispatching control and authority of the CFRC. Train dispatching on the CFRC includes all functions related to operations.

The new Control Points shall be installed as part of Phase 2 South into the existing Ansaldo NGD CAD System. This integration shall include all database updates, pre-testing of system operation and final update/tapeload and system testing (CAD and Field Verification) as required for complete operation of the new Control Points as part of the entire CAD system. Coordination with the O&M Firm is required to seamlessly integrate the new system with the existing CAD system.

2. Voice Communications

Train Dispatcher to/from train and Train Dispatcher to/from maintenance worker voice communications are provided by conventional VHF base stations. The fiber optic network provides a data path for voice communications between the OCC and the radio base stations.

The existing radio location at Kissimmee shall connect into the new fiber optic network installed as part of Phase 2 South. Coordination with the O&M Firm is required to seamlessly integrate the new fiber optic network installed as part of Phase 2 South with the existing communication system.

Passenger to OCC telephones (Passenger Assistance Telephones or PAT) are also monitored from the OCC. These telephones operate as auto-dial directly to the OCC and operate through to the communications workstation provided to each position in the OCC, and are capable of automatically being forwarded to a location outside the OCC.

Station Public Address (PA) and Variable Message Signs (VMS) are also controlled from the OCC. The communications workstations are able to send pre-determined messages, as well as direct voice or text, to both the station PA and VMS.

The new stations shall be integrated with the OCC systems including, but not limited to, interconnection of the fiber optic network, integration of the stations PA and VMS information systems and PAT. Coordination with the O&M Firm is required to seamlessly integrate the new stations with the existing OCC and communications system.

3. Data Communications:

The fiber optic network shall carry data from the OCC to the Phase 2 South stations and radio towers for both ATCS and VHF radios. The primary “codeline” communications for the OCC to Phase 2 South Control Points shall be accomplished using the fiber optic network. The 900 MHz ATCS protocol shall be used for backup communication to/from all wayside signal locations including interlockings (controls and indications). The communications shall automatically transfer to the backup system upon a fiber system failure and shall transfer back to the primary fiber when fiber communications has been restored. A visual indication is provided to the Train Dispatcher that a Control Point has transferred to the backup system.

Data communications for fare collection equipment and VMS shall flow over the fiber optic network to each station.

The fiber optic network shall be integrated as part of Phase 2 South with the existing OCC and fiber optic communications network. This integration shall include, but is not limited to, CCTV, PA, VMS, SCADA, fare collection, VHF and ATCS Radio systems.

4. CFRC Safety and Security Communications Coordinator

The function of the CFRC Safety and Security Communications Coordinator (SSCC) Desk located in the OCC includes monitoring highway grade crossing alarms and health messages, directing maintenance forces to reported trouble locations, monitoring and recording maintenance force activity, and interfacing with the CFRC Dispatcher with respect to wayside equipment that is malfunctioning or out of service.

5. Customer Service

Customer service systems include fare collection equipment (Ticket Vending Machines (TVM) and Ticket Validator Units (TVU)), VMS, Passenger Assistance Telephones (PAT), Emergency Call Boxes (ECB) activation indication only, and station Public Address (PA). All of these passenger station systems shall be connected with the OCC via the fiber optic network. Should a local alarm at a station become active, the OCC is sent messages indicating the type of alarm for appropriate action, except for the Emergency Call Boxes (ECBs), whose calls are routed directly to the local police for action; the OCC shall receive an indication that the ECB has been activated.

6. Safety and Security

Station CCTV coverage includes cameras on each platform that are controlled from the OCC. The OCC CCTV server communicates with the field locations to control the PTZ feature, as well as automatic control and display of a video image from a field request or alarm at a ECB. This feature allows the CCTV server to display the actual image of the ECB that is initiating communication.

The systems installed as part of Phase 2 South shall be integrated into the existing system to retain this functionality.

7. Passenger Information Systems

The O&M Contractor is the end-user for all Passenger Information applications including, but not limited to, station Public Address systems, Variable Message Signs and Passenger Assistance Telephones. The Designer shall coordinate with the O&M Contractor for connection information to the existing systems.

8. Passenger Information Systems

The Ticket Vending Machines (TVMs) and Ticket Validator Units (TVUs) will be installed by a separate contractor. The Designer shall coordinate with the TVM/TVU Contractor for the location, as well as include on the design plans all necessary items such as, but not lmited to, conduit, power cables, communication cables, and bull boxes to make the TVM/TVU functional.

14 SAFETY AND HEADWAY CRITERIA FOR SIGNAL BLOCK LAYOUT DESIGN

The Phase 2 South signal system shall be installed on all main tracks between existing interlocking CP 796, at CSXT Milepost 796.7 and the Poinciana Holdout Signal at MP 813.82. The signal system shall meet both the safety and headway (capacity) requirements outlined below.

14.1 General Configuration

The replacement wayside system shall be configured in general as a “three-block, four-aspect” system with the following descending aspect sequence: Clear – Advance Approach – Approach - Stop (at interlocking signals) or Restricted Proceed (at automatic signals).

14.1.1 Available Aspects

Aspects available for use are shown in the current CFRC Operating Rules

14.1.2 Restricting Aspect at Interlockings

All interlocking signals shall be capable of displaying Restricting to a block-occupied situation or for any route leading to unsignaled territory.

14.1.3 Delay in Block

Best efforts shall be made to avoid Delay in Block speed restrictions caused by station stops falling between distant signals and the interlocking signals they are distant to. Wherever possible, interlocking distant signals shall be placed within the clear sightlines of the leaving ends of station platforms.

14.1.4 Design Speeds

The design shall assume a maximum freight speed of 60 MPH and a maximum passenger train speed of 79 MPH. These maximum speeds shall apply to the entire CFRC, bounded on the north by existing interlocking South DeLand, at CSXT Milepost A749.6 and on the south by CSXT Milepost A813.82. Trains shall further be subject to the speed restrictions which shall correspond to the signal design speeds at locations shown in the current CFRC Timetable:

Limited Speed shall be 45 mph for both passenger and freight trains and shall apply to diverging movements over #20 turnouts/crossovers.

Medium Speed shall be 30 mph for both passenger and freight trains and shall apply to diverging movements over #15 and #16 turnouts/crossovers.

Slow Speed shall be 15 mph for both passenger and freight trains and shall apply to diverging movements over #8, #9 and #10 turnouts/crossovers.

14.1.5 Interlockings

The RFP lists all of the interlockings (25 total) that shall be located on the CFRC with the implementation of Phase 2 South. Of the 25 interlockings, 21 are existing interlockings that shall remain in place (but may require alterations required by the transition to the new signal system), and 6 interlockings shall be new/replacement interlockings constructed by Contractor.

14.2 Safety Criteria for Signal System Design

Signal design shall be based upon stopping/reducing distances for passenger and freight trains as outlined below. Passenger trains and freight trains have different signal design braking standards; at any given location the minimum distance provided by the signal system for stopping/reducing shall be the greater of:

1. The grade-corrected stopping/reducing distance required for passenger trains, and

2. The grade-corrected stopping/reducing distance required for freight trains.

Each Approach aspect immediately following an Advance Approach or Medium Advance Approach aspect shall be assigned a signal design speed from which the braking train must be capable of stopping at the following Stop, Restricting, or Restricted Proceed signal based on the applicable freight and passenger safe braking criteria. The signal design speed shall not be less than 15 mph for freight trains and 30 mph for passenger trains without acceptance by the Department.

The design shall provide sufficient reducing distance between distant signals and the following interlocking signals to provide for slowing to the diverging design speeds detailed in Section 14.1.5..

Braking distances required for reduction to turnout speeds shall be reviewed when planning signal spacing and aspects to be displayed and shall include reduction to the following speeds for turnouts:

- #20 Turnout – 45 MPH
- #15 Turnout – 30 MPH
- #10 Turnout – 15 MPH

14.2.1 Signal Preview Distance

Signal Preview Distance shall be provided based on a 15 second preview time as shown in the following table.

Signal Preview Time and Distance Table					
	1 MPH =	1.46666667	feet / second		
Max. Auth. Speed		30 Sec. Preview Dist.		15 Sec. Preview Dist.	
10	MPH	440	feet	220	feet
15	MPH	660	feet	330	feet
20	MPH	880	feet	440	feet
25	MPH	1100	feet	550	feet
30	MPH	1320	feet	660	feet
35	MPH	1540	feet	770	feet
40	MPH	1760	feet	880	feet
45	MPH	1980	feet	990	feet
50	MPH	2200	feet	1100	feet
55	MPH	2420	feet	1210	feet
60	MPH	2640	feet	1320	feet
65	MPH	2860	feet	1430	feet
70	MPH	3080	feet	1540	feet
75	MPH	3300	feet	1650	feet
80	MPH	3520	feet	1760	feet
85	MPH	3740	feet	1870	feet
90	MPH	3960	feet	1980	feet
95	MPH	4180	feet	2090	feet
100	MPH	4400	feet	2200	feet
105	MPH	4620	feet	2310	feet
110	MPH	4840	feet	2420	feet

14.2.2 Braking Criteria for Passenger Trains

Signal system design for passenger trains on the CFRC shall be based upon the CE-205 passenger train safe braking standard which includes eight seconds of reaction time. This reaction time shall be followed by braking at a constant rate of -0.88 MPHPS. The following tables give distances for both slowing to intermediate speeds and slowing to a stop, for grades between -1.5% and +1.5% at 0.1% intervals:

CE-205 Braking Distances in Feet for Passenger Trains **8 seconds reaction time followed by constant braking rate of -0.88 MPHPS**							
Initial Speed:	**79**	**75**	**70**	**65**	**60**	**55**	**50**
Target Speed:	**45**	**45**	**45**	**45**	**45**	**45**	**45**
Grade (%)							
-1.5	6541	5673	4649	3692	2801	1977	1219
-1.4	6325	5490	4503	3580	2721	1926	1195
-1.3	6126	5320	4367	3476	2646	1879	1172
-1.2	5941	5162	4241	3379	2577	1835	1152

CE-205 Braking Distances in Feet for Passenger Trains 8 seconds reaction time followed by constant braking rate of -0.88 MPHPS							
Initial Speed:	**79**	**75**	**70**	**65**	**60**	**55**	**50**
Target Speed:	**45**	**45**	**45**	**45**	**45**	**45**	**45**
Grade (%)							
-1.1	5769	5014	4123	3289	2513	1794	1132
-1	5608	4877	4013	3205	2453	1756	1114
-0.9	5457	4748	3911	3127	2396	1720	1097
-0.8	5316	4628	3814	3053	2344	1686	1081
-0.7	5183	4515	3724	2984	2294	1655	1066
-0.6	5059	4408	3639	2919	2248	1625	1052
-0.5	4941	4307	3559	2857	2204	1597	1039
-0.4	4830	4212	3483	2799	2162	1571	1026
-0.3	4724	4123	3411	2744	2123	1546	1015
-0.2	4625	4038	3343	2692	2085	1522	1003
-0.1	4530	3957	3278	2643	2050	1500	993
0	4440	3880	3217	2596	2017	1479	983
0.1	4355	3807	3159	2551	1985	1458	973
0.2	4273	3737	3103	2509	1954	1439	964
0.3	4196	3671	3050	2468	1925	1421	955
0.4	4122	3608	3000	2430	1897	1403	947
0.5	4051	3547	2952	2393	1871	1386	939
0.6	3983	3489	2905	2357	1846	1370	931
0.7	3918	3434	2861	2323	1821	1355	924
0.8	3856	3381	2819	2291	1798	1340	917
0.9	3796	3330	2778	2260	1776	1326	910
1	3739	3281	2739	2230	1754	1312	903
1.1	3684	3234	2701	2201	1734	1299	897
1.2	3631	3189	2665	2174	1714	1287	891
1.3	3580	3145	2631	2147	1695	1275	886
1.4	3531	3104	2597	2121	1677	1263	880
1.5	3484	3063	2565	2097	1659	1252	875

CE-205 Braking Distances in Feet for Passenger Trains

8 seconds reaction time followed by constant braking rate of -0.88 MPHPS

Initial Speed:	79	75	70	65	60	55	50	45	40	35
Target Speed:	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**
Grade (%)										
-1.5	8039	7171	6147	5190	4299	3475	2717	2026	1401	843
-1.4	7766	6930	5943	5020	4161	3366	2635	1969	1366	827
-1.3	7514	6707	5754	4863	4034	3266	2560	1915	1333	811
-1.2	7279	6500	5579	4717	3915	3173	2490	1866	1302	797
-1.1	7061	6306	5415	4581	3805	3086	2424	1820	1273	784
-1	6857	6126	5262	4454	3702	3005	2363	1777	1247	772
-0.9	6666	5957	5120	4336	3605	2929	2306	1737	1222	760
-0.8	6487	5799	4986	4224	3515	2858	2252	1699	1198	749
-0.7	6319	5650	4860	4120	3430	2791	2202	1664	1176	739
-0.6	6161	5511	4741	4021	3350	2728	2155	1631	1155	729
-0.5	6012	5379	4630	3928	3275	2668	2110	1599	1136	720
-0.4	5871	5254	4524	3841	3203	2612	2068	1569	1117	712
-0.3	5738	5136	4424	3758	3136	2559	2028	1541	1100	703
-0.2	5611	5024	4330	3679	3072	2509	1990	1515	1083	696
-0.1	5492	4918	4240	3604	3012	2461	1954	1489	1068	688
0	5378	4818	4155	3534	2954	2416	1920	1466	1053	682
0.1	5269	4722	4074	3466	2899	2373	1888	1443	1038	675
0.2	5166	4630	3996	3402	2847	2332	1857	1421	1025	669
0.3	5068	4543	3923	3341	2797	2293	1827	1400	1012	663
0.4	4974	4460	3852	3282	2750	2256	1799	1380	1000	657
0.5	4884	4381	3785	3226	2705	2220	1772	1362	988	651
0.6	4798	4305	3721	3173	2661	2186	1746	1343	977	646
0.7	4716	4232	3659	3122	2620	2153	1722	1326	966	641
0.8	4637	4163	3600	3073	2580	2122	1698	1310	956	636
0.9	4562	4096	3544	3026	2542	2092	1676	1294	946	632
1	4489	4031	3489	2980	2505	2063	1654	1278	936	627
1.1	4420	3970	3437	2937	2470	2035	1633	1264	927	623
1.2	4352	3910	3387	2895	2436	2008	1613	1250	918	619
1.3	4288	3853	3338	2855	2403	1983	1594	1236	910	615
1.4	4226	3798	3292	2816	2372	1958	1575	1223	902	611
1.5	4166	3745	3247	2779	2341	1934	1557	1210	894	608

CE-205 Braking Distances in Feet for Passenger Trains

8 seconds reaction time followed by constant braking rate of -0.88 MPHPS

Initial Speed:	79	75	70	65	60	55	50	45	40	35	30	25	20
Target Speed:	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**
Grade (%)													
-1.5	8937	8070	7046	6089	5198	4374	3616	2925	2300	1742	1251	826	468
-1.4	8630	7795	6808	5885	5026	4231	3500	2833	2230	1691	1216	806	459
-1.3	8346	7539	6587	5696	4866	4098	3392	2748	2165	1644	1184	787	450
-1.2	8082	7302	6381	5520	4718	3975	3292	2669	2105	1600	1155	769	443
-1.1	7836	7082	6190	5356	4580	3861	3199	2595	2048	1559	1127	753	436
-1	7606	6875	6012	5204	4451	3754	3113	2526	1996	1521	1101	737	429
-0.9	7391	6683	5845	5061	4331	3654	3031	2462	1947	1485	1077	723	423
-0.8	7190	6502	5688	4927	4218	3560	2955	2402	1901	1452	1055	710	417
-0.7	7001	6332	5541	4801	4111	3472	2884	2345	1858	1420	1033	697	411
-0.6	6823	6172	5403	4683	4012	3389	2816	2292	1817	1391	1014	685	406
-0.5	6655	6021	5272	4571	3917	3311	2753	2242	1778	1363	995	674	401
-0.4	6496	5879	5149	4465	3828	3237	2693	2194	1742	1336	977	664	397
-0.3	6346	5744	5032	4366	3744	3167	2636	2149	1708	1311	960	654	392
-0.2	6204	5616	4922	4271	3664	3101	2582	2107	1675	1288	944	644	388
-0.1	6069	5495	4817	4181	3588	3038	2531	2066	1644	1265	929	635	384
0	5940	5380	4717	4096	3517	2979	2483	2028	1615	1244	915	627	381
0.1	5818	5270	4622	4015	3448	2922	2436	1991	1587	1224	901	619	377
0.2	5702	5166	4532	3938	3383	2868	2392	1957	1561	1204	888	611	374
0.3	5591	5067	4446	3864	3321	2816	2351	1924	1535	1186	875	603	370
0.4	5485	4972	4364	3794	3261	2767	2311	1892	1511	1168	863	596	367
0.5	5384	4881	4285	3726	3205	2720	2272	1862	1488	1152	852	590	364
0.6	5288	4794	4210	3662	3150	2675	2236	1833	1466	1136	841	583	362
0.7	5195	4711	4138	3601	3098	2632	2201	1805	1445	1120	831	577	359
0.8	5106	4631	4069	3542	3049	2591	2167	1778	1425	1105	821	571	356
0.9	5021	4555	4003	3485	3001	2551	2135	1753	1405	1091	811	566	354
1	4939	4482	3939	3431	2955	2513	2104	1729	1386	1078	802	560	351
1.1	4861	4411	3878	3378	2911	2476	2074	1705	1368	1065	793	555	349
1.2	4785	4343	3820	3328	2869	2441	2046	1682	1351	1052	785	550	347
1.3	4713	4278	3763	3280	2828	2407	2018	1661	1335	1040	777	545	345
1.4	4643	4215	3709	3233	2789	2375	1992	1640	1319	1028	769	540	343
1.5	4575	4155	3656	3188	2751	2343	1966	1620	1303	1017	761	536	341

CE-205 Braking Distances in Feet for Passenger Trains

8 seconds reaction time followed by constant braking rate of -0.88 MPHPS

Initial Speed:	79	75	70	65	60	55	50	45	40	35	30	25	20	15	10	5
Target Speed:	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Grade (%)																
-1.5	9237	8370	7346	6388	5497	4673	3915	3224	2600	2042	1550	1126	767	476	250	92
-1.4	8918	8083	7096	6173	5314	4519	3788	3121	2518	1979	1504	1094	747	464	245	91
-1.3	8623	7817	6864	5973	5144	4376	3670	3025	2442	1921	1462	1064	728	453	241	89
-1.2	8349	7570	6649	5788	4986	4243	3560	2936	2372	1868	1422	1037	710	444	236	88
-1.1	8094	7340	6449	5615	4838	4119	3458	2854	2307	1818	1386	1011	694	434	232	87
-1	7856	7125	6262	5454	4701	4004	3362	2776	2246	1771	1351	987	679	426	228	86
-0.9	7633	6924	6087	5303	4572	3896	3273	2704	2189	1727	1319	965	664	418	225	86
-0.8	7424	6736	5923	5161	4452	3795	3189	2636	2135	1686	1289	944	651	410	221	85
-0.7	7228	6559	5768	5028	4339	3699	3111	2572	2085	1647	1261	924	639	403	218	84
-0.6	7043	6393	5623	4903	4232	3610	3037	2513	2037	1611	1234	906	627	397	215	83
-0.5	6869	6235	5486	4785	4131	3525	2967	2456	1993	1577	1209	888	615	390	213	82
-0.4	6704	6087	5357	4674	4036	3446	2901	2403	1950	1545	1185	872	605	384	210	82
-0.3	6548	5947	5235	4568	3947	3370	2839	2352	1911	1514	1163	856	595	379	207	81
-0.2	6401	5814	5119	4468	3862	3299	2779	2304	1873	1485	1141	842	586	373	205	81
-0.1	6261	5687	5009	4374	3781	3231	2723	2259	1837	1458	1121	827	577	368	203	80
0	6128	5568	4905	4284	3704	3166	2670	2216	1803	1432	1102	814	568	364	201	80
0.1	6001	5453	4805	4198	3631	3105	2619	2174	1770	1407	1084	801	560	359	199	79
0.2	5881	5345	4711	4116	3561	3046	2571	2135	1739	1383	1066	789	552	355	197	79
0.3	5766	5241	4620	4038	3495	2991	2525	2098	1710	1360	1050	778	545	350	195	78
0.4	5656	5142	4534	3964	3432	2937	2481	2062	1682	1339	1034	767	538	346	193	78
0.5	5551	5048	4452	3893	3371	2887	2439	2028	1655	1318	1019	756	531	343	191	77
0.6	5451	4957	4373	3825	3313	2838	2399	1996	1629	1299	1004	746	525	339	190	77
0.7	5355	4871	4298	3760	3258	2791	2360	1965	1604	1280	991	737	518	336	188	76
0.8	5263	4788	4225	3698	3205	2747	2323	1935	1581	1262	977	728	513	332	187	76
0.9	5174	4708	4156	3638	3154	2704	2288	1906	1558	1244	965	719	507	329	185	76
1	5090	4632	4089	3581	3105	2663	2254	1879	1536	1228	952	710	501	326	184	75
1.1	5008	4558	4026	3525	3058	2623	2221	1852	1516	1212	941	702	496	323	183	75
1.2	4930	4488	3964	3472	3013	2585	2190	1827	1496	1196	929	694	491	320	181	75
1.3	4854	4420	3905	3421	2969	2549	2160	1802	1476	1182	918	687	486	318	180	74
1.4	4782	4354	3848	3372	2928	2514	2131	1779	1458	1167	908	679	482	315	179	74
1.5	4712	4291	3793	3325	2887	2480	2103	1756	1440	1154	898	672	477	312	178	74

14.2.3 Braking Criteria for Freight Trains

Signal system design for freight trains on the CFRC shall be based upon the braking distance tables shown below. This document gives distances for both slowing to intermediate speeds and slowing to a stop, for grades between -3.0% and +3.0%, at 0.1% intervals.

Initial Speed to 45 MPH, Freight Trains

Grade	70	65	60	55	50	45	40	35	30	25	20	15
3.0	3194	2497	1911	1309	692	NA	NA	NA	NA	NA	NA	NA
2.9	3279	2577	1985	1315	692	NA	NA	NA	NA	NA	NA	NA
2.8	3369	2661	1996	1383	760	NA	NA	NA	NA	NA	NA	NA
2.7	3458	2740	2075	1452	760	NA	NA	NA	NA	NA	NA	NA
2.6	3548	2825	2149	1463	829	NA	NA	NA	NA	NA	NA	NA
2.5	3643	2909	2228	1531	829	NA	NA	NA	NA	NA	NA	NA
2.4	3802	3062	2302	1605	898	NA	NA	NA	NA	NA	NA	NA
2.3	3897	3147	2381	1679	898	NA	NA	NA	NA	NA	NA	NA
2.2	3992	3237	2460	1748	966	NA	NA	NA	NA	NA	NA	NA
2.1	4161	3326	2545	1822	971	NA	NA	NA	NA	NA	NA	NA
2.0	4324	3480	2693	1896	1040	NA	NA	NA	NA	NA	NA	NA
1.9	4430	3575	2777	1975	1109	NA	NA	NA	NA	NA	NA	NA
1.8	4604	3733	2862	2049	1178	NA	NA	NA	NA	NA	NA	NA
1.7	4779	3897	3010	2128	1246	NA	NA	NA	NA	NA	NA	NA
1.6	4958	4066	3168	2207	1315	NA	NA	NA	NA	NA	NA	NA
1.5	5143	4235	3258	2350	1389	NA	NA	NA	NA	NA	NA	NA
1.4	5391	4404	3416	2492	1457	NA	NA	NA	NA	NA	NA	NA
1.3	5581	4583	3575	2577	1595	NA	NA	NA	NA	NA	NA	NA
1.2	5845	4826	3807	2730	1668	NA	NA	NA	NA	NA	NA	NA
1.1	6109	5011	3971	2878	1811	NA	NA	NA	NA	NA	NA	NA
1.0	6384	5264	4208	3099	1948	NA	NA	NA	NA	NA	NA	NA
0.9	6663	5523	4382	3252	2091	NA	NA	NA	NA	NA	NA	NA
0.8	6949	5787	4631	3480	2239	NA	NA	NA	NA	NA	NA	NA
0.7	7313	6125	4879	3712	2381	NA	NA	NA	NA	NA	NA	NA
0.6	6927	6405	5201	3944	2592	NA	NA	NA	NA	NA	NA	NA
0.5	8063	6758	5533	4187	2809	NA	NA	NA	NA	NA	NA	NA
0.4	8522	7191	5866	4499	3094	NA	NA	NA	NA	NA	NA	NA
0.3	8992	7630	6215	4815	3321	NA	NA	NA	NA	NA	NA	NA
0.2	9478	8084	6637	5211	3685	NA	NA	NA	NA	NA	NA	NA
0.1	10048	8554	7070	5613	4055	NA	NA	NA	NA	NA	NA	NA
0.0	10639	9108	7587	6024	4435	NA	NA	NA	NA	NA	NA	NA
-0.1	11315	9741	8121	6516	4889	NA	NA	NA	NA	NA	NA	NA
-0.2	12081	10401	8733	7086	5354	NA	NA	NA	NA	NA	NA	NA
-0.3	12878	11151	9435	7682	5945	NA	NA	NA	NA	NA	NA	NA
-0.4	13707	11933	10164	8358	6647	NA	NA	NA	NA	NA	NA	NA
-0.5	14710	12815	10993	9129	7376	NA	NA	NA	NA	NA	NA	NA
-0.6	15756	13860	11917	10000	8269	NA	NA	NA	NA	NA	NA	NA
-0.7	16960	14964	12952	10903	9261	NA	NA	NA	NA	NA	NA	NA
-0.8	18274	16183	14103	11980	10370	NA	NA	NA	NA	NA	NA	NA
-0.9	19763	17530	15375	13179	11737	NA	NA	NA	NA	NA	NA	NA
-1.0	21474	19156	16854	14504	13179	NA	NA	NA	NA	NA	NA	NA
-1.1	23417	20940	18475	16035	14974	NA	NA	NA	NA	NA	NA	NA
-1.2	25751	23037	20402	17857	17028	NA	NA	NA	NA	NA	NA	NA
-1.3	28512	25545	22720	19927	19494	NA	NA	NA	NA	NA	NA	NA
-1.4	MDE	28707	25539	22408	22630	NA	NA	NA	NA	NA	NA	NA
-1.5	MDE	MDE	29061	25624	26791	NA	NA	NA	NA	NA	NA	NA
-1.6	MDE	MDE	MDE	29784	MDE	NA	NA	NA	NA	NA	NA	NA
-1.7	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA	NA	NA	NA
-1.8	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA	NA	NA	NA
-1.9	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA	NA	NA	NA
-2.0	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA	NA	NA	NA
-2.1	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA	NA	NA	NA
-2.2	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA	NA	NA	NA
-2.3	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA	NA	NA	NA
-2.4	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA	NA	NA	NA
-2.5	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA	NA	NA	NA
-2.6	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA	NA	NA	NA
-2.7	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA	NA	NA	NA
-2.8	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA	NA	NA	NA
-2.9	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA	NA	NA	NA
-3.0	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA	NA	NA	NA

MDE = Maximum Distance (30,000 ft) Exceeded

Initial Speed to 30 MPH, Freight Trains

Grade	70	65	60	55	50	45	40	35	30	25	20	15
3.0	4161	3580	2988	2439	1938	1473	1014	517	NA	NA	NA	NA
2.9	4298	3659	3062	2508	1996	1484	1019	565	NA	NA	NA	NA
2.8	4393	3744	3142	2571	2059	1542	1072	565	NA	NA	NA	NA
2.7	4530	3875	3258	2645	2117	1595	1119	612	NA	NA	NA	NA
2.6	4631	3965	3342	2756	2181	1653	1172	612	NA	NA	NA	NA
2.5	4778	4103	3464	2830	2244	1711	1177	660	NA	NA	NA	NA
2.4	4926	4240	3548	2904	2313	1769	1230	708	NA	NA	NA	NA
2.3	5079	4335	3680	3025	2418	1827	1283	708	NA	NA	NA	NA
2.2	5232	4483	3770	3099	2487	1885	1336	755	NA	NA	NA	NA
2.1	5396	4625	3902	3226	2556	1948	1389	803	NA	NA	NA	NA
2.0	5560	4778	4039	3353	2672	2054	1441	850	NA	NA	NA	NA
1.9	5734	4937	4182	3480	2788	2117	1542	898	NA	NA	NA	NA
1.8	5908	5095	4330	3612	2862	2218	1600	950	NA	NA	NA	NA
1.7	6130	5301	4478	3749	2988	2292	1658	998	NA	NA	NA	NA
1.6	6362	5470	4678	3891	3115	2402	1758	1093	NA	NA	NA	NA
1.5	6558	5692	4837	4034	3242	2513	1821	1140	NA	NA	NA	NA
1.4	6801	5919	5042	4224	3416	2629	1922	1193	NA	NA	NA	NA
1.3	7049	6151	5259	4377	3553	2751	1991	1294	NA	NA	NA	NA
1.2	7355	6389	5481	4578	3738	2920	2128	1389	NA	NA	NA	NA
1.1	7624	6642	5708	4784	3886	3047	2239	1489	NA	NA	NA	NA
1.0	7952	6943	5945	5000	4076	3221	2355	1589	NA	NA	NA	NA
0.9	8284	7255	6230	5222	4319	3400	2519	1695	NA	NA	NA	NA
0.8	8638	7577	6526	5496	4530	3590	2682	1795	NA	NA	NA	NA
0.7	9045	7915	6838	5782	4789	3780	2851	1906	NA	NA	NA	NA
0.6	9462	8305	7160	6072	5011	4023	3031	2059	NA	NA	NA	NA
0.5	9905	8670	7540	6420	5333	4271	3252	2218	NA	NA	NA	NA
0.4	10365	9140	7931	6743	5618	4530	3485	2408	NA	NA	NA	NA
0.3	10887	9583	8342	7165	5966	4847	3728	2619	NA	NA	NA	NA
0.2	11437	10095	8818	7556	6368	5169	4018	2878	NA	NA	NA	NA
0.1	12054	10676	9314	8015	6742	5555	4324	3152	NA	NA	NA	NA
0.0	12709	11283	9874	8538	7228	5951	4683	3474	NA	NA	NA	NA
-0.1	13432	11964	10513	9081	7730	6368	5058	3812	NA	NA	NA	NA
-0.2	14198	12677	11136	9705	8300	6853	5497	4161	NA	NA	NA	NA
-0.3	15096	13480	11885	10354	8965	7402	5998	4615	NA	NA	NA	NA
-0.4	16041	14325	12672	11088	9668	8026	6526	5090	NA	NA	NA	NA
-0.5	17044	15312	13554	11912	10502	8765	7123	5629	NA	NA	NA	NA
-0.6	18200	16357	14578	12783	11442	9573	7804	6204	NA	NA	NA	NA
-0.7	19525	17567	15671	13797	12492	10486	8569	6896	NA	NA	NA	NA
-0.8	20983	18897	16922	14932	13665	11558	9541	7677	NA	NA	NA	NA
-0.9	22635	20460	18311	16231	15064	12799	10586	8554	NA	NA	NA	NA
-1.0	24557	22192	19937	17714	16680	14235	11848	9520	NA	NA	NA	NA
-1.1	26780	24293	21833	19409	18623	15935	13358	10903	NA	NA	NA	NA
-1.2	29478	26722	24082	21484	20988	17984	15143	12434	NA	NA	NA	NA
-1.3	MDE	29716	26785	23934	23992	20576	17340	14346	NA	NA	NA	NA
-1.4	MDE	MDE	MDE	27018	27836	23903	20212	16738	NA	NA	NA	NA
-1.5	MDE	MDE	MDE	MDE	MDE	28401	24077	19948	NA	NA	NA	NA
-1.6	MDE	MDE	MDE	MDE	MDE	MDE	29489	24483	NA	NA	NA	NA
-1.7	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA
-1.8	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA
-1.9	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA
-2.0	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA
-2.1	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA
-2.2	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA
-2.3	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA
-2.4	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA
-2.5	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA
-2.6	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA
-2.7	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA
-2.8	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA
-2.9	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA
-3.0	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA	NA	NA	NA

MDE = Maximum Distance (30,000 ft) Exceeded

Initial Speed to 15 MPH, Freight Trains

Grade	70	65	60	55	50	45	40	35	30	25	20	15
3.0	4736	4145	3564	3047	2540	2096	1684	1304	966	671	380	NA
2.9	4842	4235	3670	3115	2624	2149	1732	1346	998	702	401	NA
2.8	4968	4356	3754	3216	2688	2207	1779	1389	1035	729	428	NA
2.7	5100	4477	3865	3289	2777	2286	1827	1431	1072	760	433	NA
2.6	5243	4578	3976	3395	2851	2344	1885	1473	1109	771	459	NA
2.5	5386	4710	4097	3501	2941	2408	1943	1515	1146	803	486	NA
2.4	5533	4847	4219	3606	3020	2497	2006	1584	1183	834	512	NA
2.3	5687	5005	4340	3701	3120	2582	2075	1631	1225	866	539	NA
2.2	5866	5153	4472	3817	3226	2656	2154	1679	1283	919	565	NA
2.1	6035	5301	4609	3960	3332	2751	2218	1732	1325	956	597	NA
2.0	6225	5481	4752	4081	3443	2846	2302	1806	1373	993	623	NA
1.9	6405	5644	4916	4213	3559	2952	2392	1864	1415	1030	676	NA
1.8	6616	5834	5069	4372	3701	3057	2481	1943	1484	1088	707	NA
1.7	6838	6035	5254	4514	3828	3184	2577	2027	1537	1125	739	NA
1.6	7065	6241	5444	4689	3981	3300	2677	2112	1605	1167	792	NA
1.5	7323	6458	5639	4863	4119	3442	2804	2202	1684	1230	824	NA
1.4	7572	6684	5845	5053	4282	3569	2915	2313	1758	1272	882	NA
1.3	7857	6948	6061	5243	4456	3722	3047	2413	1837	1341	940	NA
1.2	8147	7197	6310	5449	4641	3886	3189	2534	1927	1415	982	NA
1.1	8459	7482	6568	5687	4852	4055	3337	2645	2038	1489	1040	NA
1.0	8786	7799	6843	5929	5053	4256	3495	2777	2149	1568	1104	NA
0.9	9150	8115	7128	6188	5285	4462	3659	2941	2276	1669	1172	NA
0.8	9509	8464	7450	6468	5555	4662	3854	3089	2397	1764	1262	NA
0.7	9911	8839	7772	6774	5813	4916	4055	3268	2534	1880	1336	NA
0.6	10359	9229	8131	7102	6109	5159	4271	3453	2693	1996	1431	NA
0.5	10829	9647	8532	7445	6420	5438	4520	3654	2867	2144	1531	NA
0.4	11331	10106	8934	7814	6758	5734	4784	3886	3068	2297	1637	NA
0.3	11854	10613	9404	8226	7128	6072	5069	4134	3263	2481	1758	NA
0.2	12440	11136	9884	8686	7524	6431	5386	4393	3490	2677	1922	NA
0.1	13084	11738	10418	9156	7952	6811	5729	4699	3754	2883	2096	NA
0.0	13770	12350	11003	9694	8427	7244	6093	5042	4034	3126	2281	NA
-0.1	14525	13052	11637	10275	8955	7703	6526	5386	4361	3384	2503	NA
-0.2	15328	13802	12334	10898	9567	8221	6970	5803	4704	3685	2761	NA
-0.3	16220	14636	13079	11590	10259	8797	7471	6246	5100	4034	3020	NA
-0.4	17223	15550	13929	12355	11003	9430	8031	6753	5528	4403	3311	NA
-0.5	18300	16558	14853	13205	11869	10185	8664	7297	6009	4826	3670	NA
-0.6	19525	17677	15893	14150	12836	11030	9367	7915	6558	5291	4066	NA
-0.7	20898	18945	17054	15222	13944	12012	10175	8628	7176	5840	4536	NA
-0.8	22456	20381	18364	16421	15217	13116	11162	9409	7878	6442	5048	NA
-0.9	24214	22028	19884	17804	16685	14420	12287	10312	8670	7149	5644	NA
-1.0	26289	23929	21611	19388	18454	15951	13612	11447	9588	7946	6341	NA
-1.1	28686	26157	23665	21252	20560	17804	15228	12820	10650	8881	7139	NA
-1.2	MDE	28792	26088	23475	23137	20080	17176	14483	11885	9968	8084	NA
-1.3	MDE	MDE	29045	26168	26384	22915	19642	16574	13760	11262	9171	NA
-1.4	MDE	MDE	MDE	29478	MDE	26580	22810	19267	16004	13036	10539	NA
-1.5	MDE	MDE	MDE	MDE	MDE	MDE	27044	22878	18998	15476	12244	NA
-1.6	MDE	MDE	MDE	MDE	MDE	MDE	MDE	27921	23200	18860	14911	NA
-1.7	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	29452	23929	18823	NA
-1.8	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	25170	NA
-1.9	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA
-2.0	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA
-2.1	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA
-2.2	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA
-2.3	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA
-2.4	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA
-2.5	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA
-2.6	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA
-2.7	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA
-2.8	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA
-2.9	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA
-3.0	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	NA

MDE = Maximum Distance (30,000 ft) Exceeded

Initial Speed to Stop, Freight Trains

Grade	70	65	60	55	50	45	40	35	30	25	20	15
3.0	4884	4293	3733	3210	2719	2265	1853	1489	1167	898	665	465
2.9	5005	4404	3833	3295	2793	2328	1901	1531	1204	924	686	486
2.8	5132	4514	3934	3384	2872	2392	1959	1573	1241	950	708	502
2.7	5269	4636	4039	3474	2952	2466	2017	1621	1278	982	729	517
2.6	5407	4763	4150	3575	3036	2534	2080	1668	1315	1014	755	539
2.5	5555	4895	4266	3675	3126	2614	2144	1721	1357	1045	776	560
2.4	5713	5032	4393	3786	3221	2693	2212	1774	1399	1082	808	581
2.3	5871	5180	4520	3902	3321	2783	2281	1832	1447	1119	834	602
2.2	6040	5333	4657	4018	3427	2872	2360	1896	1494	1156	866	623
2.1	6225	5491	4805	4150	3538	2967	2439	1964	1547	1199	898	649
2.0	6410	5665	4953	4282	3654	3068	2529	2038	1600	1241	929	676
1.9	6611	5845	5116	4425	3775	3173	2619	2112	1658	1288	966	702
1.8	6822	6035	5285	4573	3907	3289	2719	2191	1721	1336	1008	734
1.7	7043	6236	5465	4736	4050	3406	2820	2281	1790	1378	1051	766
1.6	7276	6447	5655	4905	4198	3538	2930	2371	1869	1431	1093	802
1.5	7529	6669	5856	5085	4356	3675	3047	2471	1948	1494	1140	840
1.4	7788	6912	6072	5275	4525	3823	3173	2577	2033	1558	1193	876
1.3	8068	7165	6299	5481	4704	3981	3305	2688	2128	1626	1246	924
1.2	8364	7434	6542	5697	4900	4150	3453	2809	2233	1711	1304	972
1.1	8680	7719	6801	5929	5100	4330	3606	2941	2339	1800	1368	1019
1.0	9018	8026	7080	6178	5322	4520	3775	3084	2460	1895	1436	1072
0.9	9372	8353	7376	6442	5560	4731	3955	3237	2587	2001	1510	1135
0.8	9757	8701	7693	6732	5813	4953	4150	3406	2730	2117	1600	1199
0.7	10169	9076	8031	7038	6088	5196	4356	3585	2878	2244	1700	1262
0.6	10608	9483	8400	7366	6384	5454	4588	3780	3047	2381	1806	1341
0.5	11077	9916	8791	7719	6700	5739	4831	3992	3226	2529	1927	1420
0.4	11584	10380	9219	8105	7049	6040	5100	4224	3421	2698	2059	1526
0.3	12128	10882	9678	8522	7419	6373	5396	4478	3638	2878	2207	1642
0.2	12720	11426	10175	8971	7825	6737	5713	4757	3876	3078	2371	1774
0.1	13364	12012	10713	9462	8268	7133	6061	5058	4134	3300	2556	1922
0.0	14055	12651	11299	9995	8749	7566	6447	5396	4425	3543	2761	2086
-0.1	14810	13353	11943	10581	9277	8041	6864	5766	4747	3818	2988	2270
-0.2	15634	14113	12640	11220	9900	8559	7329	6172	5100	4119	3242	2481
-0.3	16547	14953	13411	11922	10586	9134	7841	6626	5497	4461	3501	2719
-0.4	17545	15877	14261	12704	11357	9773	8411	7128	5940	4842	3812	2988
-0.5	18654	16901	15206	13564	12229	10539	9045	7693	6431	5264	4161	3300
-0.6	19895	18047	16257	14525	13211	11405	9752	8321	6985	5750	4567	3649
-0.7	21289	19335	17440	15608	14330	12392	10576	9029	7609	6294	5027	4050
-0.8	22868	20798	18781	16833	15624	13533	11569	9826	8316	6911	5544	4509
-0.9	24679	22472	20323	18237	17134	14858	12725	10745	9124	7619	6151	5032
-1.0	26764	24404	22097	19863	18929	16431	14087	11906	10053	8437	6848	5623
-1.1	29209	26669	24182	21764	21078	18322	15724	13311	11135	9383	7656	6325
-1.2	MDE	29357	26659	24029	23712	20640	17730	15022	12535	10502	8617	7154
-1.3	MDE	MDE	29652	26770	27002	23538	20249	17165	14330	11838	9747	8136
-1.4	MDE	MDE	MDE	MDE	MDE	27261	23485	19927	16643	13659	11141	9340
-1.5	MDE	MDE	MDE	MDE	MDE	MDE	27799	23612	19716	16178	12936	10835
-1.6	MDE	MDE	MDE	MDE	MDE	MDE	MDE	28739	24003	19663	15681	12762
-1.7	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	24832	19705	15555
-1.8	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	26194	20476
-1.9	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	29452
-2.0	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE
-2.1	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE
-2.2	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE
-2.3	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE
-2.4	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE
-2.5	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE
-2.6	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE
-2.7	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE
-2.8	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE
-2.9	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE
-3.0	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE	MDE

MDE = Maximum Distance (30,000 ft) Exceeded

14.3 Headway Criteria for Signal System Design

The signal system shall be designed so as to support a practical CFRC following move headway of 7.5 minutes to support Amtrak running between consecutive same-direction SunRail trains. Practical headway shall reflect the simulated theoretical headway plus a 25% margin to account for train variability, temporary speed restrictions, dispatching delays and other factors. The theoretical headway shall therefore be designed for 6.0 minutes.

Field testing of the 15 minute headway is not required. 30 minute headways shall be verified at cutover and any non-compliance with the 30 minute headways shall be documented. The noncompliant headways are required to be corrected and verified to be compliant to the Department's satisfaction.

Headway shall be computed with the assumption that no SunRail train sees an aspect that requires a reduction in speed for the applicable route at any signal, with the following exceptions:

In three-block four-aspect territory, at a signal:

- which is immediately prior to a station stop;
- whose next signal in advance is beyond and clearly viewable from the station platform;
- whose control line for Clear terminates three signals (including the viewable signal) beyond the station stop;
- the headway may be based upon an intermediate aspect whose control line ends one signal beyond the signal which is viewable from the station platform.

Headway computations shall incorporate the VE Study Recommendations and in accordance with the CFCRT Project Phase 2 South TMOP provided as attachments to the RFP.

15 COMMUNICATIONS - DESIGN REFERENCES

15.1 Design References

Design Criteria for Communications shall be in accordance with this document and all applicable standards, instructions, specifications, and operating practices for railroad signaling. The design and construction of the system shall conform to the latest revision of applicable codes, recommended practices, and standards listed in Section 2.

- U.S. Code of Federal Regulation (CFR), Title 49, Parts 234, 235, and 236, Rules,

15.2 Communications Concept of Operations

The requirements listed in the following section describe, in general, the existing CFRC Communications System.

Communications systems are divided into three general categories: wayside, station, and OCC.

Wayside communications shall be provided to support the train operations. VHF voice communications shall be used to and from the train, maintenance workers, and supervisors. A dedicated fiber pair shall be used for communication of train signal system data to and from the OCC. A backup system for communications with the wayside signal system shall be provided with an Advanced Train Control System (ATCS) data radio system installed at the Control Points. ATCS radio base stations shall have a minimum of 90 minutes of back-up power. Communications between base stations and the OCC shall be over the fiber optic network.

PA and VMS messages shall be initiated by messages from the OCC. The OCC shall be capable of making ad-hoc Public Address/Variable Message Sign (PA/VMS) announcements at each station. The VMS shall display train arrival information and train arrival notification messages shall come from the OCC.

The Closed Circuit TV (CCTV) images shall be transmitted over the fiber network with storage and display at the OCC. Cameras and equipment shall be compatible with existing equipment and software.

Emergency Call Box (ECB) phones shall autodial the local 911 facility using a Plain Old Telephone Service (POTS) phone connection via outdoor twisted pair wiring. In addition, each ECB shall signal an alarm indication to nearest CCTV to pan, tilt and soom (PTZ) to view the ECB area.

All fare collection equipment shall be furnished and installed by a separate contractor. The Communications Transmission System (CTS) shall provide transport for all station fare collection devices by providing the required number of Ethernet ports for Ticket Vending Machines (TVMs) and Ticket Validotor Units (TVU) at each station, as indicated on the Contract drawings.

All communications systems and devices shall be connected to a backup power system that shall provide continuous power for all critical systems. Each station shall be equipped with a UPS capable of providing a minimum of 90 minutes of back-up power for all communications systems and devices. An external generator connection shall be provided for emergency power.

Each new station shall be connected to the fiber optic network for communications to the OCC. Passenger Assistance Telephones (PATs) shall operate via Voice over Internet Protocol (VoIP) and shall provide an automatic connection to the Customer Service Desk at the OCC.

Remote Processing Units (RPUs), compatible with the existing Phase 1 SCADA system, shall be used at each Phase 2 South station to report alarms and other status indications to the OCC, and provide controls from the OCC to certain field equipment where required. A list of items to be monitored and alarmed shall be provided based on the configuration of the existing stations.

All new equipment and software shall be compatible with the existing equipment and software and provide the same functionality as the existing system.

15.3 General Description

Communications (voice/data/video) shall be transmitted to field devices via local nodes. There are three general types of nodes: radio (for VHF and ATCS radio base stations),

station (for station services), and signal (for Control Point CTC and PTC and wayside signals for PTC) Transmission from each node shall be over the fiber network.

The CFRC Train Dispatcher shall control trains via a combination of voice radio communications (over FRA channels) and a signal control machine. All services shall be provided via an integrated command and control system.

The design shall provide an extension to the existing fiber optic network used to carry data and voice communications between the OCC and the stations and radio sites installed as part of Phase 2 South. The network design shall minimize the impact of any single point failure of a node

15.4 Communications Transmission System (CTS)

The requiremetns listed in the following section describe the existing CFRC OCC Communications Systems. Coordinate with the O&M Firm to verify that communication systems designed as part of Phse 2 South stations are compatible with the existing OCC and CTS.

The fiber optic network shall be used to carry data and voice communications between the OCC and the stations and radio sites installed as part of Phase 2 South. The CTS shall carry essential (mission critical) data such as block occupancy and switch command and control information. The CTS must be robust, highly reliable, and secure. There shall be several different types of data connections via the CTS each with different QoS requirements.

Signaling system/ ATCS data radio support: - Signal ATCS are principally low speed but mission critical data. Accurate transmission of data is an absolute requirement.

RF voice connections – RF voice requires high quality audio to retain intelligibility and have low latency.

All voice communication channels shall provide a minimum 64 kbps to support a 300 – 3,000 Hz frequency range. The CTS shall be compatible with the existing system and support communications and signaling (including base station steering) used by the radio system and the OCC equipment.

The CTS backbone shall implement Managed Ethernet Field Switches (MFES). The MFES shall be capable of prodicing wire-speed fast Ethernet connectivity at transmission rates of 1000 megabits per second from the remote node installation location. Provide sufficient number of Ethernet ports on each switch to meet the design requirement plus an additional 30% for future expansion

15.5 Radio Communications

15.5.1 ATCS Data

The ATCS data radio system will be used for a backup system in the event of a fiber optic system failure in Phase 2 South. The existing locations will remain using the data radio system in normal operations with a cellular backup system until the fiber is extended throughout the entire corridor and the CP control is transferred to the fiber optic system. The 900 MHz ATCS radio frequency assignment/licensing from the

FCC/AAR and codeline addressing for control point data communications on the CFRC is provided as part of the final design for Phase 2 South. The ATCS data radio system shall provide reliable coverage at all field signal locations for the entire CFRC. Field CP radio equipment shall be described under the signal section.

15.6 Control Center - Communications

The existing control center equipment shall distribute the voice and ATCS data to the required components within the control center environment. The new field systems shall be integrated to the existing Operations Control Center equipment.

15.7 Station Communication Equipment

The requirements listed in the following section describes, in general terms, the existing CFRC Station Communications Systems. Detailed information regarding the requirements for the new system are provided in the Specifications and CFCRT Phase 2 South Station Plans included as attachments to the RFP to enable the integration of the systems installed as part of Phase 2 South. The CFCRT Phase 2 South Station Plans govern.

15.7.1 General Requirements

The provisions contained in this Section include general requirements for communication devices and equipment used on the CFCRT system. Use only equipment and components that meet the requirements of the Specificaitons and Final Design Plans. Where possible, use equipment and components listed on FDOT's Approved Product List (APL). Use only new equipment and materials except as specified in the Contract documents.

15.7.2 Passenger Assistance Telephones (PAT)

Provide two PATs at each station, one on each platform and have battery back-up. PATs shall receive a direct connection to the OCC over a VoIP system when the PAT is manually activated by pressing a button on the PAT. A network connection shall be provided from the OCC to the PAT phone via the CTS. Each PAT shall be clearly labeled with its purpose to differentiate from the ECB.

15.7.3 Public Address/Variable Message Signs (PA/VMS)

These systems shall present dynamic passenger information required for the guidance and convenience of riders. Information shall be presented both audibly and visually and shall meet all ADA and ICC A117.1-2009 requirements. The PA/VMS system shall be controlled from the existing OCC. Audible messages and visual sign dis stored at the control center and disseminated via the CTS. All PA/ VMS equipment for Phase 2 shall be compatible with, and expand upon, existing Phase 1 equipment

Each station shall have a public address system. The system shall include sufficient speakers and power to deliver a uniform sound pressure level up to 90 dB SPL 84 dB at 5 ft. 6 in. above floor level (plus or minus 3 dB). The Department may elect to reduce this value due to local conditions. Use adaptive amplification to adjust to variations in ambient noise sources (i.e., shifting locomotives). The system shall support both ad hoc and pre-recorded audible messages. Ad-hoc messages generation must be simple allowing the operator to react to immediate situations. VMS messages shall be coordinated with audible messaging. Information provided by the PA system shall be

provided over the VMS and information represented on the VMS must automatically be provided, to the extent possible, in the audio announcements.

Each station platform shall have two VMS displays. VMS displays shall be full sunlight viewable and ambient light adaptive so that they adjust to light variations. It shall be in an outdoor enclosure a minimum of 40 inches long. VMS must be place in a prominent position and clearly viewable to passengers from the trains and platform.

Information to be presented shall include the same pre-recorded or ad-hoc information as is available for Phase 1 PA/VMS:

Interface the PA/VMS to the OCC so that there is advance warning of train arrival. The PA/VMS shall be capable of supporting any and all messages required by the train control system to provide adequate passenger alerts. Train approach information (timing of alert, nature of alert, etc.) shall be supplied by the OCC.

Messages, content and zoning shall be provided by SunRail Operations. All PA/VMS cabinets, wiring, and components shall be vandal proof and rated for the installed environment.

15.7.4 Emergency Call Boxes (ECB)

Provide two ECBs at each station, one on each platform and have battery back-up. ECB shall be fed with a direct dial-up POTS connection to the PSTN network at the station. The ECB shall be activated by pressing a red button causing the ECB to enter an off hook condition and to direct auto-dial the local 911 system with information to be provided by the O&M Firm for the local system. Each platform ECB shall be connected to separate local telephone lines powered independent of the CTS system. ECBs shall be monitored by the nearby CCTV for on hook/off hook condition. Off hook status of each ECB shall be relayed by the to the near-by CCTV, which shall cause the CCTV to pan, tilt and zoom to view the CEB area. The housing shall be blue in color and shall have “911” decals added to each side. Specific language for the “911” decals shall be provided by the Department to be consistent with the decals in Phase 1.

15.7.5 Remote Processing Unit (RPU)

1. Description:

   The RPU system shall be designed to send discrete digital messages (intrusion alarms, equipment failure alarms, loss of power alarms and any kind of remote alarm and remote control functions that are identified by other disciplines) to the OCC via the local node and the CTS. The RPU shall also create discrete digital control outputs based on control signals from the OCC.

2. RPU Communications:

   An RPU capable of transmitting all collected data to the OCC using any of the following media:

- Ethernet communications over fiber optic cable and copper-based twisted pair that transfers data at a minimum rate of 10 megabits per second (Mbps) or higher.

- Twisted-pair copper wire capable of transferring data at a rate of up to 128 kilobits per second (kbps).

- Cellular mobile telephone service with data transmission rates of up to 56 kbps.

- Commercial Ethernet services including dial up modems, cable modems, ADSL, HDSL, MPLS and related technologies that transfers data up to a minimum rate of 10 megabits per second (Mbps).

3. Remote Processing Unit:

The RPU shall be capable of supporting analog I/O devices with no modification. Use an RPU that supports EIA 232/DB9 serial protocols, and TCP/IP. Ensure that the RPU is programmable and based on an open architecture. Provide a unit having a minimum of 16 discrete digital inputs, 16 discrete digital outputs, and 1 EIA-232 serial ports and one DB9 Interface. The RPU shall provide a minimum of two RJ45 Ethernet interfaces. Ensure that the RPU has a maximum serial data transmission rate of 128 kbps. Ensure that the unit's mean time between failures (MTBF) is 100,000 hours.

Ensure that the RPU issues and communicates an alarm whenever a user defined threshold is exceeded. Ensure that the RPU is also capable of producing an output through contact closure or a digital output that imitates a contact closure or exceeds a predefined analog threshold. At minimum, the RPU shall be able to store internally the last 24 readings over a user-defined time interval of up to 5 minutes.

The RPU shall operate using a nominal input voltage of 110 to 120 VAC, and also be capable of operating on 12 VDC such as a solar power system. The RPU shall send an alarm to the OCC if the AC power supply is low or if there has been a complete power loss. Ensure that the system sends a message when the unit returns to normal conditions.

All components within the RPU shall operate throughout an ambient operating temperature range of 0° to 140°F and a maximum relative humidity of 90%.

15.7.6 CCTV Systems

1. Description

Closed-circuit television (CCTV) cameras shall be provided at the station platforms. The system shall provide unobstructed video images of the platforms, adjacent ROW, and other current conditions; that it responds to camera control signals from the OCC; and that the video images can be transmitted to remote locations for observation via the fiber communications infrastructure.

Each station shall have a CCTV system consisting of one (1) Pan-Tilt-Zoom (PTZ) camera and two (2) static cameras per platform (six PTZ cameras per station); power supplies; cables; and associated equipment. Cameras shall provide general

surveillance of the stations, platforms, parking lots, surveillance of the ticket vending areas and the adjacent ROW, plus conduits for future cameras as directed by the Department.

These shall be situated so as to provide comprehensive coverage of the platforms and pedestrian crossing area and views in both directions along the tracks. In particular, camera placement shall provide clear views of the fare collection equipment, ECB's and PAT's. The CCTV system images shall be stored at the OCC on Network Video Recorders (NVR) (digital video recorder connected with the CFRC network). The OCC NVR system shall be expanded (memory and processing power) by a minimum of 505 from current to support the additional cameras.

2. Materials

Camera

The station CCTV camera system shall be compatible with the current version of the Department's SunGuideSM Software System, and any other camera operating software indicated in the Specifications. Ensure that the CCTV camera allows remote control of camera pan, tilt, and zoom functions via the Department's SunGuideSM Software System user interface. Use either a dome-type or external positioner-type CCTV camera assembly.

Communication

The CCTV system shall use Category 6 UTP copper cable or fiber for transmission and provide video from platform areas to the equipment cabinet at the station..

15.7.7 Infrastructure

This section describes the station cabinets required to house the equipment.

1. Description

Design communications infrastructure components meeting the requirements of the Specifications, Final Design Plans and the specific requirements for each component as defined in the Department's Intelligent Transportation System (Requirements) 785-2 through 785-5.

2. Grounding and Surge Protection

2.1. Design grounding and surge protection for all equipment and materials to provide personnel and equipment protection against faults, transient voltage surges, and induced current. Ensure that the grounding system used meets the grounding requirements defined in Department Section 620 and in Section 785-1.

Design all components with surge protection devices (SPDs) as shown in the plans and according to the device manufacturer's recommendations. Ensure that the SPDs are capable of meeting or exceeding the device protection requirements as contained in Section 785-1 and that they are listed on the Department's APL. Consider multiple devices installed in the same equipment

cabinet to be a single installation for the purpose of providing grounding and surge suppression. Protect all conductive power, voice, video and data lines. Provide surge protection both ahead of and behind (i.e., on the supply side and the load side of) electronic devices connected using conductive wiring.

2.2. Grounding Specifications

Use a grounding electrode system to achieve a resistance to ground measurement of 5 ohms or less.

2.3. Surge Protection Devices

Design all equipment cabinet sites with both primary and secondary surge protection on the AC power. Design connection to the primary surge protection at the service entrance or main disconnect and the secondary surge protection on the power distribution to the equipment.

SPD Device at Power Entry Point:

Design a SPD at the closest termination/disconnection point where the 120 V supply circuit enters the equipment cabinet. Locate the SPD on the load side of the service disconnect and ahead of any and all electronic devices

SPD for Low-Voltage Power, Control, Data and Signal Systems

Design a specialized SPD at the supply and line sides of all low-voltage connections to the equipment cabinet device and its operating subsystems. These connections shall include, but are not limited to, Category 5 data cables, coaxial video cables, twisted pair video cables, and low voltage control cables that comply with Electronic Industries Alliance (EIA) requirements as detailed in the EIA-232/422/485 standards.

3. Equipment Cabinet

Communications equipment shall be housed in weather-proof cabinets located at each station (the station utility yard and the platform communicatons cabinet). The cabinets shall provide a climate controlled environment for all electronic equipment. Access to the cabinets shall be restricted, such as by latching hardware and padlocks. A UPS shall provide continuous power at each location for critical equipment including all communications equipment with at least 90 minute of backup power. Cabinets shall be installed above the 100 year floodplain.

Design an equipment cabinet for housing electronic equipment and network devices including, but not limited to, Managed Field Ethernet Switches, hub switches, device servers, digital video encoders, public address equipment and VMS equipment. The cabinet should restrict unauthorized access, constructed without sharp edges and be weather resistant under all conditions. The cabinets shall be sized so there is a minimum of 30% free space available for future use after installation of equipment, conduits, and cable.

3.1. Electrical Requirements

All equipment designed shall conform to applicable UL, NEC, EIA, ASTM, ANSI and IEEE requirements. Provide SPDs for the main AC power input at the service panel assembly and on both sides of all electronics as required by 785-2. Ensure that the SPD is accessible from the front of any panel used in the cabinet.

Service Panel Assembly: A service panel assembly shall be designed to function as the entry point for AC power to the cabinet and the location for power filtering, transient suppression and equipment grounding. Provide branch circuits, SPD, and grounding only as required for the device-connected load served by the cabinet, including ventilation fans, internal lights, electrical receptacles, etc.

Terminal Blocks:

Terminate electrical inputs and outputs on terminal blocks where the voltage and current rating of the terminal block is greater than the voltage and current rating of the wire fastened to it. Number all terminal block circuits and cover the blocks with a clear insulating material to prevent inadvertent contact.

Ground Bus Bar:

Design the ground bus bar on the side of the cabinet wall adjacent to the service panel assembly for the connection of AC neutral wires and chassis ground wires. If more than one ground bus bar is used in a cabinet, use a minimum of a #10 AWG copper wire to interconnect them.

Power Distribution Assembly: Design a power distribution assembly that fits in the EIA 19-inch rack and provides for protection and distribution of 120/240 VAC power.

Interior Lighting: The equipment cabinet shall be designed with two 20-watt fluorescent lamps and clear shatter-proof shield assemblies which are mounted on the inside front and rear top of the cabinet. The equipment cabinet shall have door-actuated switches so that the lamps automatically turn on when either cabinet door is opened and go off when the doors are closed.

3.2. Generator and Auxiliary Power Connection:

The equipment cabinet shall be designed with provisions for the connection of an external power source, such as a portable generator, through a weatherproof, water-resistant, secure interface. This feature should allow authorized personnel to access, connect, and secure an external power source to the cabinet in order to restore power within 5 minutes of arrival at the equipment cabinet.

Provide the equipment cabinet with a transfer switch rated for the design load of the cabinet's main breaker to provide an alternate power source using a generator. Use a transfer switch that can be permanently mounted inside the cabinet. Ensure that the transfer switch meets UL Standard 1008.Ensure that the transfer switch does not allow simultaneous active power from two sources.

Include a generator connection consisting of, at a minimum, the manual transfer switch and twist-lock connector for generator hookup. Locate and label the transfer switch and twist lock connector on a lockable, weatherproof and dustproof cover. Locate this

generator connection as close as possible to the main AC circuit breaker. Never locate the generator connection on the main cabinet door or back door.

Connect the power service wiring entering the cabinet to the transfer switch. Connect the alternate power source's wiring on the transfer switch to a receptacle that can accept a 120 VAC generator cord.

15.8 Fiber Optic Cable and Interconnect

1. Fiber Optic Cable System.

   1.1. Description.
   The fiber optic cable system shall consist of a minimum of 4-each 1-1/2 inch inner-ducts. One inner-duct shall have the FDOT/CFRC fiber and remaining three inner-ducts shall be spare. The system shall be designed run the length of Phase 2 South, approximately 17.2 miles. The new 96 strand trunk fiber optic cables shall be connected to the fiber installed as part of Phase 1 to create a continuous fiber backbone.

   At the south end of the Phase 2 South corridor the trunk fiber shall end at the ROW where a 1,000-foot slack coil shall be left in a pull box to enable splicing into an FDOT provided fiber optic cable to provide a redundant path back to the OCC.

   Lateral fiber cable shall be run to each radio base location along the Phase 2 South corridor with a 12 Fiber Single Mode fiber cable.

   Lateral fiber cable shall be run to each station utility yard along the Phase 2 South corridor with a 48 Fiber Single Mode fiber cable.

   Lateral fiber cables shall be run, at a minimum, to each control point and wayside intermediate signal along the Phase 2 South corridor with two - 24 fiber Single Mode fibers to support CP control and indication "codeline" and PTC functions. Each lateral fiber will be installed in discrete conduits and trenches with a minimum of 25' separation between trenches

   1.2. Materials:

   Truck Fiber Optic Cable: The FDOT/CFRC fiber shall consist of a single-mode fiber (SMF), 96 strand, suitable for underground (i.e., in conduit) and aerial outside plant installation.

   1.3. Conduit and Locate System:

   A conduit and a locate system for fiber optic cable shall be designed for Phase 2 South. Design of the conduit shall comply with the requirements of Section 630.

   A locate system shall be designed along any underground conduit installation. The design of the locate system shall include above ground route markers, warning tape, tone wire, and electronics that allow detection of buried conduit and other related underground facilities.

   1.4. Installation Coordination

To coordinate the work between the Design and Build Firm and the Signal Design-Build Firm work, the following sequence of work shall be follow:

The Design and Build Firm shall furnish, and install the following fiber network components:

- 96-count truck fiber optic cable, conduit
- All splice vaults, and splice enclosure, and splicing
- Lateral fiber optic cables and conduit into the stations
- Lateral fiber optic cables for the Signal Design-Build Firm railway signal system. The length of each lateral fiber optic cable shall be a minimum of 1000'. The lateral fiber optic cable shall be coiled inside the splice vault. The splice vault shall include a 10' stub-out conduit to allow the Signal Design-Build Firm to tie their conduit. The location of the splice vault and stub-out shall be coordinated with the Signal Design-Build Firm.

The Design-Build Firm shall immediately OTDR test the trunk and lateral fiber cables after installation. The Design-Build Firm shall submit the test result for review and approval. After approval of the OTDR results, Signal Design-Build Firm will be allowed to tie into the splice vault stub-out and pull the lateral cable into the railway signal system.

Fiber path panel termination of the Signal Design-Build Firm lateral cable shall be the responsibility of the Signal Design-Build Firm. The Signal Design-Build Firm shall immediately OTDR test the lateral fiber cables after installation. The Signal Design-Build Firm shall submit the test result for review and approval.

1.5. Testing Requirement

In addition to the fiber testing requirements found in FDOT Standard Specification Section 633, Electronic files of the OTDR test result, in the native format generated by the OTDR, shall be submitted for review and approval. Each file shall be a single trace test per fiber, per direction, and per wavelength. Copies and licenses of the OTDR software shall be provided to the Department. The OTDR software shall run on Windows operating system, and shall allow the Department to view and print each trace, as well as group of traces. The OTDR software shall compare bidirectional traces and average splice loss/gains.

15.8.1 Fiber Optic Strand Assignment

The 96-strand corridor fiber optic cable shall be continuous through the corridor and enclosed in a sheath suitable for the location. Strands assignments shall be based on the following:

- Strands 01-04 – Stations
- Strands 05-08 – VHF Radio
- Strands 09-12 – PTC Ring 3
- Strands 13-16 – BCP Radio (ATCS)
- Strands 17-20 – PTC Ring 1

- Strands 21-24 – PTC Ring 2
- Strands 25-28 – Stations
- Strands 29-96 – FDOT D5 ITS

16 STATIONS

16.1 Description

This section establishes specific guidelines and standards for the station platform design, which shall be at-grade.

The design of the stations shall be standardized wherever possible, including shelters, platform features, structural elements, equipment, furniture and signage. Local communities shall determine design and amenity characteristics.

16.2 General Design Standards

The facilities must be able to serve the needs of patrons conveniently and comfortably. The facilities shall aesthetically address the use of proven modern technology and appropriate architectural design. They shall also provide for the traditional requirements of public transit systems, identity in the neighborhood or downtown area as a location for public transit, and cover and/or screening from average weather conditions.

In designing the facilities, the anticipated growth and long-term life of the system shall be considered. Function and life cycle considerations are important, as are aesthetics and the overall quality and character of the facilities. Station design, whether it occurs in downtown areas, commercial districts, historic districts or suburban neighborhoods shall be compatible with the immediate vicinity and reflective of the regional context of the central Florida area.

Stations shall be standardized where appropriate to provide a consistently understandable experience for transit users. Standard graphic information systems are especially important. However, standard furnishings, lighting fixtures, construction design and materials are also desirable where they appropriately complement existing and proposed features and land uses. Standardization, where practicable, also reduces inventories for replacement parts and equipment for maintenance and costs.

Station circulation and operation (i.e., where and how to buy tickets and boarding location) must be simple and easily understood for maximum convenience.

In all segments, it is essential that great care be taken in coordinating final design with the Department, affected communities and neighborhoods, adjacent property owners or developers, public agencies and community groups having significant interest in the human environment and design of facilities at stations and along routes. Coordination with the development plans and master plans of local communities and neighborhoods is essential to blending the transit system into the urban fabric of the respective areas and in assuring that the Department and community needs are met. Individual permits are not required for each platform from each local jurisdiction in accordance with Florida Statute 553.73 (9) (b).

All maintenance of station stops shall be performed by local municipal personnel during revenue hours and maintenance and repair equipment shall be moved to the station from a central facility where most equipment, supplies and materials shall be stored. Power and water shall be provided at each station. Maintenance staff shall access stations by small utility trucks or by other approved means.

Any conduits runs and pull boxes for electrical and communications shall be designed to minimize the length of conduit and number of pull boxes required in the platform. Conduit trunk lines shall run along the backside of the platform. Each canopy column not used for drainage shall have a minimum of one electrical and one communication conduit run up the column whether used for station amenities or as a spare. Positive drainage for pull or junction boxes shall be provided regardless of weather resistant or proof boxes are provided.

17 STATION GEOMETRY

17.1 Configuration

The side platforms configuration is preferred. The locations and configurations of the various platforms together with all pertinent dimensions are to be shown in the station plans.

Dimensional requirements for the station are established by code, ADA requirements and by the day to day patron requirements as established in this section. Where both sections reach different conclusions, the more stringent shall control.

For day to day operations, the platform shall be sized to comfortably accommodate the expected patrons on the platform under normal operating conditions. Missed headways and/or delayed headways need not be considered (missed headways and NFPA peak factors must be considered for Fire/Life Safety requirements). Under severe site constraints, day to day patronage requirements can be reduced as accepted by the Department, but Fire/Life Safety requirements must be met.

The Station Platform plans identify a “Platform Dimensioning Control Point” on each platform to coordinate dimensions. Locations are on the plans included as an attachment to this RFP.

17.1.1 ADA Requirements

Commuter stations shall provide accessibility in compliance with Section 2 of this document. Passengers should not be expected to step down from a platform into a rail passenger car. The platform height relative to the vehicle floor threshold should be measured with worn vehicle components (wheels, springs, center plate, etc.). New vehicles shall typically be a few inches higher than ones with worn components.

Refer to Sections Mini-High Platforms, Station Surfaces, Platform Width, General Station Site Design Guidelines and Signage and Graphics.

17.2 Dimensions

The minimum width for a side platform is 14 feet.

The edge of the platform shall be parallel to the track.

17.3 Platform Heights and Offsets

The track side edge of main platforms shall be 8 inches maximum above the top of the plane of the rails and 5 feet 1 inch from track centerline in accordance with the CFOMA. Platforms in curved or superelevated track shall have additional clearance as described in 4.3.1.

All platforms shall have a minimum drainage cross slope of 0.5%. All platforms shall slope away from the track.

17.4 Mini-High Platforms

Mini-high platforms are an alternative to car borne lifts to facilitate ADA level boarding. The track side edge of mini-high platforms shall be 22 inches maximum above top of rail (ATR) and 7 feet 6 inches from track centerline. Concrete for mini-high platforms shall be provided in accordance with Section 24, Structures. Mini-Highs shall be located such that they will not impact pedestrian crossings when SunRail operates a three train consist. The pedestrian crossings at the stations are to be located a minimum of 56 feet from the southern edge of the mini-high except at the Kissimmee Station, where the pedestrian crossing is to be located at 15.25 feet south of the southern edge of the mini-high.

The design of the mini-high platforms shall conform to the Section 2 of this document.

Means of Egress: Ramps used as a part of a means of egress shall have a running slope not steeper than one unit vertical in 12 units horizontal (8.33% slope). Ramps that are part of a required means of egress shall not be less than 44 inches wide. At a minimum, there shall be a means of egress from both ends of each station platform.

Accessibility: Any ramp in new construction shall have a running slope not steeper than 1:12. Provide ramps with the least possible running slope. The maximum rise for any ramp run shall be 30 inches.

Landings: Ramps shall have level landings at bottom and top of each ramp and each ramp run. Landings shall have the following features:

1. The landing shall be at least as wide as the ramp run leading to it.

2. All landings on ramps shall be not less than 60 inches clear, and the bottom of each ramp shall not have less than 72 inches of straight and level clearance.

3. All landings and ramps shall be clear of any obstructions.

Handrails and Guardrails: Pedestrian paths with a running slope steeper than 1:20 and a rise greater than 6 inches shall have handrails on both sides. Handrails are not required on curb ramps or adjacent to seating in assembly areas. Handrails shall have the following features:

1. Handrails and Guardrails shall be provided along both sides of ramp segments. The inside handrail on switchback or dogleg ramps shall always be continuous.

2. Handrails and Guardrails on ramps which are not continuous shall extend not less than 12 inches beyond the sloped segment at both the top and bottom, and shall be parallel to the floor or ground surface.

3. The clear space between the handrail and any vertical face shall be 1 ½ inches.

4. Gripping surfaces must be continuous and have no sharp edges.

5. Top of handrail gripping surfaces shall be mounted between 34 and 38 inches above ramp surfaces.

6. Ends of handrails shall be either rounded or returned smoothly to floor, wall or post.

7. Handrails shall not rotate within their fittings.

The cross slope of ramp surfaces shall be less than 2%. Ramps and their approaches shall be designed so that water shall not accumulate on walking surfaces.

17.5 Station Surfaces

The surface of all station walking surfaces shall be non-skid and of long-wearing weather resistant materials. ADA-compliant detectable warning surface platform edge strips shall be provided. Graphics to warn waiting passengers to remain behind the detectable warning stripe shall be provided.

Material shall be precast concrete pavers with integral color or carbon reinforced composite units (24 in x 48 in). Detectable warning surfaces shall be installed in accordance with manufacturer's instructions.

17.6 Intertrack Fence at Platforms

Platforms shall be separated by an intertrack fence. A fence centered between the two tracks shall provide a barrier to deter unauthorized passengers from crossing the tracks. The top of the fence shall be 3 feet 6 inches higher than the top of the lowest rail. The fence shall be black vinyl coated steel chain link and posts with steel top and bottom rails. The fence shall be constructed in interlocking, removable sections to facilitate track maintenance. Supporting posts shall be removable from sleeves placed in a concrete foundation embedded a minimum of 2 feet. The top of the concrete shall be no higher than the top of the lowest tie. The intertrack fence shall extend beyond the platform at each end a minimum of 100 feet beyond the pedestrian crossing or to the nearest roadway crossing..

17.6.1 Hazard Rock at Platforms

Hazard rock shall be used to channelize pedestrians away from unauthorized areas/ deter trespass activity at the station locations. Hazard rock shall not be placed on the ties or in any locations where it would interfere with maintenance/inspections of the rail.

17.7 Platform Area

The platform minimum area, excluding a 24 inch strip adjacent to the platform edges, shall accommodate the peak 15-minute entraining load at 10 ft^2/person or the peak 15-minute entraining and detraining loads at 7 ft^2/person. Peak hour design headways shall be factored into area calculations.

17.8 Platform Width

Platform layout must also be consistent with available right-of-way width. The minimum distance from the 24 inch safety edge strip to any continuous element (wall, bench, guardrail, etc.) shall not restrict patron entraining and detraining movements, which would add to the vehicle dwell time. Platform clearances must comply with ADA wheelchair lane and turning zone requirements. Any deviations from the preceding limits must be accepted in advance by the Department.

17.9 Station Utility Yards

Each station shall contain a utility yard accessible to maintenance equipment that shall be secured on all sides by a 6-foot black vinyl coated chain link fence with a locked gate. All cabinets within the lockable enclosure shall be accessible on all sides. The yard shall be constructed to prevent vegetative growth. The equipment yard shall contain at a minimum the electrical and communication feeds coming into the station in addition to the lighting and irrigation controls for the facility. Utility yards shall be in a location to not interfere with SunRail customers and pedestrian flows and shall never be closer than 7’6” from tangent track and additional clearance shall be provided adjacent to curved track sections.

18 STATION AMENITIES

18.1 Vertical Clearances

Any station element that could be targeted for theft or vandalism (e.g., light fixtures, sign units, speakers, cameras, etc.) shall be located a minimum of 7 feet 6 inches above traveled pathways, including on the platform. The potential to use benches, trash receptacles, etc. to access and vandalize these elements should also be considered when determining the location for these elements. In addition, horizontal elements (e.g., low member of canopy framework, etc.) shall be located a minimum of 9 feet 0 inches and a maximum of 11 feet 0 inches above the traveled pathways.

18.2 Weather Protection

Generally, there shall be a canopy over at least a portion of each platform. The extent of initial canopy construction shall vary for each station.

Generally, the canopy shall be located as close as possible to the back of the platform and cantilevered to provide maximum coverage of the platform. Where possible, the canopy shall be of uniform design and size and allow for ease of expansion. The canopy

shall be composed of durable components for use in the project area and economic to maintain or repair.

As a minimum, protection from rain shall be provided for the following:

- Fare collection equipment, including a 3 feet x 3 feet area in front of the equipment
- Seating as described under 18.3

The design should assume that the rain is falling at a 30 degree angle from vertical (slightly windblown). Drip lines should not be over traveled pathways. Canopy mounted equipment shall be placed to minimize impacts from weather.

18.3 Seating

Provide for a minimum of 20 seats per platform distributed to four or more locations along the platform protected by canopies.

Bench and/or seat designs shall strongly discourage individuals from lying down and/or sleeping. They shall be compatible with station “architecture”. Seats shall not permit rain to accumulate nor stain easily when vandalized by graffiti.

18.4 Restrooms

Public restrooms shall not be provided at stations.

18.5 Ancillary Space

Ancillary spaces (e.g., electrical, train control communications) may be required at specific stations. In addition to the mechanical and electrical requirements of each space, the following shall be incorporated into the design:

- Reasonable (less than 200 feet travel distance) access to a permanently maintained service vehicle parking stall where provided at a station.
- Provision for conduits, including an allowance for spares. Local jurisdictions may also require additional conduits for future utility services.

18.6 Advertising

Station amenities may accommodate standard advertising venues (i.e., posters) with the amenities program. Refer to the Department for policy and applicable agreements with local funding partners.

18.7 Trash Receptacles

Trash receptacles with clear plastic containers shall be provided on the platforms, fare vending areas, platform plazas and bus/shuttle areas. Trash receptacles shall not be provided for the parking or kiss-and-ride areas. Refer to FTA Transit Agency Security and Emergency Management Protective Measures, Appendix B, Section 2, Sequence No. 2.51 which states: “For passenger stations with identified, significant risks, to the extent practicable, remove trash receptacles and other non-essential containers, except

for bomb-resistant receptacles and clear plastic containers. Install bomb-resistant receptacles to the extent that resources allow."

Trash receptacles shall not be placed in the travel path of the station platforms and plazas.

Maximum travel distance to the nearest receptacle on the platforms shall be 90 feet. A minimum of one receptacle per fare vending area and two minimum per platform shall be provided. Minimum capacity of combined fare vending and platform receptacles shall be 0.12 gallons x peak hour entraining and detraining load. Receptacles shall be fastened to the ground to minimize movement. Liners of receptacles shall be system standard 32 gallon round or square.

18.8 Hose Bibs and Water Fountains

Provide a minimum of two standard flush hose bibs (quick-couplers) with lockable covers located to allow full coverage of the platform and fare vending area(s) with a 75 foot hose using potable water. Do not locate in close proximity to any electrical outlet. The design should minimize the opportunity for trash/water to accumulate. The hose bibs shall be installed vertical and not flush mounted in the ground or slab.

A minimum of one water fountain is to be provided on each platform. Water Fountains are to meet ADA requirements and be located so they are accessible.

18.9 Electrical Convenience Outlets

Provide two 110V, 20 amp, single phase GFI protected electrical receptacles in weatherproof housing/box with a lockable cover located to allow full coverage of the platform and fare vending area(s) with a 75 foot extension cord. Convenience Outlets located in the Plaza and site areas shall also be GFI protected electrical receptacles in weatherproof housing/box with a lockable cover. The design should minimize the opportunity for trash to accumulate or standing water and shall either be installed on pedestals or installed in line with existing station canopy lighting or VMS signage. Either location shall have waterproof protective covers. Electrical outlets shall not be installed at or below grade.

18.10 Patron Information Center

Provide a patron information center at each fare vending area. These centers shall include the following:

- General Information Panel
- System Map
- Neighborhood Map
- Passenger Assistance Telephone (PAT). PAT on the platforms using VoIP telephones and the local Ethernet switch for connectivity to the OCC.
- Security Telephone/ Emergency Call Box (ECB with auto-dial direct to county police and Blue Light Illuminated tower). Installation of blue light tower shall be mounted (bolted with minimum 1-3/4 inch x 3 inch anchor bolt) into an appropriately sized concrete foundation.

18.11 Fare Collection

The fare collection system is based on a policy of self-service barrier free fare collection and shall be comprised of the following features:

- Ticket Vending Machines (TVM's) positioned at an ADA accessible central location on each platform.
- Connections for data communications, drainage of air conditioning condensation, and an independent power circuit need to be provided at each TVM.
- Ticket validators at each station platform shall be housed within the TVM's or installed separately.
- The ticket validators shall be located near the main entry points, but not in the travel path of the station platforms. Provisions shall be made for additional equipment to be added near the initial installation to accommodate future expansion.

19 CIRCULATION ELEMENTS

The stations in the system are functional spaces for patron circulation, waiting, and access to the transit vehicle. Therefore, the stations shall be designed as efficient conduits to accommodate peak demands without undue delay.

19.1 Pedestrian Patterns

There are three distinct groups that must be considered in the design of pedestrian circulation: regular commuters, infrequent users such as tourists and persons with disabilities. The three groups move through the systems in varying ways: commuters move quickly with a minimum of guidance, infrequent users move easily with great reliance on signs for guidance, and persons with disabilities may move slowly with the guidance required depending on the frequency of use and the degree of the disability. The following general principles shall be employed to accommodate these varying demands:

- Right-hand flows are the norm and therefore desirable.
- Pedestrian flow shall take the path-of-least-resistance. Stations should be designed to directly and safely accommodate anticipated pedestrian movement and minimize the potential for trespass. The direction of circulation elements shall be as obvious as possible to aid recognition.
- Grade changes are to be minimized.
- Circulation shall be designed to accommodate room for hesitation or slow passage so a person with disability, infrequent user or waiting patron can pause adjacent to but out of the mainstream of pedestrian flow.
- No obstructions shall be permitted within the main pedestrian flow.
- Shelter areas and circulation elements shall have sufficient transparency to give adequate visual surveillance of these spaces for user safety and to discourage vandalism.

- Pedestrian access from bus, kiss/ride and park/ride areas must be clear and as simple as possible with no visible barriers.

Signalized pedestrian crossings and second train warning signals shall be provided at each station (see Section 9 Highway/Rail Grade Crossing Systems).

19.2 Basic Goals

- Safety achieved through proper relationship of basic circulation elements and the details of construction.
- Maximum convenience for patrons, achieved through the establishment of uniform circulation patterns throughout the system.
- Comfort achieved through proper sizing and layout of the circulation elements.
- Facilities designed to provide for persons with disabilities.
- Standard design to facilitate maintenance.

19.3 Special Requirements for Horizontal Travel Elements

- Drainage shall be provided along walkway surfaces to collect rainwater and drain to an approved storm water collection system.
- Allow unencumbered passenger movement along walkway without overlapping of queuing zones for customer amenities.
- Incorporate system signage and graphics directing passengers to destinations.

19.4 Lighting

Light fixtures for platform illumination shall be incorporated into the integrated structural elements of the station canopy and light standards and shall serve to illuminate signage as well as platform edge, advertising, seating, fare areas, ramps and stairs. Walks, rail and pedestrian crossings, driveways and parking areas shall also fall within the scope of station lighting. Stray light shall not be allowed to intrude on the adjacent neighborhood.

Artificial lighting shall be provided for safety in all open station site areas with due consideration for adjacent land uses. The average maintained foot-candle values are indicated in *19.7 Illumination Design Levels*. The average foot candles listed may require reduction at station locations in low density residential areas. Light fixtures shall be provided with a cutoff feature to eliminate candlepower at high angles.

Artificial light sources to obtain the required foot candle levels shall be no higher than 12 feet in station plaza and 24 feet in parking lots. Light fixture size, pole height, and number of poles shall be selected to optimize foot candle and aesthetic design criteria with minimum capital and operating costs. Light sources shall include lighting control systems to implement on/off commands and photocells with time clock schedule adjustments.

Point by point method of illumination design calculations shall be prepared to document output of the design immediately prior to lamp change using published coefficients of utilization for such light sources.

Pole foundations shall extend 24 inches above parking lot grade when not located behind curb or curb stops to reduce pole damage; however, pole locations within the lot area shall be selected to permit future re-configuration of stall and aisle layout to accommodate vehicle size.

All light fixtures shall be:

- Vandal resistant construction
- U.L. rated for exterior use
- Reasonable to maintain
- Designed to withstand corrosive environments
- High wind proof

19.5 Specific Lighting Requirements by Area

Each area shall be provided with an illumination system that achieves the following functional and aesthetic requirements:

19.5.1 Station Public Areas

Incandescent lamps are not permitted. Luminaries and lamps to accentuate specific architectural features or special requirements may be selected by the designer from the prepared palette. “Warm” light tones are preferred.

19.5.2 Parking Lots and Yard Areas

The lighting of parking lots and similar areas shall consider the following:

- LED lighting shall be provided for maximum energy efficiency.
- Avoidance of “spill” light and objectionable glare
- Proper scale of the pole heights with relation to site and surrounding area. Light poles and fixtures to conform to local requirements and standards.

To avoid interference with light reaching the parking lot surface and, thereby, to establish continued efficient utilization of the lighting system, the placement of poles shall be coordinated with the proposed tree locations and estimates of anticipated tree growth.

Lighting poles shall be located generally along parking barriers or the parking lot perimeter. The placement of poles shall present minimum obstruction to car movement and parking.

19.5.3 Plazas and Roadways

Lighting of outdoor plazas, station sites, pedestrian walkways, and similar area shall be accomplished by utilizing luminaries on low poles. Security lighting shall be provided for parking lots, plazas, and entrance and exit roadways including any roadways that are not illuminated and are used to gain entry or provide an exit to an arterial roadway. Security lighting may utilize the same fixtures as normal lighting.

19.6 Emergency Lighting

Each station shall be equipped with emergency battery backup lighting for the platform (90 minutes) and a connection to accommodate mobile emergency generators.

19.7 Illumination Design Levels

Stations:

Station Area	Recommended Minimum Maintained Illumination Level in Foot Candle
Fare Vending Areas	30
Platform under canopy	15
Platform beyond ends of canopy	5
Ancillary spaces	30
Service and utility rooms	15

Surface Parking Areas:

Site Area	Recommended Minimum Maintained Illumination Level in Foot Candle
Entrance Plaza	10
Bus platforms	5
Bus loops	2
Kiss and Ride areas	5
Park and Ride areas	2
Pedestrian walkways	3
Entrance and Exit roadways	2

The illumination on all entrance and exit roadways shall be graduated up or down to the illumination level of the “feeder” street or highway.

Poles shall not exceed 30 feet in height. Dual or quad fixtures may be utilized on the interiors of parking lots to minimize number of poles. Pole locations shall be coordinated with landscaping. Lamp life shall be 10,000 to 20,000 hours.

19.7.1 Brightness Ratio Design Goals

The following values apply as a practical standardization for background lighting and shall not limit small areas of lighting provided for accent, design interest, or message purpose.

Stations

Wall to Floor	No limit
Wall to Ceiling	No limit
Luminaries to adjacent surfaces	40:1
Typical brightness ratio between all stairs to general platform or mezzanine area	2:1

19.7.2 Glare Design Goals

A major objective of the lighting system is to minimize excessive brightness and contrast ratios by proper determination of number, location, luminance and shielding of luminaries.

The following general guidelines apply to all system facilities:

- Maximum, typical, compatible brightness for outdoor lighting fixtures on the line of sight shall be 850 to 1,000 Foot lamberts.

- Typical beam spread for downlight luminaries shall be 25-35 degrees, but in no case shall exceed 60 degrees.
- Low grazing angles which emphasize surface irregularities shall be avoided. Luminaries shall include shielding to prevent an angle of incidence of less than 20 degrees to the nearest vertical surface.
- Care shall be exercised to avoid specular reflections from porcelain enamel or plastic sign surfaces or from graphic display units.
- All forms of projector lamps shall be faced away from commuter traffic with the exception of parking lot perimeter lighting.
- Outdoor lighting shall be positioned to avoid glare which affects adjacent street or highway traffic, adjacent residential or commercial occupancies. Special glare shields may be added to fixtures to prevent glare in such cases.
- Luminaries in station approaches shall be shielded to prevent direct glare from obscuring views of the track area from the transit vehicle cab.
- Care shall be exercised to avoid placement of reflective surfaces conflicting with CCTV operation.

19.7.3 Reflectance

19.7.3.1 Design Goals

Generally high reflectance factors are desirable for determination or surface brightness if visual comfort is to be attained through the reduction of glare and high contrast ratios. The values below shall not inhibit the section designer's choice of color; however, generally lighter ranges of hue are recommended for ceiling, wall, and floor surfaces. Specular surfaces shall be avoided.

19.7.3.2 Reflectance Value Ranges for Dominant Areas:

Ceilings	60 to 95 percent
Walls	45 to 75 percent
Floors	15 to 55 percent

19.7.4 Color

19.7.4.1 Design Goals

The overall ambiance of the transit environment is heavily dependent on the color rendition properties of the family of lamp types chosen for particular purposes. Specifically, interior finish colors and patron appearance are seriously affected by the light sources. The basic type of light to be used throughout the System shall involve the use of LED and high-intensity discharge lamps for all station platforms, entrances, and sites. Color temperature shall be 4,000 k with CRI of 65 and lumen per watt of 90. Lighting source shall be LED or metal halide. Consistency of lamp type is of primary importance to maintenance as well as appearance. The basic intention of such a selection shall be to standardize light sources on a system-wide basis.

19.7.4.2 Location and Mounting

Lighting shall be mounted above the 10 feet 0 inches minimum headroom requirement. Light fixtures under platform canopies shall be an up light component.

19.7.4.3 Design Consideration

Entrance lighting designs shall anticipate the employment of CCTV surveillance. Lighting levels shall be examined for compatibility.

20 GENERAL STATION SITE DESIGN GUIDELINES

20.1 Travel Modes

Modes of travel which patrons shall utilize to arrive at or depart from station stops shall include provisions for patron access in all the listed classifications where applicable.

1. Pedestrian
2. Person with Disability: self-driver
3. Bus
4. Kiss-and-ride
5. Park-and-ride
6. Bicycle
7. Motorcycle
8. Rail

The design shall provide mitigation measures to minimize the security risk of Large Conventional Explosive (LCE) and Vehicle Borne Improvised Explosive Device (VB IED), by providing mechanisms and design measures to deny and prevent unauthorized vehicles access/ intrusion/ encroachment into the station platform area. Automotive barriers, planters, bollards and stand-off zones, as applicable shall be provided to prevent an unauthorized vehicle from accessing/intruding/encroaching into the station Platform area. Kiss-and-ride parking areas are to be configured with adequate stand-off zone from the station platform. Provide bollards at potential vehicular access locations around the station perimeter.

20.2 Vehicular Entrances to Station Site Facilities

The design of entrances for motor vehicles shall take into consideration adjacent land uses by avoiding large unplanted, paved areas of dimensions that are out of scale compared to adjacent streets and structures. Curb cuts shall be minimized, while fulfilling the following requirements:

- Direct access from major highways or streets into a station site shall be minimized. Streets designated for service and minor nonresidential streets shall be utilized.
- Direct access from quiet residential streets shall be minimized.

- Entrance roadways to station sites should be designed to contain sufficient traffic storage capacity to meet expected transit patronage at peak times and to prevent backing up into public streets.
- Security lighting shall be provided for any roadways that are not illuminated and are used to gain entry or to provide an exit to an arterial road. Security lighting may utilize the same fixtures as normal lighting.
- Conflicts should be avoided between entrance roadways and large pedestrian movements.
- Access by motor vehicles into a station site with more than 1,000 spaces should be from more than one street since the availability of several feeder routes is a desirable feature.
- The centerline of the station entrance should be aligned with the centerline of the opposite intersecting street or curb cut. In cases where such an alignment is not practical, the minimum distance between the centerlines shall be 150 feet, or the minimum distance required for weaving and/or left-hand turn stacking, whichever is greater. Similarly, the minimum distance between any intersection and a station entrance should be 150 feet or as required for weaving and/or left hand turn stacking, whichever is greater. Weaving distances shall be determined in accordance with the Highway Capacity Manual and shall meet levels of service acceptable to the Department and the local government agency. Left-hand turn stacking lengths shall be determined in accordance with Department requirements.

20.3 Vehicular Exits from Station Site Facilities

For larger stations, more than one station exit to the local street system shall be considered to reduce traffic delays.

20.4 Access Roadways

Roadways intended to provide patrons with access to handicapped stalls, bus zones, park-and-ride and kiss-and-ride facilities, shall be designed in accordance with the Department's Plan Preparation Manual and/or the Florida Greenbook.

One-way traffic operation on such roadways is preferred, and provisions for passing a stalled vehicle shall be made along roadways directly exiting from public streets.

Major pedestrian movements shall be separated from vehicle maneuvers as much as possible.

20.5 Kiss and Ride Facilities

Kiss-and-ride drop-off in the station area shall be designed to allow easy movement to locations near the station platforms; shall be separated from the parking area and shall have direct routing from the adjacent street to drop-off and pick-up points and back to the adjacent street system. Ideally located, they should provide the driver with a direct view of the station platform and should require no backing movements.

Appropriate signage that deters vehicles parking in close proximity to the station platform shall be considered, as directed by FDOT, in accordance with FTA's security guidance

20.6 Park and Ride Facilities

The park-and-ride areas shall be designed to optimize the site area allocated by using the following criteria and in compliance with ADA requirements. Minimum dimensions for vehicular stalls shall be 8.5 feet wide and 18 feet deep, unless otherwise dictated by governing entity/municipality. Stall depths may be reduced 2 feet when against a curb. Curbs or concrete barriers shall be provided around obstructions such as light poles and landscape areas.

20.6.1 Accessible Parking (ADA Requirement)

Accessible parking spaces at stations shall be provided near the station platform and in conformance with State and Federal requirements. Continuous smooth surface ramps without vertical rises and grades less than 8 percent shall be provided from the handicapped parking surface to sidewalks and station platforms. In particular, the placement of these parking spaces within the stations' footprints shall consider the distance individuals with disabilities must travel as well as user convenience, particularly safety, security and protection from environmental factors specific to Florida's climate. At the entrance to each SunRail station parking area, wayfinding signage shall be provided to direct users to the location of the accessible parking spaces.

20.6.2 Motorcycle Parking

Motorcycle parking stalls may be added in triangles and corners set off by the park-and-ride layout which are readily accessible to the station and which would otherwise be wasted.

20.6.3 Hardscaping

20.6.3.1 Seat Walls

Seat walls provided in the station area shall conform to the requirements listed below:

- Designed for minimum interference with pedestrians, station access, fare collection and bus loading.
- Provide visual interest and interruptions for large paved surfaces.
- Seating.
- Enhance pedestrian safety and security by reinforcing designated pedestrian areas and circulation.
- Ensure that seating area has arm rests or some other design to prevent people from sleeping in the seating area.

20.6.3.2 Exposed Aggregate

Exposed aggregate provided in the station area shall conform to the requirements listed below:

- Provide visual interest for large paved surfaces.
- Walking surface is non-skid and conforms to ADA standards.

20.6.3.3 Concrete Pavers

Concrete pavers provided in the station area shall conform to the requirements listed below:

- Provide visual interest for large paved surfaces.
- Material shall be precast concrete pavers with integral color.
- Walking surface is non-skid and conforms to ADA standards.

20.6.3.4 Stamped Concrete

Stamped concrete/asphalt provided in the station area shall conform to the requirements listed below:

- Provide visual differentiation between pedestrian and vehicular areas where pedestrian and vehicular circulation intersect.
- Material shall be integral color or color hardener.
- Surface is non-skid and conforms to ADA standards.
- Surface is sealed.

20.6.3.5 Bicycle Storage

Bicycle storage may be provided in the station area (not platforms) according to the schedule of elements per station site and shall conform to the requirements listed below:

- Constructed on hard surfaces.
- Easily accessible to the interior station site and the street system.
- Designed for minimum interference with pedestrians, station access, fare collection and bus loading.
- Preference over motorcycles as to location.
- Provide secure bike racks to allow bicycles to be locked.
- Appropriateness for site, including safety and security considerations and scale.

20.6.3.6 Decorative Fencing

Decorative fencing provided in the station area shall conform to the requirements listed below:

- Provide visually interesting barrier.
- Barrier provides safety and security by reinforcing designated pedestrian and vehicular circulation system movement.

20.6.3.7 Vinyl Coated Chain Link Fencing

Vinyl coated chain link fencing provided in the station area shall conform to the requirements listed below:

- Barrier provides safety and security by reinforcing designated pedestrian and vehicular circulation system movement at the Utility Yards, intertrack fencing, and to channelize pedestrian circulation. Fencing locations are site specific.

- Fencing fabric to have black polyolefin elastomeric coating.

20.6.3.8 Art-in-Transit

An art program is desirable and required under FTA funding guidelines. Therefore, “art opportunities” should be considered in the design of the stations. Art-in-Transit criteria as outlined by FTA shall be as follows:

- Quality of art or design.
- Impact on mass-transit customers.
- Connection to site and/or adjacent community; art that relates, in form or substance to the cultures, people, natural or built surrounding, or history of the area in which the project is located.
- Appropriateness for site, including safety and security considerations and scale.
- Durability of materials.
- Resistance to vandalism.
- Minimum maintenance

Art elements need to follow Crime Prevention Through Environmental Design (CPTED) guidelines. Sharp edges capable of causing injury are to be eliminated as well as elements that act as a barrier where people can hide.

20.6.4 Perimeters of Parking Areas

In general, parking lots shall be designed so as to avoid the use of earth retaining structures, and to keep all work within right-of-way lines. Curbs should be provided at all parking lot edges. Perimeters shall be wide enough for landscaping and planting. Requirements for stormwater management and critical areas may override these guidelines.

20.6.5 Pedestrian Access

Pedestrian circulation shall provide direct and convenient approaches to station platforms from off the site and from each of the individual sections of the lot. Parking aisle orientation shall be planned to consider pedestrian directness, lot capacity, and pedestrian safety. Pedestrian walkways shall be provided to reduce the risk of vehicle-pedestrian interactions by channeling pedestrians toward vehicle-free zones, minimize vehicular interference, to reduce the number of points where pedestrians cross the aisles, or to shorten irregular routes through successive aisles by a considerable distance. Walkways shall be at least 5 feet 0 inches wide. Ensure that the design does not allow short cuts through the bus bays by adding fencing or other means to prevent passengers from walking through the bus bays to the parking areas.

20.7 MATERIALS AND FINISHES GUIDELINES

The following basic requirements and criteria have been established for the finish of public areas and ancillary areas within the system. While convenience, comfort, and attractiveness shall be considered in the selection and application of these finishes, safety and security, durability and economy are essential attributes.

20.8 Safety

Edging and flooring shall be electrically insulated adjacent to trackway. No grounded metallic surface shall be installed within 5 feet 0 inches of the edge of the platform.

20.9 Durability

Provide materials with excellent wear, strength, and weathering qualities with due regard for both initial and replacement costs. The materials must be color fast, weatherproof, vandal-resistant and maintain their good appearance throughout their useful life.

20.10 Ease of Maintenance

20.10.1 Cleaning

Facilitate cleaning and reduce cleaning costs by the use of materials that are vandal-resistant, do not soil or stain easily, which have surfaces that are easy to clean in a single operation using standard equipment and cleaning agents, and on which minor soiling is not apparent.

20.10.2 Repair or Replacement

To reduce inventory and maintenance costs, materials shall be used that can be easily repaired or replaced without undue cost or interference with the operation of the Department's system. For example, hose bibs, electrical outlets, lighting fixtures and lamps, glass or plastic lights, etc. shall be standardized on commonly available sizes and finishes to ease inventory stocking or direct purchase.

20.11 Resistance to Vandalism

Provide materials and details that do not encourage vandalism and that are difficult to deface, damage or remove.

All surfaces exposed to the public shall be finished in such a manner that the results of casual vandalism can be readily removed with common maintenance techniques.

20.12 Color

Unless local agencies specify colors that are most compatible with the surrounding community, colors shall be consistent with system wide line identity colors and of sufficient contrast and accent to provide visual interest, warmth and concealment of minor soiling.

20.13 Non-Proprietary Materials

Non-proprietary items shall be used in the system wherever possible, in order to obtain competitive bids and comply with Federal regulations. Proprietary items shall be used only where it is established that no other materials exist which would meet the particular design requirements.

20.14 Unit Size

Units shall be large enough to reduce the number of joints yet small enough to facilitate replacement if damaged. Monolithic materials may be used if they can be easily repaired without the repair being noticeable.

20.15 Installation Standards

Materials shall be detailed and specified to be installed in accordance with industry standards and manufacturer's printed directions for long life, low maintenance, and compliance with warranty requirements.

21 SIGNAGE AND GRAPHICS

Coordinated systems of signing and graphics shall be provided in order for users to comprehend any complex urban environments encountered. Effective signing shall be provided for better circulation and traffic control, more efficient use of facilities and services, improved appearance, and a better public image. The wayfinding knowledge of the public shall be augmented through the proper use of external graphics on directional traffic signs and regulatory signs upon arrival to the station – and internal graphics on pedestrian directionals, informational signs, regulatory signs, directories and maps upon arrival at the platforms. The inclusion of international symbols should be encouraged in order to minimize language barriers. The signing and graphics program shall be provided to optimize safety and security in accordance with CPTED concepts, reduce ambiguity and visual clutter. It shall establish clear paths of movement and facilitate the comprehension of the functions and uses of space, and it shall improve legibility and communications while paying careful attention to the cumulative effects of signs and information in the environment.

A comprehensive signing and graphics program shall prescribe standards for all identification, direction, orientation and regulatory information, and provide detailed instructions for uniform, consistent application of the various design/informational components.

21.1 Signage Types

The signage system shall be divided into sign types that display differing types of messages. The primary sign types shall consist of the following:

External Signage Types [Site Signs]

- Station Identification/Directional Pylon
- Vehicular Entrance Directionals
- Vehicular Wayfinding Directionals

- Vehicular Traffic Signs
- Pedestrian Wayfinding Signs
- Regulatory/Warning Signs as needed
- ADA Wayfinding Signs

Internal Signage Types [Platform Signs]

- Station Identification – Platform
- VMS with CCTV
- Platform Directory/Identification Pylon
- System Platform Directional Signs
- Regulatory/Warning Signs as needed
- ADA Signage

The Station ID Pylon shall include the station identification as well as directional messages. All font sizes to conform to applicable/relevant legibility standards. This sign could possibly be illuminated either internally or with up-lighting. This particular sign shall be approximately 10 feet high, allowing it to be visible from distances, pending local ordinances and site conditions.

Vehicular Entrance Directional shall include the station identification as well as directional messages. All font sizes to conform to applicable/relevant legibility standards. This sign shall be indirectly illuminated by site lighting. This sign shall be approximately 6 feet high.

Vehicular Wayfinding Signs shall include directional messages. All font sizes to conform to applicable/relevant legibility standards. This sign shall be indirectly illuminated by site lighting. This sign shall be approximately 6 feet high.

Pedestrian Wayfinding Signs font sizes to conform to applicable/relevant legibility standards. This sign shall be indirectly illuminated by site lighting.

The Platform Directory/Poster Kiosk shall include the station identification, a graphic system map for boarding passengers and a neighborhood map for disembarking passengers. These directory maps shall be modular pop-out panels which can be easily up-dated. This sign shall be illuminated internally. The maps shall comply with ADA standards. All font sizes to conform to applicable/relevant legibility standards.

VMS shall include the station's electronic messaging. The VMS shall be a minimum height of 7 feet 6 inches to avoid visual obstruction.

The Platform Directional signs should be located adjacent to the platform to aid in pedestrian traffic flow, as needed. All font sizes to conform to applicable/relevant legibility standards. These signs shall be indirectly illuminated by site lighting.

Station Identification signage shall be indirectly illuminated by the canopy lighting as well. All font sizes to conform to applicable/relevant legibility standards.

Regulatory and Warning signs shall be placed where required. This sign type may include “No Smoking” signs, Warnings at the track crossings, and “Do Not Enter” signs. These signs shall conform to ADA requirements. The mounting height of these signs is typically 5 feet 0 inches from finish floor to horizontal center line of the sign.

An area shall be provided on the Station Identification Pylon, Vehicular Entrance Directional and the Platform Directory Pylon for the SunRail Logo.

22 LANDSCAPING

This section provides objectives and design parameters for landscaping, including stations, park-ride lots and kiss-ride areas. Landscaping at these facilities encompasses and contains embankments and earthworks for the purpose of shape and drainage; view corridor and sight line preservation; plantings for boundary treatment; the enhancement or screening for stations and ROW alignment; conservation and/or enhancement of the indigenous flora and fauna and wetlands.

22.1 Objectives

- Provide a landscape design responsive to and compatible with intended commuter rail operations, station architecture, graphics, and lighting design.
- Provide a safe, secure, comfortable and attractive environment throughout the transit system, particularly at and along approaches to station entrances.
- Control access to the system by reinforcing designated pedestrian and vehicular circulation system movement and creating barriers elsewhere along the ROW as required.
- Achieve landscape design that is compatible with the local climatic conditions and conserving of water resources.
- Create a permanent landscape that requires minimal maintenance through the use of irrigation systems and/or plant selection.
- Establish visual identity through the districts through consistent use of plant materials, while maintaining visual interest and compatibility with adjacent areas through the use of other materials that vary from site to site.
- Protect, frame, and enhance existing views and vistas.
- Protect and enhance attractive plant materials and to replace such materials which must be removed during construction.
- Coordinate grading required for landscape design with overall site grading requirements.

22.2 Station Goals

- Establish a common visual identity for station compatible with district theme or character.
- Enhance pedestrian safety and security.
- Establish visual screening where desirable.
- Provide harmonious transition between the station and adjacent areas.

- Provide shade and visual interruptions for large paved surfaces.
- Provide attractive approaches to stations.
- Design in harmony with adjacent landscaping.
- Reinforce the lines of vehicular and pedestrian movement.

22.3 Park and Ride Lots

- Provide shade and visual interruptions for large paved surfaces.
- Enhance pedestrian safety and security.
- Provide attractive approaches to stations.
- Design in harmony with adjacent landscaping.
- Reinforce the lines of vehicular and pedestrian movement.

22.4 Codes and Standards

All local codes shall be followed to ensure acceptance of landscape designs during jurisdictional design reviews. In addition, the following standards and guidelines should be referenced:

- American Standard for Nursery Stock ANSI 260.1 as adopted by the American Association of Nurserymen, Inc.
- Florida Nursery Growers Association industry standards.
- Plant material shall be specified as Florida No. 1 or better.
- Crime Prevention Through Environmental Design (CPTED) for Transit Facilities

22.4.1 Finish Grading

Sodded areas shall have a minimum slope of two percent and a maximum slope of one to three.

22.4.2 Slope Stabilization

Aesthetic gradings shall be used where appropriate to control pedestrian movements, obscure objectionable views, incorporate drainage ways, and reduce objectionable noise.

- All slopes shall be stabilized to prevent physical failure, erosion, and maintenance problem.
- Slopes that are to receive mowed turf or aggregate mulches shall not exceed one (vertical) to three (horizontal).
- Slopes that are to receive non-moved grass or ground covers shall not exceed one (vertical) to two (horizontal).
- Vertical transition curves appropriate to scale of slope shall be provided at top and bottom of slopes or mounds.

Where retaining walls are used, they shall be treated as an architectural element with consideration being given to scale, color, texture, contrast, and appropriate materials in relationship to both the transit facilities and adjacent neighborhoods.

22.5 Plant Materials

Plantings shall be used to strengthen the visual quality of the station areas and to integrate them with their surrounding environment.

The use of plant materials shall enhance historic buildings. They shall also be used to reinforce the stations' setting in the urban space, softening the transition from building to site where desirable.

Plantings within the areas encompassed by the project shall include materials that are suitable for planting Zone 9 unless otherwise approved.

22.5.1 Landscape Considerations

Considerations for the selection of plant material include the following:

- Initial cost
- Initial visual impact/enclosure
- Mature height and spread
- Growth rate
- Drought resistance
- Seasonal form and color
- Hardiness
- Sun/shade preferences
- Seed/fruit formation
- Disease of pest resistance
- Soil and drainage conditions
- Tolerance to wind, pollutants, and salt
- Transplant tolerance
- Availability
- Maintenance requirements
- Security and minimization of opportunities for crime against patrons of the Department system, employees, or the general public, by minimizing opportunities for perpetrators to hide.
- Safety and minimization of obstruction of pedestrian paths, and providing ample clear view of the surrounding to passenger and the general public near the right-of- way.

22.5.2 Irrigation Requirements

An automatic irrigation system achieving 100% coverage shall be utilized in selected areas only. These areas include, but are not limited to, vehicular site access points, high visibility areas and areas at/or immediately adjacent to the station platform and pedestrian plaza areas.

22.5.3 Trees, Shrubs, and Ground Covers

Mature, healthy existing trees of appropriate species shall be preserved where possible and shall be indicated in the contract documents. Appropriate protection during construction shall be specified.

Proposed trees shall enhance an existing street tree pattern, if any, or shall be a part of a street tree pattern established by the local governmental authority for adjoining areas. Where no pattern exists within an urban or streetscape area, an orderly pattern shall be established as appropriate.

Minimum caliper of trees located in paved pedestrian areas shall be 3 inches. Minimum caliper of trees in unpaved areas shall be 1.5 inches. Trees shall be spaced an appropriate distance apart, depending on the species and design intent.

Tree location shall be adjusted to accommodate subsurface conditions such as utilities and vaults, as well as special conditions such as existing or proposed sidewalk canopies, awnings, and shelters.

Excavation for tree root balls shall be minimally one time the width of the root ball plus 6 inches both sides per FDOT Design Standards.

A tree grate with minimum area of 16 square feet shall be provided to prevent compaction of the soil surface, if compatible with the district's architectural character. Tree grates shall be designed to support the weight of one wheel of a service vehicle.

Steel tree guards shall be considered at locations where tree trunks are likely to receive abuse from service vehicles or pedestrians, if appropriate to the district's character.

Trees in pedestrian areas shall be staked per FDOT Design Standards. For non-pedestrian areas, trees over four inches in caliper shall be staked or guyed.

Where shrubs are used, they shall be selected and grouped in a manner to minimize maintenance.

Ground cover shall be used in landscaped areas and slopes where pedestrian activity is to be discouraged.

Vines should be used selectively to landscape and soften vertical surfaces.

22.5.4 Herbicides/fertilizers

The correct application of herbicides and fertilizers is of prime importance. Those used shall be proven as non-persistent and non-damaging to the environment.

23 STRUCTURES

23.1 Design

23.1.1 Structural Design Requirements

The design of all structures constructed as part of this Project shall comply with the criteria provided herein. Where special design cases are encountered that are not specifically covered in these criteria, supplemental design criteria based on documented technical sources shall be submitted for acceptance.

23.1.2 Governing Design Codes and Standards

The latest editions of codes, manuals and specifications shall be used, but not limited to, as specified in Section 2.:

23.1.3 Bridge Layout

Railway bridge layouts shall be based on AREMA design practice. The permits are based on the Concept Plans. Bridge layouts may only be modified if accepted by the Department and the jurisdictional agencies of all required permit modifications.

The layout of the bridges shall be based on the following design practices:

- The final layout of the bridge shall show the railroad valuation stations at face of begin and end bridge abutment backwalls and at centerline of the bridge. Distance from centerline of the bridge to nearest milepost shall be shown on the plan.
- For bridges on curves, the girders, abutments and piers shall be located with reference to chords.
- Bridge walkways shall be installed on both sides of the structures.

23.1.4 Clearances

Where bridges are rehabilitated or modified, existing horizontal and vertical clearances, at a minimum, shall be maintained.

Where the superstructure is replaced, provide horizontal clearances as shown in Figure 15-1-1 of the AREMA Manual.

23.2 Materials

Structural steel for bridges shall be ASTM A709 Gr50. The toughness shall be T1 for non-fracture critical members or F1 for fracture critical members. Thickness of flange plates shall not exceed 3 inches. Bridges with steel deck, deck plates and side plates (curb plates) shall be ASTM A709 Gr50 T1 steel. All exposed surfaces of the deck and side plates not protected by waterproofing shall be painted. Fracture Critical Members (FCM) shall be designated on the plans.

Concrete for bridges shall be air entrained and utilize Portland cement meeting the requirements of ASTM-C150 Type I or IA. Concrete for substructures, crash walls and retaining wall caps shall be FDOT Class IV with a 28-day compressive strength meeting or exceeding 5,500 psi. Concrete for concrete box culverts shall be FDOT Class III or IV depending on environmental classification with a 28-day compressive strength meeting or exceeding 5,000 or 5,500 psi (specific requirements listed on plans). Concrete for precast prestressed concrete girders shall be FDOT Class VI with a 28 day compressive strength meeting or exceeding 6,000 psi and a release strength of 5,000 psi.

Concrete for platforms, mini-highs, footings and column block-outs shall be designed with a 28-day minimum compressive strength of 4,000 psi with a water/cement ratio <0.50, maximum slump of 4 inches ± 1 inch, have 2-4% air entrainment and utilize Portland cement meeting the requirements of ASTM-C150 Type I or IA. Concrete mix design shall be in accordance with the latest edition of ACI 301, Chapter 3, Method 1 or Method 2. All concrete work shall be in accordance with the latest edition of ACI 318.

Where pavers are to be later placed on recessed platform sections, the concrete shall receive a broom finish.

All reinforcing steel shall be new domestic deformed billet steel conforming to ASTM A-615 Grade 60.

23.3 Loads

23.3.1 General

Unless otherwise specified, the load requirements specified shall be used for structural design, including load requirements for electrical, signal and communication equipment as appropriate. Where appropriate, the design shall consider the maximum combined load condition. In the event any imposed loads that are not specified or included are encountered, Department acceptance shall be obtained to include such load in the design.

Bridges and other structures shall be designed for the required loading conditions, including wind loading per the applicable codes.

23.3.2 Design Loads for Bridges

Railroad bridges shall be designed for all loads specified in Chapters 8 (including Part 17 Prestressed Concrete) and Chapter 15 Steel Structures of the AREMA Specifications. The following live loads shall be used:

Concrete Design:	Cooper E-80 loading with full diesel impact and the AREMA Alternate Load, whichever produces the greatest stresses.
Steel Design (non-composite design):	Cooper E-80 loading with full diesel impact and AREMA Alternate Load, whichever produces the greatest stresses.
Steel Design (composite design):	Steel beams used for composite designs shall be designed using Cooper E-80 loading with full diesel impact and AREMA Alternate Load, whichever produces the greatest stresses. In addition, the steel beams shall also be designed to carry a minimum Cooper E-65 with full diesel impact on the non-composite steel section acting alone.

When computing the structure's dead load, include an allowance for the weight of an additional 6 inches of future track surfacing ballast. Ballast decks shall also be constructed with sufficient section to accept the 6 inches of additional ballast without modification.

Parts of bridges required to temporarily support heavier loading during construction shall be designed to provide a higher rating per AREMA guidelines.

Wind load on loaded bridges shall be in accordance with AREMA except wind load on unloaded structures shall be increased to account for a base design wind velocity of 130 mph.

23.3.3 Retaining Walls

The design of retaining walls for roadways shall conform to the requirements of FDOT Structures Manual. AREMA requirements shall apply for retaining walls subject to railway loading.

Special consideration shall be given to construction sequencing when the wall types are determined. Soldier pile walls with concrete panel components or steel sheet piling may be used for permanent installations adjacent to the railroad. Soldier piles may be either steel HP piling or concrete piling; however, steel soldier piles or steel sheet piling shall require corrosion protection for exposed areas (2 ft below grade and above).

Where the distance from the top of any retaining walls to ground level exceeds 2 ft in height, handrails are required on the top of the retaining wall. Reflective markers are also required along the top of any retaining wall identifying a potential hazard to crew operations. Warning signs in advance of the retaining wall are required 100 ft in advance on both sides.

23.3.4 Cofferdams and Shoring

Shoring to protect railroad traffic shall be designed in accordance with AREMA requirements and shall also resist a minimum vertical live load surcharge of 1,800 lb/sf in addition to active earth pressure. The surcharge shall be assumed to act on a continuous strip, 8 ft 6 in wide centered along centerline of track. Lateral pressures due to surcharge shall be computed using the strip load formula shown in AREMA Manual, Chapter 8, Part 20.

23.3.5 Miscellaneous Structures

Miscellaneous highway related structures such as overhead and ground-mounted sign structures, mast arm traffic signal supports and drainage structures subjected to highway loads shall be designed in accordance with Department requirements. Design of drainage structures according to Department Roadway and Traffic Design Standards do not apply when they are subjected to railroad loading. The Contractor shall design drainage and any other structures subjected to railroad loading in accordance with AREMA Guidelines.

The net bearing pressure for shallow foundations shall be compression under the entire footing support area for all service load cases.

23.3.6 Culverts

Culverts shall be designed in accordance with the Department's Structures Manual and AREMA guidelines. Where headroom is restricted, concrete box culverts shall be considered. Abrupt changes in direction or slope of pipe shall be avoided. The minimum culvert grade shall be in accordance with the Department's *Drainage Manual (latest edition), Chapter 3.6.1 Pipe Slopes*. Grade shall be calculated as a straight line between the inlet and outlet elevations. Culverts shall be placed on the most economical slope

and at the most economical depth. Concrete box culverts shall meet the height of cover requirements detailed in the AREMA Manual for Railway Engineering, Chapter 8, Part 16 for reinforced concrete box culverts. Culvert materials are to be in accordance with AREMA requirements. Culverts shall have a minimum cover of 4 ft under tracks measured from the top of culvert to bottom of track tie unless specifically designed for less cover after a variance is obtained from the Department.

Headwalls at inlets and outlets exceeding 2 ft in height within 20 ft of the nearest track require handrails.

23.3.7 Walkways and Handrails

Handrails shall be designed in accordance with the AREMA Manual for Railway Engineering, Chapter 15, Sections 8.5 Walkways and Handrails on Bridges and ADA requirements. Handrail and guardrail design should not have any sharp edges.

23.4 Design Methods

23.4.1 Determination of Design Methods

The design methods specified in the applicable codes shall be used unless otherwise specified. The chosen design method shall be applied consistently to similar structures and elements.

23.4.2 General Structures

Any structure or part of a structure not subject to railroad loading shall be designed using the applicable design criteria of the agency having jurisdiction. Platforms, canopies and other railway ancillary facilities are excluded from local agency jurisdiction.

For the VSLMF Crew Building, the Basic Wind Speed is 138 mph for Risk Category II, Site Exposure Category C and roof dead load is 20 psf.

For canopies, the Basic Wind Speed is 139 mph and roof dead load is 20 psf. The design shall allow for all required conduits for electrical, communication, lighting, etc. and provide the number of spares designated by the Department.

23.4.3 Bridge Decks

Load distribution of axle loads shall be determined using an approved method of analysis as specified in AREMA for the design of bridge decks. The design method shall be described in the calculations, with references listed.

23.5 Bridges - New Construction

23.5.1 Bridge Foundations

Applicable and appropriate Department design guidelines shall supplement design requirements in AREMA. Battered piles shall not extend outside of the Right-of-Way.

Precautions shall be taken during design and construction to develop and install a foundation system that shall prevent damage to existing structures and utilities, e.g.,

through the use of special foundation installation procedures and/or strengthening of the existing structures where applicable. The proposed foundation installation methodology shall be developed to prevent any disruption to rail operations. The proposed foundation type and method of installation addressing protection of existing structures and a plan for continuous monitoring of the existing structures during construction shall be submitted with each design submittal.

23.5.2 Abutments

Abutments shall be designed as deep foundation (piles or drilled shafts) supported reinforced concrete abutments. Spread foundations shall not be accepted. Abutments shall be designed in accordance with Chapter 8 of the AREMA Manual, including requirements for temperature reinforcing steel and dampproofing.

Provide minimum edge distance of 6 inches from edge of masonry plate or shoe to edge of abutment.

23.5.3 Piers

Piers shall be designed as deep foundations supported by piles. Spread foundations shall not be accepted. Piers shall be designed in accordance with Chapter 8 of the AREMA Manual. Requirements for temperature reinforcing steel and dampproofing shall be satisfied.

Provide a minimum edge distance of 6 inches from the edge of masonry plate to edge of concrete.

23.5.4 Superstructure

Ballast deck simply-supported precast prestressed concrete spans or structural steel girder spans are the preferred type of superstructure and shall be used wherever possible. If structural steel spans are proposed, reinforced concrete slabs or steel deck plate superstructures are required.

Intermediate stiffeners for steel spans shall consist of two angles, one on each side of the web, and shall be bolted to the web. End bearing stiffeners may be plates or angles, welded or bolted.

When bottom lateral bracing system is recommended by AREMA guidelines, it shall be bolted to the girders.

Continuous spans shall not be accepted.

If through-plate girder spans are proposed, end floorbeams and connections shall be designed such that jacks can be placed under the end floorbeams for lifting the span.

Provide 4 inch minimum clearance between end of structural steel and face of back wall.

Minimum thickness of reinforced concrete slabs shall be 12 inches for composite design and 9 inches for non-composite design.

23.5.5 Splices and Connections

Field connections for steel framing shall be bolted using minimum 7/8” diameter high strength bolts in accordance with ASTM A325 and AREMA guidelines. Welding shall not be used for field connections. Bolts shall be tightened using turn-of-nut method.

23.5.6 Deck Drainage

Open deck structures shall not be accepted.

Prestressed concrete deck spans are to drain at the center longitudinal joint between slabs. Build drainage slope into reinforced concrete decks. For steel decks, build slope using asphalt underlays.

Minimum drainage slope is ⅛ in per foot.

Provide 2 ft of porous backfill, measured horizontally, behind all abutments and wingwalls. Provide perforated pipe drains behind abutment at bottom of abutment wall to collect and remove water from deck drainage.

23.5.7 Waterproofing

All deck joints between spans shall be watertight.

Provide PVC 9 in x ⅜ in Hollow Bulb (Bulb ¾ inch I.D., 1 ½ inch O.D.) waterstops continuous across joint at all construction joints.

Waterproofing or dampproofing shall be applied to the entire surface of the bridge deck and inside faces of parapets or curb plates. Materials and construction shall be in accordance with AREMA Chapter 29.

23.5.8 Bearings

Bearings shall preferably be reinforced elastomeric for appropriate conditions unless an analysis is submitted and accepted by the Department that justifies an alternate type of bearing.

End diaphragms shall be designed for jacking to facilitate future bearing replacement. A section shall be provided in the design plans showing proposed jack locations and the design jacking force. The design jacking force shall be equal to 150 percent of the load calculated for the dead load of the bridge including any potential increase in ballast weight if appropriate.

23.6 Crashwalls

23.6.1 Requirements

Crashwalls shall be in accordance with AREMA guidelines, Chapter 8. Crashwalls are required when face of the pier is closer than 25 ft from centerline of the track, measured perpendicular to the centerline of track. Provide minimum clearances in accordance with CFOMA.

Crashwalls shall also be used at locations where a derailment would cause significant structural damage to adjacent, vulnerable structures or to the railroad's other equipment, as directed by the Department.

24 DESIGN FOR PASSENGER WAITING STRUCTURES

Station platform shelters shall be designed using structural steel with rounded columns and tube steel shapes. All exposed steel shall be coated using primer and high performance paint. Canopies shall utilize factory color metal roofs and an integral gutter system draining to the right-of-way. The drainage system shall not impede pedestrian flow or walkways nor create slippery areas. Design loadings and criteria are specified in the *Structures* section. Platform loading shall be in accordance with the latest edition of the Florida Building Code (FBC).

25 CANOPIES AND METAL ROOF DECKING

Metal deck roofing shall be used on all canopy shelters. Decking panels shall be secured to the steel structure and run continuously.

25.1 Codes and Standards

Comply with provisions of the latest editions of codes and standards, but not limited to, in Section 2 of this document.

25.2 Structural Steel Components

Structural Steel is that work defined in American Institute of Steel Construction (AISC) "Code of Standard Practice" and as otherwise shown on drawings.

25.2.1 Materials

Metal Surfaces shall be smooth and free of surface blemishes including pitting, rust and scale, seam marks, roller marks, rolled trade names and roughness.

1. Structural Steel Shapes, Plates and Bars: ASTM A36
2. Cold-Formed Steel Tubing: ASTM A 500, Grade B
3. Steel Pipe: ASTM A 53, Type E or S, Grade B; or ASTM A 501
4. Finish: The Manufacturer shall submit specifications and samples of paint system for Architects approval prior to commencement of metal fabrication.

25.2.2 Structural Steel Coatings

Structural steel shall be finished with high performance coatings that comply with provisions of the following specifications and standards:

ASTM D 4060	Abrasion
ASTM D 3359	Adhesion
ASTM 3363	Hardness

ASTM D 4585	Humidity
ASTM B 117	Salt Spray

All coatings shall be compliant with Specification 560 of FDOT's Standard Specification for Road and Bridge Construction.

26 NOT USED

27 DRAINAGE DESIGN AND PERMIT REQUIREMENTS

27.1 General

The following sections outline the Federal, State and local stormwater quality and quantity criteria applicable to the Project. The criteria and parameters outlined in this Section are derived from the applicable published regulations, permit design manuals and design standards.

Refer to the *Request for Proposal* regarding permit requirements.

27.2 Project Drainage Overview

The existing drainage system consists mainly of ditches located on both sides of the tracks and generally should not change. The ditches collect and convey on-site and off-site runoff. In general, the ditches are interconnected through culverts located at the crossing roads (south to north) and at the track embankments (west to east). The ditches presently overflow into various receiving points. These receiving points include canals, lakes, wetlands, adjacent drainage systems, residential backyards, industrial sites and others.

As a result of the embankment construction activity to accommodate the double track, the existing ditches shall need to be relocated and re-graded. The ditch grading and sizing shall comply with stormwater quality and quantity criteria as required by the South Florida Water Management District (SFWMD) and the Department. The proposed drainage Work activities shall also include the modification, extension, relocation and replacement of existing drainage structures and cross drains as needed to accommodate the railroad corridor improvements. Stormwater shall not be diverted onto property not previously receiving water from trackside ditches.

The SFWMD and the Army Corps of Engineers have jurisdiction over the stormwater quality criteria within the project limits and their criteria and guidelines shall apply.

Ditches shall be proposed where required along the areas of new second mainline track through the corridor to serve as a best management practice to provide the appropriate water quantity volumes for stormwater runoff.

27.3 Permit Requirements

An Environmental Resource Permit application for track and platform construction within the corridor shall be submitted to the SFWMD. The Contractor shall comply with permit requirements.

28 Utilities

Refer to the RFP.

29 VEHICLE STORAGE AND LIGHT MAINTENANCE FACILITY

29.1 General

Phase 2 South of the CFCRT project shall include one facility that shall serve as a Vehicle Storage and Light Maintenance Facility (VSLMF) to provide for fueling, daily inspections and daily interior vehicle car cleaning.

The VSLMF shall be constructed adjacent to Poinciana Blvd in Kissimmee FL to layover train consists. Light maintenance and inspections are conducted at the VSMF facility at Sanford, FL. Intermediate and heavy vehicle maintenance, major overhauls and repairs shall be sent off-site.

The VSLMF shall provide the following maintenance functions for the CFCRT vehicles:

- Mandated FRA daily inspections
- Minor running repairs (corrective maintenance)
- Coach toilet service
- Interior car cleaning
- Fueling

The design of the VSLMF shall allow for the initial construction of:

- One run-around track
- Two storage tracks with track mats capable of storing two consists (three-cars and one locomotive; 8 vehicles) on each storage track.(for a total of four consists)
- Fueling, interior cleaning and daily inspections will be conducted on these two storage tracks.
- A trackside service area with double sided standby power units. With compressed air supply and potable water supply, shall be provided between each pair of train consist to allow for simultaneous connections to each independent train consist. Daisy-chaining the standby power units or between consists is not permitted.
- Fenced material laydown area to store signal gates, ties, switch points, rail, etc. The laydown area shall have a surface that allows for vehicles to unload materials and inhibits the growth of weeds. The surface shall be approved by the Department.
- Interior car cleaning can be performed from either storage tracks

- One crew building to accommodate support facilities, and staff accommodations
    - The crew building shall include restrooms, storage, a small kitchen and a crew resting area
- One toilet dumping station with holding tank

The VSLMF shall be designed to support 24 hours per day, seven days per week commuter rail operations, and must allow for flexibility in inspection procedures. While overall operating concepts are unlikely to change, the procedures shall evolve as operations personnel become familiar with the requirements of the vehicles and as the fleet grows through subsequent car procurements.

The VSLMF main gate shall be equipped with an emergency responder secure access vault and system that will provide immediate access to the VSLMF by local Fire Department in the event of an emergency. The emergency access system will be comparable to that used for the VSMF system. Coordination with local emergency responders and the CFRC Office is required to ensure the system will function for the local responders. The VSLMF main gate shall be further equipped with a siren operated sensor to open the gates automatically by Police and Fire Departments.

29.2 Standards, Codes and Guidelines

The design for the VSLMF yard and building shall comply with applicable local, state, and federal laws, regulations, rules, codes, and standards relating to building construction, site design, engineering and environmental requirements, as specified in Section 2 of this document..

29.3 Vehicle Criteria

The proposed consist includes three bi-level cab/coach vehicles hauled by a diesel locomotive. The nominal length of the coach shall be 85 ft with a nominal width of 10 ft and nominal height of 16 ft above top of rail (bi-level car). Diesel locomotives are 70 ft long. The Yard and maintenance facilities shall be designed to fully support four consists.

29.4 VSLMF Functional Requirements

29.4.1 General Requirements

The layover facility shall be designed to provide the following functions:

- Storage for 16 vehicles (4 train consists)
- Fueling of locomotives, daily inspections and interior cleaning of coaches
- Support facilities, including staff accommodations and short-term component and materials storage for above activities
- Secure building for train operating employees to come on duty, receive train orders and tie up at the end of shift
- Facilities for midday layover of trains and operating employees

- Communications equipment for communicating with train operators, track maintenance crews, and other engineering and maintenance operations personnel
- Parking for rail operating and maintenance personnel

29.4.2 VSLMF Maintenance Functions

The VSLMF facility shall be equipped to perform daily FRA inspection tasks

- Storage for four train consists with a runaround track
- Mandated FRA daily inspections, including Class I air brake tests
- Visual inspection and some testing of vehicle systems, both interior and exterior in addition to those required for FRA daily inspections
- Minor repair/maintenance activities
- On-board signal/communications equipment tests
- Interior sweeping and basic cleaning
- Locomotive fueling
- Emptying coach toilets into a holding tank
- Filling non-potable water system for cab car sink and toilet

29.5 Yard

29.5.1 Wayside Power System

The Yard shall be designed to provide two double-ended wayside power units (400 Amp per side / 480V 3 phase, 3 wire yard power with concrete housekeeping pad to match those installed at the IOS VSMF) for storage of a minimum of four train consists. Electrical service shall be available to maintain air conditioning while the train consists are waiting to enter mainline service. In addition to wayside power, connections for water and compressed air are to be provided for each train consist.

29.5.2 Yard Operations

Within the limits imposed by site size and configuration, maximum flexibility is to be provided. Direct access from the mainline to the storage tracks is required.

Movements to and from the layover tracks shall be allowed without fouling the mainline.

29.5.3 Yard Layout

Basic guidelines for developing the Yard layout are as follows:

- Direct access to and from the mainline to the storage tracks.
- Space storage tracks to allow sufficient clearance between track centers for cleaning and fueling operations.
- Storage for a total of 16 vehicles (4 consists) is required. A standard consist is made up of one locomotive, two coach cars and one cab car.

- Lighting shall be sufficient for operations to be performed safely (see Yard and Roadway Lighting for specifics).
- Security fencing (see Fencing for specifics)
- Access road to storage yard and service aisle
- Access road shall accommodate service and emergency vehicle access
- Provide bollards or other intrusion-deterrent material to protect VSLMF equipment, holding tanks or building entrances adjacent to the service road and parking areas. Bollards must be placed to protect wayside power units.
- Fire protection (hydrants) at various yard locations as required by code
- Compressed air for the Yard shall include, at a minimum:
    - Appropriate number of 0.5 hp compressors capable of maintaining 110 psi pressure with integrated refrigerated air dryer complete with receiver tank. If compressed air is used for cleaning purposes, the Occupational Safety and Health Administration (OSHA) standard 29 CFR 1910.242(b) requires that compressed air must be reduced to less than 30 psig (pounds per square inch gauge, 204 kPa). Compressed air used for cleaning must only be permitted with effective chip guarding and personal protective equipment to protect the operator and other employees from the hazards of the release of compressed air and flying debris.
    - Units located on a concrete pads designed to secure and support the unit
    - The air compressor is contained in a weather-proof and conditioned enclosure.
    - All prewired gauges and other air system components shall be pre-tested and stored inside the enclosure (as designed and manufactured by the vendor).
    - Microprocessor based system controller
    - Above ground oil / water separator for the compressed air system
- A single Toilet Dumping Station (10,000 gal underground holding tank) for train toilet effluent shall be provided. Toilets on each cab car shall be drained to an underground holding unit adjacent to the storage track with entry at least 1 ft below the minimum static elevation (airbags deflated) of the dump valve on the cab car for gravity dumping. The holding unit shall be periodically emptied by an outside vendor. A water source shall be provided adjacent to the Toilet Dumping Station. The Toilet Dumping Station location shall include a paved access roadway with a minimum width of 13 feet.
- Mechanical derails, painted blue, permanently fixed to cross ties at the entering end of each track at the clearance point leading into the fueling/storage yard tracks. The blue mechanical derails shall include a blue stop flag on metal plate that latches in the up and down position. Blue flags shall comply with 49CFR218.
- Pans or fabric mats shall be installed on all layover tracks where fueling will occur
- A concrete dumpster pad
- A 20’ x 20’ x 1’ thick storage pad. Provide power stub-out for up to 240 volt/200 amp service from the main building to the end of the parking lot, based on the location of the 20' X 20' storage pad.

- A shower and eyewash station shall be provided adjacent to the storage tracks in the immediate vicinity of where the vehicle servicing and fueling is to be performed.

29.6 Fueling Area

The Fueling Contractor tanker truck shall pull alongside locomotives on the fueling/storage track and shall fuel locomotives directly from the tanker. A paved area with a minimum width of 13 feet shall be provided for fueling truck access. The fueling Contractor shall be responsible for spill protection, containment and remediation of all fuel spillages resulting from fueling operations.

The fueling area shall include purpose-built track drip/containment pans or track mats with a retention system of sufficient length to simultaneously accommodate all train consists for fueling and lubrication top-up.

29.7 CFCRT System Support Facility (Crew Building)

In addition to providing overnight storage four train consists, Yard and Inspection Facilities, space for the following CFRC System support functions are required (refer to Appendix) and shall be provided from a single building:

29.7.1 Operating Crew Facilities

An operating crew building shall be provided with adequate space for a minimum of four train crews. Building layout and configuration must be deemed acceptable by the Department.

This building shall provide:

- A Secured building with separate key-card access to support train crew preparation activities. (Minimum 1765 sf, Minimum width of 30.0')
- Site accessibility and life/safety requirements shall comply with all applicable codes.
- Equipment for communicating with train dispatchers, track maintenance crews and other engineering and maintenance operations personnel including the ability to receive daily track bulletins and train orders.
- Adequate lighting and emergency lighting. Lighting for the building entrance shall not be placed directly over or adjacent to the doorway to/from the building.
- The building shall be protected from lightning and have surge protection devices as required for the protection of control and communications equipment.
- All exterior and interior materials and finishes shall maximize the use of durable and low maintenance materials with a focus on life-cycle maintenance requirements.
- The mechanical, electrical and plumbing elements shall focus on energy and water consumption efficiency.
- An automatic sprinkler system for fire protection covering all areas of the building interior.

- A general crew area suitable for train crew reporting, paperwork, job briefings, meetings and crew layovers, dining and rest areas. (Minimum 370 SF, Minimum Width of 15')
- At a minimum, the following individual rooms need to be provided within the building
  - Two individual office rooms with separate key-card access (Minimum 115 sf, Minimum width of 10')
  - One secure server room with separate key-card access for housing communications and CAD system racks, communications connections and components (Minimum 110 sf, Minimum width of 10.5')
    - The server room shall accommodate 3 racks (84"HX30"LX20"W) and provide 36" of walking space around the racks. The server room shall not have raised floors. Racks and cable trays shall be provided.
  - One conference room with separate key-card access (Minimum 160 sf, Minimum width of 10')
  - One Multi-user work room with separate key-card access (Minimum 200 sf, Minimum width of 12.5')
  - Restroom and locker room shall be provided for both genders (minimum 140 sf, Minimum width of 12.5)
  - Utility/Janitorial closet shall be provided including wall mounted shelving, water service and either a utility sink or taps with a floor drain (Minimum 16 sf)

29.8 Civil

The Contractor shall obtain any necessary permits, including but not limited to stormwater, building and occupancy.

29.8.1 Geometric Criteria

- Horizontal curves shall be simple curves without super elevation or spirals
- Minimum horizontal curve radius shall be 300 ft
- Yard tracks shall have a maximum grade of 1% Storage tracks shall be spaced as shown in the plans
- No. 10 turnouts with curved switch points are required from the mainline tracks where shown on the Design Plans
- No. 10 turnouts are required for all other turnouts

29.8.2 Yard Drainage

Drainage system elements should have minimum slopes indicated in the following table:

Slopes for Drainage System Elements	
Drainage System Element	Minimum Slope
Under Drains	0.15%
Laterals	0.15%
Main Collectors	0.15%
Ditches	0.05%

Clean-outs shall be provided at the terminus of each under drain and lateral, and manholes should be provided at maximum intervals of 300 ft at the laterals and main

collectors in order to facilitate the maintenance of the Yard drainage system. Reinforced-concrete pipes shall be connected by manholes every 300 ft.

29.8.3 Site Utilities

Prior to the design effort, the size, capacity, and location all existing utilities in the area of construction shall be located and documented.

29.8.4 Water Service

Water service to the VSLMF crew building and yard are required for basic sanitation, vehicle cleaning, fire protection and train consist daily service requirements.

29.8.5 Sewers

The sewer systems for the crew building and layover yard shall be divided into separate sanitary sewer and storm drainage systems.

The storage yard shall be provided with a series of sub drains that shall be connected to the storm sewer through reinforced concrete sewers. Surface drainage, particularly near switches, shall be provided as necessary.

29.8.6 Electric

Electric service shall be provided to the site sufficient to power components of the Crew Service Building as well as the standby power units at the storage tracks. Surge protection and lightning arrestors shall be provided for the electric service.

Provision for Backup Power:

Provide a weather-protective housing to enclose an engine-generator set, including batteries and battery charger. Housing shall be reinforced and anchored to concrete pad to withstand 130 mph wind (2008 NFPA 110 sect. 5-2.1, FBC). The set shall consist of a single diesel engine directly coupled to an AC generator, mounted on a rigid base made of steel structural members. The generator shall be a commercial design and shall include outdoor sound reducing housing and all necessary equipment, devices, controls and instrumentation for complete standby generation system to meet all power requirements for the VSLMF facility.

A double walled sub-base fuel tank shall be used in conjunction with the diesel powered generator set and shall contain a minimum of 400 gallons but no more than 550 gallons.

Power to loads shall be automatically transferred from normal utility power to the emergency generator upon loss of normal power. Transfer and assumption of load shall occur in 10 seconds or less. Loads shall be automatically retransferred upon restoration of the normal utility power source. Each automatic transfer switch shall consist of a power transfer module and control panel module, inter-connected to provide complete automatic operation. The equipment supplied shall meet the requirements of the National Electrical Code and all applicable local codes and regulations.

Emergency Generator control panel shall be configured to detect failure conditions (conditions that would prevent the generator from functioning as intended) including but

not limited to the following conditions and generate an alarm indication sent to the crew building when failure conditions exist: This alarm should be sent to the OCC also.

- High Coolant Temperature
- High Oil Temperature
- Controller Internal Fault
- Low Coolant Level
- Low Oil Level
- Customer programmed digital auxiliary input on or off
- Customer programmed analog auxiliary input out of range
- Locked Rotor – fail to rotate
- Overvoltage with user adjustable level, range 105% to 135%
- Over/under Frequency with user adjustable level
- Coolant Temperature signal loss
- Oil Pressure Gauge signal loss

Emergency Generator Control Panel shall be configured to detect warning conditions (generator shall continue to operate but may lead to a failure condition) including but not limited to the following:

- Battery Charger Failure
- Customer programmed digital auxiliary input on or off
- Customer programmed analog auxiliary input out of range
- Ground Fault Detection
- High Battery Voltage
- High/Low Coolant Temperature
- Loss of AC Sensing
- Low Battery Voltage
- “Low Fuel Level” or “Pressure Low Oil Pressure”
- Speed Sensor Fault

The generator shall be configured to start and run for approximately 30 minutes each month.

29.8.7 Communications

Communications for the VSLMF will be provided via the redundant loop fiber communications infrastructure network for the CFRC.

The fiber communication infrastructure system will support the LAN/WAN system, communications services such as telephones through VoIP and data, CCTV cameras, and all other communications required. The Contractor is responsible for providing all wiring and devices up to and including the cables and terminations on the exterior of the building necessary to interface with communications services from the OCC facility.

All communications equipment associated with the LAN/WAN, access control and CCTV systems shall be backed up with UPS power for a minimum of 90 minutes at full load.

29.8.8 Roadways / Parking

Internal roadways and parking lots shall consist of 2 inch structural asphalt pavement on a 12 inch lime rock base and a 12 inch stabilized sub-base layer. A minimum 10 ft x 15 ft

concrete pad will be constructed adjacent to the layover facility building for trash service containers.

Parking, including accessible parking spaces shall be provided within the fenced facility in conformance with State and Federal requirements (referenced in Section 20.6).

Artificial lighting shall be provided for safety in all open parking areas with due consideration for adjacent land uses. The average maintained foot-candle values are indicated in *19.7 Illumination Design Levels*. Pole foundations shall extend 24 inches above parking lot grade when not located behind curb or curb stops to reduce pole damage.

A minimum of 23 parking spaces shall be provided at the VSLMF, including a minimum of two spaces meeting the ADA requirements for size, striping and signing.

29.8.9 Fencing and Security

VSLMF security shall be achieved by the following:

Gates:

- Provide 6 ft high Type B FDOT fencing that includes barbed wire for the periphery of the Yard, in conjunction with lighting, surveillance, and remote access control mechanisms.
- A secure access system shall be provided for use in admitting visitors and deliveries to the facility. Gates shall be provided at all access points, including walkways, the primary access road and the track.
- Gates can be sliding or swing type as appropriate, but shall, in all cases, be provided with mechanisms which restrain gates from encroaching on roadways or track clearance envelopes when in the open position.
- Provide a minimum storage of 100 feet for vehicle queuing between Old Tampa Highway and the secure entrance gate.
- Entrance road dimensions shall allow adequate width to accommodate large tractor trailer trucks entering the facility. A minimum of 13 feet, free of obstructions including the gates and security access system installed, shall be provided for each direction of travel to accommodate WB-62FL vehicles.
- A moveable, motor-operated gate shall also be provided across the entrance track to the facility with a lockable gate control panel provided at the gate accessible from both sides of the fence. Separate panels may be provided.
- The track gate control panel(s) shall be capable of being locked with a standard CFRC switch key.
- The entrance track gates shall also be equipped with a Dual Tone Multi-Frequency Input/output (DTMF I/O) Remote Activation System. The system shall provide a DTMF code to enable train crews to remotely open the entrance track gates and a similar code to close the gates.
- Key cards in use with the existing OCC shall have the ability to operate the security/access systems installed at the VSLMF.
- Roadway gates shall be provided with a remotely monitored locking system that provides an indication of gate status to the VSLMF Office.
- Security lighting shall be placed as necessary to illuminate gate areas must be a minimum of 5 ftc.

Yard and Driveways:

- Provide 6 ft high (FDOT Type B) fencing that includes barbed wire for the periphery of the Yard, in conjunction with lighting, surveillance, and remote access control mechanisms.
- Lighting in the yard and driveways shall be a minimum of 5 foot candles with no dark areas. Photometric surveys must be conducted to verify illumination levels in all areas of the VSLMF.

Buildings:

- A security access control system shall be provided to allow security card access for the VSLMF buildings to employees.
- Key cards in use with the existing security systems at the OCC shall have the ability to operate the building security access system.
- The server room shall not have a window.

Video System:

- Pan/tilt/zoom (PTZ) CCTV security cameras shall be provided at the entrance gates.
- PTZ CCTV security cameras shall be installed in the yard to provide coverage of all storage tracks, parking areas and buildings within the yard to ensure that all areas can be viewed from the CCTV system.
- Video from the CCTV security cameras shall be fed to the OCC video control system.
- Video cameras shall support fiber optic cable interconnections and 24Vac powering or Category 6 cables with Power over Ethernet. Video systems shall be fully compatible with existing OCC systems so that camera and system control software in the OCC can be used to control all camera settings and functionality.

29.8.10 Structural

The structural design of the building shall conform to the requirements of Section *23.4* General *Structures*.

APPENDIX A – Acronym List

AAR ..... Association of American Railroads
ADA ..... Americans with Disabilities Act
AFTC ..... Audio Frequency Track Circuit
ANSI ..... American National Standards Institute
APTA ..... American Public Transit Association
AREMA..... American Railroad Engineering and Maintenance-of-Way Association
ASR ..... Approach Stick Relay or At Stop Relay
ATR…… ..... ……..……At Top of Rail
ASQC ..... American Society for Quality Control
ASTM …… ..... ……..……. American Society for Testing and Material
AWG ..... American Wire Gauge
BICSI ..... Building Industry Consulting Service International
CCTV ..... Closed Circuit Television
CFCRT ..... Central Florida Commuter Rail Transit
CFRC ..... Central Florida Rail Corridor
CPTED ..... Crime Prevention Through Environmental Design
CSXT ..... CSX Transportation Company
CTC ..... Centralized Traffic Control
DBQCP..... Design/Build Firm Quality Control Plan
ECB ..... Emergency Call Box
FDOT ..... Florida Department of Transportation
FFGA ..... Full Funding Grant Agreement
FRA ..... Federal Railroad Administration
FTA ..... Federal Transit Administration
IOS ..... Initial Operating Segment
LED ..... Light Emitting Diode
MFES ..... Managed Field Ethernet Switch
MTBF ..... Mean Time Between Failures
NEC ..... National Electric Code
NESC ..... National Electric Safety Code
NFPA ..... National Fire Protection Association
OCC ..... Operations Control Center
O&M ..... Operations and Maintenance

PA ..... Public Address
PAT ..... Passenger Assistance Telephones
PHA ..... Preliminary Hazard Analysis
PMC ..... Project Management Consultant
PTC ..... Positive Train Control
ROW ..... Right of Way
RPU ..... Remote Processing Unit
SCADA ..... Supervisory Control and Data Acquisition
SPD ..... Surge Protection Device
SSI ..... Security Sensitive Information
TIA ..... Telecommunications Industry Association
TVM ..... Ticket Vending Machines
TVSS ..... Transient Voltage Surge Suppressor
UL ..... Underwriters' Laboratories
VSLMF ..... Vehicle Storage & Light Maintenance Facility