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High Speed Rail – Tampa to Orlando
District 7 Response to Comments dated 9/14/09

From: Jennifer Lewis & Howard Newman
To: Ming Gao & Ronald Chin

Roadway Design Comments By: G. Britton Hardy, P.E.
District Roadway Design Engineer
Phone 813-975-6083

In reviewing the Florida High Speed Railroad profile sheets provided there are locations with possibly substandard vertical clearances and grades.

1. Assumptions using American Railway Engineering and Maintenance of Way Association (AREMA) as quoted in an RTD design criteria guideline for commuter railways was used as a reference in this review.

   Response: Design Guidelines for the Florida High Speed Rail Project were developed in 2002 and provided to the District on July 29, 2009. These are the basis for the design of this project. The minimum vertical clearance per these design criteria is 19 feet from top of rail to bottom of structure. The preliminary engineering plans intend for 19.5 feet of vertical clearance within this envelop. Attached at the end of this document is a copy of the design guidelines.

2. Locations near Station 1040+00, 6130+62, & 6157+05 at an existing railroad is under the profile with vertical clearance identified at 17, 23, & 17 feet respectively. Generally 28' is required for CSX freight railroad overhead clearance. Please discuss design guidance from Central Office as required.

   Response: The CSX freight railroad overhead minimum clearance required is 23'-6". Station 1040+00 is not on the preferred alignment. Station 6130+62 is a railroad to be abandoned at the I-4/ Crosstown Connector Interchange. Station 6157+05 is a railroad crossing where clearance for light rail or, if necessary, freight rail will be achieved by raising the FHSR profile during the design phase.

3. Another location is near Station 6030+75 over Henderson Avenue with vertical clearance identified at 14 feet. This is below roadway design standards of 16' minimum for vertical clearance even under the Minimum standards in the 2007 Florida Green Book.

   Response: Henderson Avenue is now closed. Part of Harry Parrish, Sr. Park was sold to a private owner (GTE) and this area is used for parking. If required the HSR vertical profile could be raised in the section of the alignment.

4. Clearance to overhead structures at Station 6363+43, 6392+32, 6422+28, 6484+05, 6489+55, 6521+45, 1671+00, 1726+34, 1934+70, & 1974+35 are not identified but appear to be plotted at 19.5 – 20 feet clearance. Is this sufficient for high speed rail vertical clearance? We would anticipate the minimum clearance to be 23.5' to any object over the high speed railway.

   Response: Yes, per Section 10.3 of the July 16, 2002 FHSR Design Guidelines, 19' vertical clearance is adequate. This was verified by the GRC vendor in response to the DBOM&F RFQ that proposed to use an electric powered train.

5. Vertical clearance over Tampa Bypass Canal at station 6415+10 is not shown and cannot be determined. Possible coordination with agencies to verify navigable waters clearance must be verified.

   Response: Vertical clearance over this waterway will be verified and coordinated with the agencies during design phase.

6. Maximum grade for high speed rail should be 1.5% yet there are grades of 1.270, 1.287, 1.358, 1.654, 1.640, 1.734, and 2.008. While 2.5% may be considered absolute maximum for commuter railways any grades over 1.5% may require specific approval from AREMA. Steeper grades may require specially designed equipment to traverse those steeper grades. Please discuss.

   Response: Per Section 9.1 of the July 16, 2002 FHSR Design Guidelines, desirable maximum grade is 3.5% and absolute maximum grade is 5%.

7. The tangent distance between vertical curves near Station 1854+00 to 1856+00 at 220' appears to violate the minimum allowable distance formula Lg = 3V where: Lg = Minimum length of constant profile grade (feet) and V = Design velocity through tangent (miles per hour). The absolute minimum Lg shall be 90 feet when approved by governing authority. Assuming 80 MPH x 3 = 240' thus the 220' shown may not be acceptable or at least may be marginally acceptable.

   Response: Per Section 9.1 of the July 16, 2002 FHSR Design Guidelines, the minimum grade length shall be determined by the formula: L=2.22*V, where L is in ft and V is in mph. At 80 mph the minimum vertical tangent length is 178', 220' is acceptable.

8. The Typical Sections indicate a minimum of 9'-2" clearance to shoulder barrier wall and 11'-2" clearance to the centerline of median (presumed). The minimum clearances for rail should be 8'-6" minimum clearance envelope to non-structural objects and 12'-6" to structural objects.

   Response: Per Section 10.1 of the July 16, 2002 FHSR Design Guidelines, minimum horizontal clearances are achieved. Please clarify which typical sections are referenced.

9. Bridges for roadway overpass structures would likely have a pier located in the center of the median. Using 3' as the nominal dimension of a pier this would make the clearance remaining at 11'-2" less 1'-6" or 9'-8". What mitigation is proposed to address this issue since it will likely be "typical" condition for the corridor?

   Response: Crash barrier will be employed to mitigate bridge piers.

10. All the median bridge piers would likely require upgrades with crash worthy barriers since all are likely within 25' of the centerline of the tracks. Please discuss.

    Response: Crash barrier will be required at bridge piers with clearance from center of rail per attached design guidelines.

11. The clearance to the traffic travel lane is less than 25' however is presumed to be acceptable by design standards from railroad governing criteria. The shoulder barrier mitigates the roadway clearance issue.

    Response: We concur.

12. The centerline clearance between adjacent main commuter railway tracks is generally required to be 25' but the typical indicates 23'-1" and may require a variation/exception for the reduced distance between main tracks.

    Response: Per Section 10.1 of the July 16, 2002 FHSR Design Guidelines, track centers at 15' are desirable and 13.5' is minimum.

13. As these appear to be preliminary plans, there are not many other features for review.

    Response: Comment noted.

Structures Design Comments By: Scott C. Arnold, P.E.
District Structures Design Engineer
813.975.6136

1. The rail alignment is shown to cross over east-bound I-4 at station 6090+00, near Ybor City. The extremely shallow skew will result in a long span, possibly around 700 feet. The profile sheet indicates a planned depth of about 10 feet from bottom of superstructure to top of rail. This may not be sufficient for such a long span. Please discuss.

   Response: The reevaluation alignment is modified here to reduce the skew. It was, and is, anticipated that straddle bents may be required.

2. Has consideration been given to placing the rail underground from the Tampa station to the I-4 median?

   Response: Underground option was not considered here due to groundwater issues.

3. Every road and ramp that crosses over I-4 has a median pier, which will require crash barriers due to the proximity of the rails. Please discuss protection system planned.

   Response: Crash barriers will be required. Specific design requirements will be coordinated during the design phase.

4. Will the barriers between the rails and the I-4 travel lanes have to be taller than 42" in curved sections, and will the barriers cause sight-distance problems for the cars? Please discuss barrier crash level and needs thereof.

   Response: The High Speed Rail Project Civil Infrastructure Design Criteria, July, 2002 identifies that standard FDOT median barriers shall be employed on the boundaries of the highway median running high speed rail systems to deflect errant highway vehicles from entering the guideway. On the inside of curves of the rail alignment (outside of interstate mainlines), the height of the standard barriers shall be raised to 7.5 feet. In addition, FRA requirements of 49CFR 213.361 would be met during design and construction. These requirements include preparation and approval of a 'Right of Way Plan from the owner of a Class 8 and 9 track operating at speeds in excess of 125 mph. The plan includes provisions in areas of demonstrated need for the prevention of: vandalism, launching of objects from overhead bridges or structures into the path of trains, and intrusion of vehicles from adjacent right of way. The issue of barrier protection will continue to be reviewed with final approval through the design phase.

5. Why doesn't the rail terminate at Tampa International Airport? Another system will have to be in place to take passengers from the downtown station to the airport or to car rental locations. Please discuss.

   Response: Tampa International Airport previously, and recently, confirmed the airport is not capable to receive a high speed rail stop at the airport. Coordination with other local transit agencies will provide a connection from downtown CBD to the airport.

Utility Accommodations Comments By: Sally A. Prescott
District Environmental Permits
And Utilities Administrator
Phone (813) 975-6151

1. TECO has some OE Transmission crossings throughout the corridor. In places where the proposed track follows along the outside of the roadway, such as the downtown interchange area, may require widening and relocation of the OH transmission poles. The outages involved with such relocations, as well as the MOT for the interstate, may be complicated as far as constructability and coordination with power outage scheduling. There is also the interstate street lighting involved in that area, which adds to the complexity.

2. The downtown Tampa station area is in an older part of the city and may have old and fragile utilities in the area. There may also be contamination in the area. We need to determine if there are any more underground oil-cased power transmission lines such as we encountered during design of the Cross-town Connector.

3. Per the proposed Florida Gas Transmission loop maps, Loop 10 proposes a gas transmission main crossing at the easternmost point of the westbound exit ramp to Forbes Road, STA 2045+50. This would need to be coordinated with both construction efforts (rail and gas main).

4. Underground utilities are generally permitted at depths of 3' under pavement (for jack & bores) and there may be instances where they may be in conflict. Any utilities placed by directional drill methods are at depths of 10 x diameter of the pipe, so they are probably clear.

5. Upon the study evaluation for the FEIS/EIS for FHSR in 2005, we have assumed all environmental permitting needs were reviewed as a part of the NEPA process. If there are any outstanding agencies to be dealt with regarding environmental permits (DEP/EPC/SWFWMD/USACOE/Port Authority/Etc.), please contact me or Katasha Cornwell so we may facilitate your evaluation and/or concerns.

6. I am attaching a map of the proposed Florida Gas Transmission loop #10.

   Response: Thank you for this information. Many utility conflicts are anticipated along the HSR alignment. The FEIS Reevaluation identifies several utility owners and their facilities. The design team will be required to coordinate closely with FDOT and applicable utilities for mitigation/ relocation.

Traffic Design Comments By: Rochelle Garrett, P.E.
FDOT District 7 Traffic Design Engineer
(813) 975-6733

1. Some of the clearances between the RR and existing roadways appear too close. Station 6093+00 and MLK are examples. Please discuss barriers/types and offsets.

   Response: Please see discussions included in responses to Roadway Design comments.

2. Something appears peculiar with the profile or the stationing around 6198+00 (Columbus). We may need a bridge over Columbus and not a retaining wall through it.

   Response: The FEIS Reevaluation includes a FHSR bridge at the new location of Columbus Drive per new construction since the 2005 FEIS.

3. The segment with the grades lower than the existing grade is in the vicinity of the Tampa By Pass Canal. This is likely a ditch so does this present a potential flooding issue? Please discuss accommodation of hydraulics.

   Response: The drainage design will meet requirements of the Water Management Districts in coordination with the Department. In this particular area of the comment, the HSR vertical profile is in a long run from a high point near I-75 to the Tampa By Pass Canal. It is anticipated that the drainage design will have treatment areas that will pop off runoff from the HSR along this alignment.

4. Profiles end at 2456+00 but the track ends at 5480+00. Please discuss.

   Response: Various project segments are stationed with different stationing designations. Station limits and equations are shown on the plan sheets.

5. How will passengers get from the proposed stations at 2490+00, 2745+00 and 4525+00 to the train? If passengers go overhead to the center of the interstate; then, is the median wide enough for platforms, a waiting area, and possibly a spur track for loading and unloading?

   Response: Double tracking is proposed with no spur tracks. It is anticipated, and confirmed by DBOM&F RFQ proposals that median platforms with a crossover to a station area parallel to the interstate right of way would be utilized. In areas such as the Kathleen Road (alternative station site in Lakeland), the track may crossover to the outside of the mainline, remain within the interstate right of way, and have a platform contiguous with the station. It is the intent of the Department to further evaluate each station as the private-public partners are identified for design and operation of the HSR, to further coordinate station sites from both design perspective and location in coordination with local governments.

6. Plan set FHSR_Reev_plan_set.pdf is missing sheets but FHSR_plan_set.pdf under the folder "plan sets profile from pde" seems to have all pages.

   Response: Comment noted. Only plan sheets that reflect the need for any change to the preliminary engineering review are to be included in the Reevaluation documentation.

7. The barrier walls on the typical section should exceed our standard height and width. Crashing vehicles sometimes "jump" the wall but the median area for the opposing lanes and the ability for drivers to divert their travel path provides some additional factor of safety. The typical section shows the track elevation higher than the roadway elevation and the carriage about 5.5' from the back of the median barrier. Should a high speed or heavy vehicle breach the wall the possibility for a catastrophic collision is high.

   Response: Concur. Please see response to Comment 4 in the Structures Design comments.

Drainage Design Comments By: Megan Arasteh, P.E.
District Drainage Engineer
813-975-6162

1. The information provided was preliminary. The drainage concept provided in the typical section generally looks acceptable as long as existing drainage patterns and basin limits are maintained.

   Response: Comment noted.

2. Changes to the profile may be required pending the actual design of the drainage conveyance system. Any changes to the profile will impact the clearance to the bridges. The provided profile shows the existing ground to be above the proposed profile in many locations. As-built plans and the calculations of the in-place system are required to determine if the profile will work as shown.

   Response: Comment noted and will be addressed by design team.

3. The permits and design calculations will need to be investigated for all roadway sections. Sections of I-4 in D-7 were likely designed to treat and attenuate R/W to R/W while this may not be the case for I-4 sections in other districts. The review of the existing environmental resource permits is recommended to determine whether additional pond sites or floodplain compensation sites will be required for the rail corridor.

   Response: Comment noted and review will be completed prior to design efforts.

4. In the sections outside District Seven there are locations where the alignments take the rail through low areas or ponds in the median; additional RW will likely be required in these areas to mitigate for floodplain or pond impacts. Please discuss.

   Response: These areas will be further evaluated in the design efforts including cost comparison of placing the alignment on structure at indicated areas versus acquiring additional right of way and meeting potential permitting issues to replace/relocate current treatment areas.

5. Utility conflicts will need to be investigated for any proposed lateral storm sewer systems.

   Response: Comment noted.

6. In areas where the profile grade drops below existing ground, say within the I-75 or US 301 interchanges with some 6-7'(+/-) below grade, how will drainage be accommodated with the likelihood of prevailing groundwater. Please discuss typical section for these scenarios.

   Response: The design team will utilize drainage pattern and basins to provide treatment. Groundwater and soil conditions will be part of the design effort as required.

Ronald A. Chin
District Seven Design Engineer
813.975.6030

1. I am aware that Messrs, Gao and Perez have made you aware of ongoing I-75 PD&E studies that need to be coordinated and addressed. I also recommend that you are reminded to coordinate with Adam for all the ongoing Design contracts along I-4 and/or I-75 and for that matter any other service or system interchanges currently under design within the study limit so you cover all bases.

2. In your response with these, please also discuss the accommodation of District Seven's Contra-Flow plan in the event of an emergency that we have to use all lanes one way on certain segments of our Interstate System as shared with by Angela Allen/Terry Hensley.

Response: The Department and the FHSR project development teams are aware of the ongoing efforts in the I-75/I-4 interchange area. Coordination between both efforts will be on-going.

Emergency Crossovers for Contra-flow of Eastbound I-4 to Westbound lanes have been added between 50th Street and MLK Blvd. and at the I-75 Interchange. The crossing near MLK Blvd. is accommodated in the reevaluation plans with the addition of a FHSR bridge and raising the FHSR profile. The I-75 crossing is subject of ongoing coordination.

Florida High Speed Rail Authority
High Speed Rail Project Civil Infrastructure Design Guidelines

July 16, 2002

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Florida High Speed Rail Authority
High Speed Rail Project Civil Infrastructure Design Guidelines
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1.0 Introduction

It is anticipated that a high speed rail system will be constructed in the State of Florida under a design build operate and maintain (DBOM) contract. Preliminary engineering and environmental assessment are proceeding on the St. Petersburg to Orlando corridor in order to select a preferred alignment, satisfy the NEPA process and develop DBOM request for proposal documents.

Multiple high speed ground transportation technologies exist, including diesel-electric and electric powered steel wheel/steel rail systems and magnetic levitation systems. Rail systems offer both conventional and tilt suspensions. The performance and infrastructure requirements of each technology are different. The key differences for alignment are the maximum speeds attainable with each technology – a range of 120mph to 250 mph.

In order to enable the competitive marketplace to present the best option for the citizens of Florida, the Authority has not made a technology selection. This complicates the preliminary engineering task, as the alignments and infrastructure must be designed to allow the application of the range of technologies. The alignments must be designed, so as not to preclude the use of or unjustly penalize the performance of any technology. (One exception to this concept exists – Maglev systems shall not be permitted adjacent to the existing CSX railroad due in part to the perception by CSX that EMI may affect the performance of the CSX signal system.) The High Speed Rail Project Civil Infrastructure Design Guidelines are established to guide the preliminary design decisions in a manner consistent with these objectives.

The basic infrastructure design during the preliminary engineering phase shall accommodate an electrified high speed rail system capable of speeds of 150 mph. On award of a contract to a DBOM contractor, it is anticipated that the contractor shall optimize the alignment and infrastructure design for his technology within right of way and other constraints.

The high speed rail system shall be designed to serve high speed passenger equipment and will not be used by general railway freight equipment. The high speed passenger equipment may include special, similarly constructed freight cars operating in separate trains or within the passenger train consists. Conventional track maintenance equipment including work trains, diesel electric locomotives, ballast cars, tampers, geometry cars and hi-rail inspection cars shall operate on the track (except Maglev).

2.0 Codes, Standards and Regulations

Tracks shall be designed to meet applicable requirements of Track Safety Standards 49 U.S.C. Part 213 Subpart G for Class 8 track.

Except as noted specifically herein, infrastructure design shall be in accord with Florida DOT standards including:

- Project Development and Environmental Manual
- Roadway Plans Preparation Manual
- Manual of Uniform Minimum Standards for Design, Construction, and Maintenance for Streets and Highways
- Bicycle Facilities Planning and Design Manual
- Right-of-Way Engineering Manual
- Survey Manual
- Drainage Manual
- Soils and Foundations Manual

- Structures Design Guidelines
- Computer Aided Design and Drafting (CADD) Roadway Standards and Guidelines

Railroad track and structures shall be designed in accord with recommended practice of the AREMA Manual for Railway Engineering 2002.

3.0 Survey and Right of Way

The preliminary engineering alignment shall be plotted on scaled low resolution aerial photography base maps. Scaled high resolution aerial photography and digital terrain models shall be provided to potential design build contractors during the RFP process to enable the contractors to optimize the alignment for their systems.

During preliminary engineering, approximate right of way limits shall be determined from existing highway plans and railroad valuation maps. Boundaries shall be plotted on the plan sheets.

Tangent segments of the high speed rail alignment shall be designed to fit within a 44 foot envelope in highway medians and 50 foot envelope within existing railroad alignments. Curves and spirals may require a greater envelope width and/or additional right of way. Excursions outside the existing median or right of way shall be identified on the plans. In addition, excursions outside the existing right of way are required for connections between railroad and highway median alignments, between highway median alignments and station sites and between different highway alignments. Additional right of way requirements shall be identified on the plans.

4.0 Typical Sections

Typical sections are provided for the following configurations:

- Open Terrain Electrified Center Pole Rail Tangent Track
- Open Terrain Electrified Side Pole Tangent Track
- Electrified Rail Tangent Track in Highway Median Depressed Under Roadway Overpass
- Electrified Center Pole Rail Tangent Track Adjacent to Existing CSX at a 25 foot Track Centers with Standard Ditch
- Electrified Center Pole Rail Tangent Track Adjacent to Existing CSX at a 25 foot Track Centers with Underdrains
- Maglev Tangent Track at Grade in Highway Median
- Maglev Tangent Track at Grade in Highway Median Depressed Under Roadway Overpass
- Electrified Side Pole Rail Tangent Track in Highway Median
- Electrified Side Pole Rail Curved Track in Highway Median
- Electrified Side Pole Rail Tangent Track Adjacent to CSX 25 foot Centers
- Electrified Side Pole Rail Curved Track Adjacent to CSX at 25 Foot Centers

Where standard roadbed and ballast section back-slopes intersect existing ground lines beyond the existing ROW, retaining walls shall be designed and constructed within the property with diversion ditches or drains provided behind the retaining wall to divert runoff from adjacent properties toward stabilized drainage outfall structures. Where applicable, profiles may be adjusted to minimize earthwork and reduce or eliminate the need for retaining walls.

Due to the minimal ROW width or inaccessibility due to geological conditions a parallel access roadway shall not be constructed.

Emergency and inspection walkways shall not be required in constrained right of way or highway median construction. Emergency access and evacuation shall be provided along the adjacent track.

Soil engineering and analysis shall be employed to design the subgrade embankments and cuts. New side slopes shall not be steeper than 1.5:1. Unless designed from site specific soils data, slopes shall not be steeper than 2:1

To minimize right-of-way and excavation requirements, underdrains rather than ditches shall be employed where necessary for drainage.

5.0 Design Speeds

The preliminary engineering alignment shall be designed for a peak speed of 160 mph (maximum 150 mph operating speed), where not restricted by right of way limitations.

6.0 Track and Guideway

Mainline roadbed, trackwork and alignment shall be designed for high speed passenger service at speeds up to 160 mph, unless otherwise restricted by geometric considerations, special trackwork, or yard limits. All track on earthen roadbed shall be ballasted construction. Direct fixation shall be permissible on flyover structures to eliminate the dead load of the heavy rock ballast and provide longer span lengths. Where high-speed operation is permissible, the facilities shall be designed to support Class 8 gage, alignment and surface criteria without excessive maintenance.

A double track mainline shall be constructed to ensure reliable service. High speed crossovers are required at roughly 25 mile intervals to allow heavy maintenance under single track operations without shutting down the system.

Main tracks used by passenger service shall be constructed using new 136RE continuous welded and controlled cooled rail (CWR). Rail for sidings and yards shall be either new 136RE CWR (as above) or relayed continuous welded rail of not less than 115 lbs. per yard.

Main track shall use 8’6” reinforced concrete ties, spaced at 24 in centers. Yard track may use either concrete or timber ties. Timber ties shall be spaced at 19.5 in centers. The concrete tie track shall be suitably designed to provide electric isolation of one rail from the other and both from ground to satisfy train control circuit integrity requirements, and, if the track is electrified using the running rails as the negative return, the track shall include electric isolation sufficient to provide suitable protection of adjacent facilities from stray current corrosion.

Track gage shall be 4 ft 8.5 in measured at right angles to the track alignment 5/8 in below the top of rail.

Rail fasteners installed with concrete ties shall be spring clip design with elastomeric pads to prevent tie wear. Timber ties shall employ tie plates, spikes and anchors.

Ballast shall be suitable for use with concrete or timber ties. Mainline ballast gradations shall conform to No. 24, 3 or 4A to provide for drainage and performance under load. Yard ballast shall meet No. 5 gradation requirements to provide for improved walkway and safety conditions along the track. Due to the high crushing loads under concrete ties, ballast materials shall be limited to granite, trap rocks or quartzite. The minimum ballast depth shall be 14 in under mainline ties. The minimum ballast shoulder width shall be 12 inches. Ballast shoulder slopes shall not be steeper than 2H: 1V.

Subballast shall conform to Florida DOT specifications for crushed aggregate base course and shall consist of hard, durable particles of crushed stone or crushed concrete and a filler of natural sand, stone sand or other finely divided mineral matter. Subballast depth shall be not less than 8 inches. Subballast shall be sloped as shown on the cross section prints to promote drainage of the track structure.

The mainline track shall be entirely grade separated. Grade crossings are permitted in yards and possibly in slow speed territory, where grade separation is not economically feasible. Where such grade crossings exist, precast steel reinforced concrete panels with elastomeric flange fillers shall be used. Concrete panels provide the most uniform crossing surface and security of installation of the commercially available grade crossing products. Grade crossings shall include gated warning systems.

7.0 Special Trackwork

All new turnouts, crossovers, and special crossings shall be in accordance with current AREMA Portfolio of Trackwork Plans for standard curved switch and rigid frog lateral turnouts, unless otherwise modified due to location within mainline track curves and spirals.

The point of switch or heel of frog shall be located no closer than the following:

TS or ST of adjoining mainline track curve	200 feet
PVC or PVT of a vertical curve	100 feet

Where unconstrained by geometry, all mainline crossovers shall be #32.75 with movable point frogs. Crossovers and turnouts in close proximity to terminal stations may be #20 with curved switch points and RBM frogs. Yard turnouts shall be no smaller than #8. All mainline turnouts shall be on concrete ties.

8.0 Horizontal Alignment

The following design guidelines are based on AREMA 2002. All horizontal alignment design shall conform to current AREMA guidelines.

8.1 Tangents

The minimum tangent length between curves shall be the greater of 100 feet or three times the design speed. The alignment shall be tangent through the platform area to a distance of 100 feet from platform edges.

8.2 Curvature

Curvature shall not exceed 9 degrees on mainline tracks and 12 degrees on yard tracks. The minimum length of circular curve shall be determined by the formula: $L = 2.22*V$, where L is in ft and V is in mph. In no case shall the length of circular curve be less than 100 feet

8.3 Superelevation/Cant Deficiency

Mainline curves shall be superelevated. The maximum design superelevation E(A) shall not exceed 6 inches. FRA permits a maximum superelevation of 7 inches.

Maximum cant deficiency E(U) shall not exceed 9 inches. (FRA permits a maximum cant deficiency of 9 inches on qualified equipment, i.e. tilt body equipment. For non-tilt body equipment E(U) shall be limited to 3 inches unless the roll angle is within limits specified by AREMA in which case the E(U) may be increased to 4.5 inches.)

Mainline curves shall be designed with E(A) established to balance forces on both rails, employing cant deficiency as required to achieve design speeds. The balancing speed in a curve shall be determined by the formula: $E(A) = .0007*D*V*V$, where E(A) is in inches, D is in degrees and V is in mph. The maximum permissible speed in a curve shall be determined by the formula: E(A)+E(U) = .0007*D*V*V, where E(A) and E(U) are in inches, D is in degrees and V is in mph. The sum of E(A)+E(U) shall not exceed 15 inches.

Superelevation shall be run off at a constant rate in the spiral. Superelevation shall not be runoff on tangent track.

Actual and unbalanced superelevation may be simultaneously introduced provided that AREMA spiral length guidelines are followed.

8.4 Spirals

Mainline curves and tangents shall be connected with a spiral transition. The length of the spiral shall be determined by the maximum value determined by the following formulae:

- L(S) = 1.63*E(U)*V, where L(S) is in ft, E(U) is in inches and V is in mph.
- L(S) = 1.30*E(A)*V, where L(S) is in ft, E(A) is in inches and V is in mph.
- L(S) = 124*E(A), where L(S) is in ft and E(A) is in inches. (Applies to Class 8 track)

Spiral and curve geometry shall be determined using the formula and notation of AREMA 5-3-2 through 5-3-5.

The application of spirals for high speed operation is anticipated to result in conflicts with existing CSX railroad and highway median alignments, as the original alignments were not constructed with long spirals. Each curve shall be evaluated to determine site specific solutions. Where the cost of realigning existing infrastructure proves prohibitive, the design speed and spiral length shall be reduced as necessary.

9.0 Vertical Alignment

The following design guidelines are based on AREMA 2002. All vertical alignment design shall conform to current AREMA guidelines.

9.1 Grades

The vertical alignment shall follow the existing track or highway gradients, wherever practicable. The desired maximum grade shall not exceed 3.5%. Under no circumstances shall the grade exceed 5%. The minimum grade length shall be determined by the formula: L=2.22*V, where L is in ft and V is in mph. Yard tracks and station track grades shall not exceed .25%. It is desired to design such tracks at 0% grade.

9.2 Vertical Curves

Where changes in grade occur, gradient lines should be connected by vertical curves, observing the following provisions:

The length of a vertical curve is determined by the difference in grades to be connected and the rate of change adopted. For high-speed main tracks, the rate of change should not be more than 0.05' per station of 100' in sag curves and not more than 0.10' per station of 100' in crest curves.

Where geometric constraints prevail, the following formula shall be used to determine the vertical curve lengths:

LVC = Delta g*V*V*K/A, where:

LVC = Length of Vertical Curve (in ft)
Delta g = difference in grades (in ft/ft)
V = speed (in mph)
K = 2.15, constant to convert mph into feet
A = 0.60 ft/sec/sec)

The minimum vertical curve length, $LVC_{(min)}$, shall not be less than 100 feet

10.0 Clearances and Track Centers

10.1 Tangent

Main tracks shall be constructed at 13.5 foot minimum track centers on tangent The desirable main line high speed rail track centers shall be 15.0 feet. Track centers shall be increased to provide clearance for center catenary support structures. The minimum clearance to catenary poles support structures shall be 9.5 feet as recommended by AREMA. The desired clearance is 12 ft-0 in. High speed rail tracks shall be separated from adjacent freight rail tracks by a distance of not less than 25 feet measured between freight and high speed rail track centerlines.

Yard and storage tracks shall be spaced at not less than 13.5 feet measured between track centerlines.

The minimum permissible clearance from track centerlines to adjacent fixed obstructions shall be 8 feet measured from the track centerline in accord with Florida law.

10.2 Curves

The minimum horizontal clearance (8.0 feet) and track spacing (13.5 feet) shall be increased 1.5 inches per degree of curvature. Where superelevation is applied, the minimum horizontal clearance of 8.0 feet shall be increased on the inside of the curve 3 inches per inch of actual superelevation.

10.3 Vertical Clearance

The high speed rail alignment shall be designed to provide 19 feet of clearance between the top of rail and the low point of the bridge. This clearance value allows the installation of a catenary system with sufficient electrical clearance to the bridge for a 25kV power system. Clearance for existing structures may be obtained by rebuilding the structure or lowering the track elevation.

10.4 Vehicular Dynamic Clearance

The vehicular dynamic clearance shall not exceed AREMA Plate C.

11.0 Structures

11.1 Bridges

Highway bridge piers within 25 feet of a track centerline shall be protected with a reinforced concrete deflection wall to a height of 6 feet above the top of rail elevation.

High speed rail bridges shall be constructed with a side walkway, where permitted by median width or railroad right of way width.

11.2 Retaining Walls

The desirable clearance to retaining walls shall be 10.0 minimum from centerline of track to near face of wall.

11.3 Barriers

Standard Florida DOT highway median barriers shall be employed on the boundaries of highway median running high speed rail systems to deflect errant highway vehicles from entering the guideway. On the inside of curves the height of standard barriers shall be increased to 7.5 feet.

11.4 Culverts

Per FDOT drainage criteria.

12.0 Drainage

Per FDOT drainage criteria.

13.0 Fencing

Chain link fencing 6 feet high shall be installed on the boundaries of the new rail alignment. The fencing shall be installed on the top of the highway median barrier separating high speed rail from automotive traffic.

14.0 Provisions for Systems Elements

Nominal contact wire height shall be 23 feet in accord with AREMA recommendations per 33-4-10. The minimum contact wire height shall be 17 feet. An envelope of 18 inches in width shall be provided for catenary support structures. The preferred location of catenary support structures is on the outside of the double track main line. This permits one catenary support system to remain in service if the other is out of service for any reason. All train control and communications cables shall be installed below grade by either direct burial or in ducts.

15.0 Overhead Roadway Bridges

Per FDOT standards with clearances to high speed rail tracks as defined herein.

16.0 Highway Modifications

Per FDOT standards.

17.0 Maintenance of Traffic

Per FDOT standards for highway traffic. Per affected railroad for work adjacent to operating railroads.

18.0 Stations

Platform length shall be not less than for 9 car trains including locomotives. For preliminary design a platform length of 800 feet shall be used. Center platforms shall be a minimum of 24 feet in width. Platforms shall be high level and meet ADA clearance requirements. For preliminary design, a distance from centerline of track to platform edge of 5.25 feet shall be used.