HIGH SPEED RAIL IN NEW JERSEY
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ABSTRACT

Amtrak is continuing its incremental approach to the implementation of high speed rail in the eastern United States through the implementation of the New Jersey high speed rail improvement program. This 450 million USD program, now in its second year will raise the maximum speeds on a 22 mile segment of the NEC from 135 MPH to 160 MPH. One of the greatest challenges of the program is to raise the commuter capacity over this intensely utilized segment (between New Brunswick and Trenton) while also raising the speeds and operating frequencies of high speed trains (from 1 train per hour to 2 trains per hour).

The program is also aimed at improving the reliability and maintainability of this railroad which was originally electrified in the mid-1930s by the Pennsylvania Railroad and which continues to operate with the electrification system of that era. The base element of the program is a carefully developed concept of operations (CONOPS), which describes new service frequencies and train routing patterns and maintenance requirements. This CONOPS which was developed by Amtrak in conjunction with FRA and NJ Transit served as the basis for configuration definitions for system design. This paper addresses the resolution of the apparent paradox between simultaneously increasing speed, capacity and reliability while maintaining safe operations. It also describes the basic scope of work and implementation methods.

BACKGROUND

Historically, #3 Track between “County” and “Hamilton” in New Jersey has served as the high speed test section of the Northeast Corridor (NEC). This designation dates as far back as 1966, where joint US DOT/Pennsylvania Railroad tests were conducted on specially equipped “Silverliners” at 150+ MPH speeds, as a prelude to testing of the original “Metroliner” EMUs at speeds of 160+ MPH. It is this section of the Right of Way (ROW) that was selected by Amtrak to serve as the prototype area for current high speed improvements.
In 2011, Amtrak received a grant, (FR-HSR-11-001), from the Federal Railroad Administration (FRA) for improvements to the NEC infrastructure as part of the High-Speed Intercity Passenger Rail (HSIPR) Program. The New Jersey High Speed Rail Improvement Program (NJHSRIP) seeks to accomplish specific, tangible “in the ground” improvements which demonstrate Amtrak’s next step in its stair-stepped approach to achieving High Speed Rail and high performance passenger rail in the United States. The $450 Million NJHSRIP will implement Amtrak’s vision of incrementally raising speeds while concurrently achieving significant increases in NEC capacity and service reliability. Within the specific program limits, generally between New Brunswick, NJ (MP 32) and Trenton, NJ (MP 54), the NJHSRIP Program objectives include:

1. Achieve an operating speed of 160 MPH on the primary high speed Tracks 2 and 3.
2. Add new interlockings which are capable of supporting high speed intercity, as well as high performance commuter rail and sustaining the level of local freight service which currently exists.
3. Install new constant tension catenary on all four tracks. (County to Ham)
4. Improve both the capacity and reliability of traction power through the construction of a new frequency converter and up to two new sub-stations.
5. Improve the reliability of signal power through the installation of redundant distribution and feeder lines.
6. Raise speed and improve reliability through implementation of selected track improvements including curve realignments and removal of Midway interlocking (to be replaced by a new interlocking).
7. Install new signals which include PTC and reverse running capability on all tracks.

Implementation of these improvements will also serve as a baseline for refinement of Amtrak’s operating and maintenance practices, including employee training and development (e.g., on new signal technology), along with employee and system safety. Additional areas for improvement are intended to be targeted in subsequent grants. The deployment process will also be used to refine Amtrak’s business practices with respect to large scale engineering based programs. Amtrak will effectively fill the role of a Design/Build Contractor and Program Manager. This Program will also refine Amtrak’s business methods with respect to cooperative work with other users of the NEC (e.g., NJ Transit).

The extension of the design standards, advanced technology, operational and safety practices and refined business methods of the NJHSRIP to other locations (whether on the NEC or elsewhere) is also a major objective of this Program. As such, this Program represents a technical, operational and business prototype.

Specifics of how this program may serve as a prototype to other increments in Amtrak’s step-wise approach to achieving high speed rail will be considered. For
example, additional segments of 160 MPH territory along with the associated reliability and capacity improvements may be warranted where sufficient lengths of high speed operation can accomplish meaningful travel time reductions. This program may also represent an intermediate step in raising NEC speeds above 160 MPH, to as high as 186 MPH, again where geometry and distance warrant the investment.

CONCEPT OF OPERATIONS (CONOPS)
NJ HSRIP, NEW BRUNSWICK TO HAMILTON

Capacity vs. Speed

Given the vast array of passenger and freight services in operation on the NEC, a simple increase of maximum operating speeds alone will have negative consequences with regard to line capacity. Were the NJHSRIP to myopically consider Acela’s maximum operating speed as the primary program goal and scope the program accordingly, the resulting impacts to NJ Transit and long distance service would be disastrous. Capacity must be optimized to balance the needs of high speed operations with those of slower speed commuter services. The performance capabilities of the assortment of rolling stock currently in use and projected for use on the NEC must be carefully considered relative to maximization of capacity. In order to guide design efforts, Amtrak worked in concert with NJ Transit and the FRA to develop a concept of operations (CONOPS) as the base element of the program. The CONOPS was the genesis of multiple program elements to improve capacity while increasing reliability such as the inclusion of additional traction power substations and redundant signal power. Given the pre-defined infrastructure of the NEC, line capacity or the number of trains per hour, will depend on the train control system, the performance characteristics of the rolling stock and the type of services provided. Local and Commuter passenger services with an inherently greater density of station stops must be considered when optimizing capacity for this section of the NEC.

The reconfiguration of the NEC between County and Ham Interlockings is directly related to NJ Transit’s and Amtrak’s CONOPS for high performance commuter and regional rail coupled with improved High Speed Rail. This segment of the NEC is to be configured to a specific service plan, while retaining flexibility to adapt to alternate or temporary service patterns. This includes the service patterns described below. The NJHSRIP currently extends as far west as “Ham” and includes new high speed interlockings which consist of #32.7 crossovers at “Delco” and “Adams” and provisions for a loop track and North Brunswick station to be constructed by NJ Transit at the former Johnson & Johnson manufacturing facility. The Loop track would eliminate at-grade crossings of the entire 4 track alignment by NJ Transit trains that currently originate at the Jersey Avenue Station. Elimination of the at-grade crossings effectively increases available train
capacity in this segment of the NEC. In conjunction with other improvements, the Loop will allow for future service increases for Amtrak and NJ Transit.

The following is a summary of service patterns which are anticipated on this reconfigured section of NEC. These operational requirements serve as a basis of the configuration design.

**Amtrak HSR**

Through service, stopping at Newark, NJ and limited stops at Metro Park – operating at speeds of up to 160 mph on tracks # 2 and # 3. Ultimately this service will be provided by Tier III equipment (preferred design) which will first supplement, and then replace the existing Tier II (Acela) fleet; the planned configuration supports higher speeds and current service levels. Currently Amtrak operates one High Speed frequency per hour; the near term goal is to increase this to two frequencies per hour and a longer term design goal is the operation of three High Speed frequencies per hour.

**Amtrak Regional and Keystone Service**

This includes through service with selected station stops at Newark and/or Newark Airport, and/or Metro-Park and Trenton. Currently, Amtrak regional service also provides for a limited number of stops at Princeton Junction and New Brunswick. This service is provided by Tier I equipment with maximum speeds of up to 125 mph. Trains stopping at Trenton today use ‘Fair’ Interlocking and this general dispatching pattern is expected to continue. Included in this class of service are the Amtrak long-haul trains. The design goal for this service is two frequencies per hour to accommodate future state-supported services.

**Amtrak Long Distance Service**

This consists of through service to points beyond the NEC with station stops at Newark and Trenton. Currently service levels and stopping pattern is expected to remain unchanged with the potential exception of Trains 50/51, The Cardinal, to run daily after receipt of additional long distance equipment now in production. Long distance equipment is designed to Tier I standards and will be capable of 125 mph service once the current “Heritage Fleet” is retired with the delivery of new cars.

**NJ Transit Outer Zone Express Service**

Regional Express Service with trains operating on Tracks # 2 (eastbound) and # 3 (westbound) east of “Adams” and Tracks # 1 and # 4 west of “Adams.” Service is provided predominantly by (electric) locomotives and ‘multi-level' coaches in push/pull configuration with nominal MAS of 100 mph to 110 mph. Outer Zone stations are Trenton, Hamilton and Princeton Junction. On the shoulders of the
peak, NJT outer zone trains add stops in New Brunswick. This service currently operates on the interior tracks between Newark and Midway Interlocking in order to overtake and pass NJ Transit’s inner and middle-zone trains and will continue to do so but in a shorter, more efficient zone in the future. Outer-zone trains will utilize the new Delco and Adams interlocking to move from/to the inside tracks. The currently planned track and signal configuration provides for the potential implementation of a proposed new station located on the former Johnson & Johnson site in North Brunswick. Outer zone express trains might service this new station on the shoulders of the peak but are not expected to serve this station during the height of the peak. NJ Transit outer zone expresses will operate in revenue service to Trenton and be serviced and yarded at NJ Transit’s Morrisville Facility.

NJ Transit Middle Zone Service

Semi-express service provided between NYC and New Brunswick’s Jersey Avenue Station with a possible extension to the previously described new station at the Johnson and Johnson site. Service to be provided with EMU equipment which will be supplemented and ultimately replaced by bi-level consists made up of coaches, power cars, and cab cars. MAS for this service is expected to be 80 to 100 mph range and it will generally operate on the “outside” tracks (i.e. # 1 or # 4 tracks). The majority of middle-zone trains are expected to be yarded at an expanded facility near County Yard/the Loop, thereby reducing requirements to deadhead equipment to/from Morrisville. The configuration of the projected improvements also permits these trains to continue to Trenton on the outside tracks with no interference to HSR service. In the event that the proposed North Brunswick Station is not implemented, it is expected that improvements will be made to the Jersey Ave. Station including adding an eastbound platform alongside Track #4. This would permit this station to function properly with the aforementioned Loop.

NJ Transit Inner Zone Service

These trains will serve stations between Newark Penn Station and Rahway (inclusive), operating on tracks ‘A’ and ‘B’ between Elmora and Union, and then operate either west along the Northeast Corridor to Jersey Ave. and/or Trenton, or down the North Jersey Coast Line to South Amboy or points south. Service is presently and is expected to continue to be provided primarily by EMU’s (either single or multi-level) or single level push pull trains. Track or platform configuration currently permits inter-zone transfers at Rahway. North Jersey Coast Line service is also supplemented by frequent express trains which operate without stopping between Newark and Union Interlocking and which then depart the NEC along the North Jersey coast.
Freight

Operation of local freight, although largely diminished in volume from levels of ten years ago is expected to continue in the current or a similar pattern. Currently, locals are operated from Morrisville Yard on the west end of the project or from Edison Yard on the east end with traffic relayed to/from Lane Interlocking where it exits the NEC.

Operational Notes

Cab speeds of 160 MPH will be available on Tracks # 2 and # 3 only, County to Ham, with possible extension east to Edison (MP 28). Maximum Cab Speed on Tracks #1 and # 4 will be 125 mph, with capacity optimization at 80 mph. Preliminary planning for higher future service levels for both Amtrak and NJ Transit is underway. Additional coordinated planning is required to determine precise requirements. NJ Transit and Amtrak are confident that the current NJT and Amtrak projects build toward these future additional requirements.

Interlocking Configuration

Delco and Adams are each configured with one 80 mph crossover for use in switching NJT outer zone expresses. Allowance is made for future additional lower speed turnouts to permit NJT trains to operate between mainline #1 or #4 and loop tracks.

Midway retained for use in case of MOW work or for service diversion. Because Midway will not be utilized for scheduled diversions, it will be constructed with limited speed crossovers (except for Jamesburg turnout and the lead to the maintenance yard, which will be No. 10 Turnouts).

Ham – No changes to Ham other than eastward signals (will conform to rule 562) and prototype safety interlocking lighting. Potential future changes to Trenton operations will be coordinated with this base line design.

County – No changes to County are included in the scope of this grant, pending further evaluation of Loop Design.

Signalization and Train Movement Pattern

ALL tracks, ‘County’ to ‘Ham’ to be signaled for rule 562 (cab, no wayside). In order to improve capacity on tracks #1 and #4, controllable ‘station’ signals will be installed at Princeton. Service Diversions for planned work will make full use of signalization, however the expected daytime diversions from County to Ham for HS trains operating track 3 west is track 4 west, and for HS trains operating track 2 east is track 1 east account of:
a. The presence of high speed turnouts at Delco and Adams.
b. Low speed diversions at County.
c. Train density in opposing direction particularly if two HS frequencies are operated.

As shown in the above section, considerable emphasis has been placed on creating a plan for operations that is both fully integrated with current service requirements and aligns with planned future improvements. Careful planning of program elements was undertaken so as not to preclude future expansions of service and to accommodate the needs of future equipment. Having rationalized the approach to program planning with a concept of operations which balances the needs of various transportation services within the region the logical next phase of project planning is focused on improving the safety of the system to the extent possible given the significant system constraints of the NEC.

PROGRAM SYSTEM SAFETY APPROACH

Given the design for maximum capacity and reliability within the program section, significant attention must be paid to the maintenance of system safety throughout the program. System safety on the NEC shall be maintained (as a minimum requirement) and improved where possible within the constraints of the system. Assuming an established baseline of existing safe operations, the premise and the basis for executing the grant obligations is that this is a series of improvements that represent incremental improvement to an existing high performance railroad, not a “new start” system.

The existing Amtrak operations wherein 150 MPH operations in New England and 135 MPH on the New York Division have proven to be safe through continued operation. Hundreds of thousands of train miles and millions of passenger miles have been operated without incident.

The FRA grant for NJHSRIP recognizes and is duly consistent with Amtrak’s stair step approach to deploying improved HSR and is also consistent with the FRA’s desire to advance the safety, capacity, and reliability of high performance commuter rail in New Jersey. This particular program is systems based and involves multiple engineering systems (eg signals, catenary, traction power supply track and right of way.

Amtrak’s system safety approach for evaluating 160 MPH operation is made within the context of managing changes from an established baseline. Robust configuration management serves as the basis for evaluation of changes in systems as well as operational practices from the existing “proven to be safe” conditions. Thus, as is expected, incremental changes from baseline are reviewed and hazards associated with these changes from baseline are identified and mitigated. It is worth noting at this point that the difference in the baseline operation between New England and New Jersey is the catenary system. The
former territory possesses modern constant tension catenary system erected in 1997; in New Jersey the catenary is original circa 1935 Pennsylvania Railroad.

As such, specific changes to the railway configuration and operations are proposed as follows:

New York Division: In New Jersey, high speed trains will receive an increase in MAS from 135 to 160 MPH between MP 31 (approximate) and MP 54 (approximate). This will apply on tracks 2&3 and will be for designated equipment (currently Acela) only.

New England Division: Acela equipment currently operate at 150 MPH over selected segments. This is proposed to be raised to 160 MPH.

**Approach to Establishing the System Safety Case**

The phased production of safety cases, in step with an evolving design, is essential to managing the potential risk associated with system certification. The identification, assessment, and resolution of potential hazards have been, and remain, the prime means of assuring the highest practical level of safety in any system. The approach now widely used for the transportation industry follows the DEPARTMENT OF DEFENSE STANDARD PRACTICE FOR SYSTEM SAFETY MIL-STD-882D methodology, published by US Department of Defense in 2000. The process that the Amtrak program team will use for the segments of the Northeast Corridor on which intended operating speeds will reach 160 MPH will follow these guidelines, but with effort concentrated on system differences from existing operational segments.

The safety case is the document, or set of documents, presenting the argument that a system is acceptably safe to operate in a given context. For safety-critical and related systems, an acceptable safety case must typically be presented to the appropriate regulatory authority, in this case the FRA prior to the system being allowed to enter service. Due largely to the fact that system certification is seen as a final ‘hurdle’, historically the production of the safety case has often been left until towards the end of the project – following system development, analysis and testing. However, the risk with such an approach is that when producing the safety argument a ‘shortfall’ is discovered, due to the design and/or the analysis, that then demands potentially large amounts of rework. Another drawback is that by leaving safety case production until ‘all is said and done’ on system development it can be difficult to recall and capture the safety rationale that underlies safety-related design and analysis decisions. The ‘why?’ behind how safety features are implemented and the assumptions that were made in analysis can be lost. To avoid these problems Amtrak has implemented a phased development of the safety case for 160 MPH operations, in step with the evolving design of the program elements, to occur with regard to the program’s system improvements. This is consistent with good engineering
design practice, in which a preliminary hazard analysis (PHA) is required as part of the design development/preliminary design process.

Ideally there should be a continuous and progressive development of the Safety Case from one phase of development to the next. As such, Amtrak intends to prepare three (3) formal Safety Case Documents as part of the system certification:

- Preliminary Safety Plan – after definition and review of the system requirements and constraints
- Interim Safety Case – after initial system design as well as preliminary testing and validation activities. This will also serve as the genesis of the Safety Management Plan (SMP) which will guide the implementation phase of the project.
- Operational Safety Case – just prior to revenue service, including complete evidence of having satisfied the systems requirements.

Figure 1 outlines the intended direction of the development of the safety cases.

Fig. 1- Safety Document Roadmap
The start of the safety analysis process, the identification and analysis of hazards, calls for a rational application of engineering principles, operational rules and practices, past experience, and expert judgment on the part of those performing the tasks. Experienced personnel performing hazard identification and analysis may sometimes differ on the assessment of the probability or severity of a particular hazard, but usually to a minor degree. Given this, the results of the process for one system segment would be largely applicable to another system segment designed and constructed to the same criteria. No two systems are identical, however, and it is necessary to verify the similarities, and apply the full hazard identification, analysis, and resolution process to the differences. The preliminary hazard analysis process has been executed via a multi-disciplinary team at Amtrak. The hazard assessment teams are comprised of labor representatives with craft expertise along side management personnel and are supplemented by support contractors and consultants.

A Holistic Approach to Hazard Analysis

The basis of development is operational experiences (Amtrak and other roads) formal research (including that conducted by Volpe) and general industry information. In addition fundamental engineering analysis is utilized as in the case of any system safety review to identify and address hazards. Increasing maximum authorized operating speeds (MAS) on the NEC in accordance with the NJ HSR CONOPS raises a number of operational and engineering issues which require analysis. Evaluation of these issues is necessary in order to fully identify the engineering design requirements as well as to evaluate their potential impact on the global system safety posture and risk profile of the NEC. As such, Amtrak is using a deductive or “top-down” methodology to identify and evaluate hazards from the operations envisioned by the CONOPS. Likelihood, or frequency of occurrence, plays an important role in hazard analysis and mitigation. Considerations of the likelihood of occurrence of each phenomenon are estimated from the NJ HSR CONOPS and prior operational experiences. Figure 2 outlines the conceptual relationship between the CONOPS and Hazard Identification within this program.
Amtrak recognizes that changes made to system elements do not have isolated impacts within the operation of the railroad. Therefore, Amtrak will conduct analysis of the potential impact to the system’s global risk profile in relation to the system interfaces and in overall conjunction with the proposed improvements. The engineering hazards are addressed in separate technical memoranda as required, and are reviewed in the safety case. As we used here HSR refers to the operation of existing Acela train sets at speeds of up to 160 mph on the designated track segments.

It must also be emphasized that the stair-step is being implemented in a railroad which complies with a large body of FRA regulation; these safety regulations govern operating practices as well as specific engineering systems eg. Track, signal, rolling stock). A number of these existing regulations are in place to govern 160 MPH operations. Although the original grant suggested that speeds ranging from 160 MPH to 186 be targeted, the baseline objective was set with the FRA’s concurrence at 160 MPH, largely due to the existence of regulations, for example class 8 track standards, as well as preliminary engineering analysis wake effect proportionate to $V^2$ and previous test operations of Acela at speeds...
up to 170 MPH. The Preliminary Safety Plan provides additional information on the setting of the specific performance objectives of the program.

A summary review of the engineering hazards which require consideration under this proposed speed increase include:

1. Vehicle Track Interaction (VTI) – This issue is related to the protection against high speed derailment. It is evaluated through an FRA reviewed testing and analysis program in accordance with 49 CFR part 213 Subpart G.

2. Positive Train Control (PTC) – The purpose of Amtrak’s PTC system is to ensure train separation as well as to assure conformance with permanent and temporary speed restrictions. The operation of Amtrak’s PTC at 160 mph will be validated through a testing program.

3. Safe Braking / Signal Block Layout – Verified through testing and confirmation of appropriate block layout design and installation. Refer to Block Layout Design for NJ HSRIP. This design will receive a Professional Engineer Stamp; there will be design validation as well as verification that the field installation is in accordance with the sealed designs as well as Amtrak Standards and FRA regulations for signal systems (CFR). In addition, the block layout on designated 160 mph segments of the New England Division will be verified for safe braking at 160 mph. This “change in risk” from existing operation will be completely “designed out”.

4. Pantograph / OCS Interaction – This is primarily a reliability and life cycle issue which will be ‘designed out’ through the installation of an “engineered design” for new overhead catenary. New catenary will be constant tension and its design will accommodate all effects of the increase in speed, including any increase in uplift forces.

5. Ground Waves – The propagation of the ground waves for train speeds of up to 160 mph will not cause resonance nor will it result in soil liquefaction for sandy / silty soils of the type which make up the sub-grade and in-situ ground conditions in New Jersey (or in the designated 160 mph segments in New England). The hazards associated with a train “catching” its own ground waves do not exist under the scope to be accomplished under NJ HSR. The rate of propagation of ground waves vis a vis train speed may require analysis for train speeds approaching 186 mph, or for speeds of 160 mph or greater where roadbed (sub grade and/or in situ ground) is composed of organics and/or clay-based soils, e.g. in Maryland.

6. Energy Consumption – Energy Consumption provides a measure of the disturbance in air caused by the passage of a train as an indirect estimate. For a given shape (and associated coefficient of drag), energy consumption (power requirements) increase as the cube of speed. As a result, the NJ HSR Program includes significant improvements in the energy conversion and distribution capability along this section of NEC. Although the increased energy demand does not create new hazards or
increase the severity or likelihood of existing hazards, reliability and other service quality issues (including the goal of more frequent HSR service) dictate these improvements.

7. Hazards induced by Aerodynamic Effects – The aerodynamic forces associated with movement of a train generally increase as the square of train speed and are also strongly influenced by the shape of the train.

8. Hazards associated with ongoing correction of existing system conditions including:
   a. Concrete tie failures
   b. Gauge plate failures
   c. Culvert & drainage conditions
   d. Trees/vegetation
   e. System access and barriers

CONCLUSION

It is recognized that the NEC has been safely operating HSR at speeds of up to 150 mph for over a decade and that millions of train miles have been operated without incident. The variety of service requirements ranging from high speed rail to commuter and long distance services were outlined relative to establishing system infrastructure demands.

This paper presents a theoretical framework for evaluation and analysis of capacity, reliability and system safety associated with increasing MAS on selected portions of the NEC to 160 MPH. The value of a balanced concept of operations for guidance in design of system improvements while maintaining desired service levels cannot be underemphasized. System capacity must be optimized relative to service objectives with consideration given to the global impact to baseline operations in terms of reliability and system safety.
High Speed Rail in New Jersey
Speakers

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One Railroad of Great Capability and Even Greater Service Demand

Conrail
- Local Freight

NJ TRANSIT
- Zone operations

Amtrak
- High-speed
- Regional
- Intercity/Long distance

A Range of Improvements

Speed
Capacity
Reliability
Modifications to the configuration and the operational plan

Scope of Work

Hamilton Substation
Adams Substation

Well Coordinated Scopes - One Program in Two Parts

Task 1 - High-Speed Rail Improvements Newark, NJ, to Trenton, NJ
Upgrades or replacement of catenary, power, track, and signal systems on the NEC between New Brunswick, NJ and Trenton, NJ

Task 2 - New York Penn Station West Interlocking Improvements
Interlocking improvements at the western throat of the New York Penn Station terminal

OBJECTIVES of this Program:

- Enhance Safety.
- Raise speed to 160 mph.
- Improve capacity.
- Achieve a measurable improvement in across-the-board reliability for all services and all users of the NEC.
Elements of the Program (Continued)

For increased capacity:
- New signal system on tracks #1 and #4 is specifically designed to NJ Transit new service plan. New high speed crossovers will be added for Trenton express service. Additional Traction Power Substations and a new Frequency Converter.

For improved reliability:
- Rebuild of Midway Interlocking (it is an old original!!) as well as reliability. Contributions for all of the above items.

Elements of the Program (Continued)

Establishes the baseline methodology for upgrades to sections of the NEC and establishes the basis of design for parallel upgrades of the system as part of the next step - the operation of Tier III equipment on the NEC.

BMT

- Speed v. Capacity

Partnership with NJ Transit
NJ HSRIP: Progress Report

- Track work and Signal installation underway
- New Constant Tension Catenary design; advance contract for supply of poles is out for bid
- Hamilton TPSS in construction
- Adams TPSS in design
- New Frequency Converter at Metuchen is in design and a turnkey D/B contract will be advertised next year.
- New high speed (80 mph) turnouts

NJ HSRIP Progress

Hamilton Substation

- Construction Contractor NTP: 1/29/13
- Excavation Completed
- Foundation Caissons Installed
- Ground Grid Installation Completed

NJ HSRIP Progress

Hamilton Substation

- Track 4 Spread 3 Feet For New High Speed Switch In South Brunswick, NJ
**NJ HSRIP Progress**

**Track - Straight Rail For Interlockings**

- Over 500 Feet New Track Panels Built For Interlockings

**Signal System**

- Temporary Track 4 Reverse Signaling For Construction Will Be Completed August, 2013
- Designs Released To Production At Amtrak’s Lancaster Signal Shop
- 50% Of Cross Track Conduits For Signal Cable Installed
- 25% Of New Insulated Joints Installed

**Signal System**

- Wiring of Signal House At Amtrak’s Lancaster Shop
- Delivery Of Signal House At Amtrak’s Lancaster Shop

**Prototype Interlocking Lighting**

- New Safety Lighting At Ham Interlocking

Unlike other domestic HSR projects, the NEC is **NOT** a new start system!
Program Progression

In order to accomplish the goals of the program more than design and construction work is required.

Amtrak is working collaboratively with the FRA Office of Safety and the Volpe Center to progress the program; establishing the benchmark for system safety management of high speed rail systems in the US.

The Benefits of Age

- Established Baseline Conditions
  - “known to be safe” daily operations
- Existing state of compliance
- Mature Protocols
- Wealth of operating and safety data

The Challenges of Maturity

- Legacy Systems and Equipment
- Maintenance, retrofits and existing demands for access
- Institutional knowledge
- Analysis and documentation

The Program’s System Safety Approach

- A system safety approach is used in conjunction with minimum safety standards to increase safety in this program.

- A system safety approach can bridge gaps in disciplinary knowledge and practice, completing the whole.

- A system safety approach will also enable analysis of the integration effects of system elements.

Phased Production of Safety Cases

The existing document which governs:
- Amtrak Safety Programs
- FRA regulations (49 CFR part 200-299)
- FRA waivers
- Existing operating practices
- Training and certification
- Maintenance Programs
- OSHA compliance programs
- Confined Space
- Hearing protection
- Etc.

Guides the installation and testing of the system.
- Operational HSR Safety Case

Develops Rule Modifications and/or waivers includes operating hazard analysis and addresses potential next “steps” of the program.
- Safety Management Plan

Based on conceptual engineering, FRA’s previous applicable R&D, Design development and operating goals while maintaining consistency with the Amtrak Corporate SSP. Sample content includes:
- Type of signalization
- Volpe Research on Vehicle Track Interaction & Aerodynamics,
- Testing requirements and criteria,
- PHA

Revisions and adjustments as required.

Operational HSR Safety Case

Guides the installation and testing of the system.
- Sample content includes:
  - Safety and Operational Review of interim railway conditions pursuant to program phasing
  - Work methods
  - Contractor Coordination & Safety Requirements

Operational HSR Safety Case

Revisions and adjustments as required.
Operational Hazards

- RWP - requires improvement in order to afford protection (hot spots)
- Locomotive Engineer Orientation
- Trespasser intervention
- Safe Movement of Track Car and or Work Equipment
- Freight derailment, adjacent track causes obstruction on High Speed Track
- Freight obstruction (non-derailment) on adjacent track contacts passing passenger train
- Train Evacuation/Emergency Response
- Potential safety impact on commuter trains
- Headlight pattern

Engineered System Hazards

- Ground Waves
- Loss of ballast and sub-grade section
- Intrusion from highway and other non-railroad sources.
- Intrusion of rail car; non-derailment cause.
- Broken rail caused derailment.
- Derailment account geometric defect.
- Derailment resulting from track buckle.
- Derailment account unacceptable VTI (exceedance of delineated limits for vehicle / track interaction)
- Unacceptable clear distance between tracks due to track shift
- Adequacy of bridge ratings
- Train to train collision due to overtaking or due to routing error.

Research Review

Prior Volpe Research has been reviewed for applicability.

Extrapolation of prior simulations is underway with Volpe support.

Instrumented testing will validate modeling and simulations.

Acela VTI Testing

135 mph to 160 mph:
- 1. Northeast Maryland/Delaware (Bacon [MP 51.0] - Ragan [MP 29.7])
- 2. Trenton-New Brunswick, NJ (Ham [MP 55.7] - County [MP 32.8])

150 mph to 160 mph:
- 3. Rhode Island (MP 151.3 - MP 180.5)
- 4. Mansfield (MP190.5) - Transfer (MP 218.3)

Testing in all four zones will involve incrementally raising the speed of operation through the test zone on the current Class 8 track segments.