Amtrak Passenger Train 501 Derailment
DuPont, Washington
December 18, 2017
Michael Hiller
Investigation Team

- Bella Dinh-Zarr – Board Member-on-Scene
- Ted Turpin – IIC
- Mike Hiller – Asst. IIC
- Dennis Hogenson – Launch Support
- Ryan Frigo – Operations & System Safety
- Dr. Steve Jenner – Human Performance
- Joey Rhine – Mechanical
- Richard Hipskind – Track
- Tim DePaepe – Signals
- Sheryl Harley – Survival Factors
- Mike Hiller – Crashworthiness
- Charles Cates – Recorders
Staff

- Dave Bucher
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- Paul Suffern
- Eldridge Harding
- Gena Evans
- Joe Scott
- Joe Gordon
- Chris Wallace
- Stephanie Matonek
- Carl Perkins
- Pummy Bawa
- Terry Williams
- Ben Allen
 Parties to the Investigation

- Amtrak
- Sound Transit
- Washington State Department of Transportation
- Washington Utilities and Transportation Commission
- Federal Railroad Administration
- Talgo, Inc.
- Siemens Industry, Inc.
- Brotherhood of Locomotive Engineers and Trainmen
- International Association of Sheet Metal, Air, Rail and Transportation Workers
Safety Issues

- Preparation for inaugural service
- Amtrak safety on a host railroad
- Training and qualifying operating crews
- Crashworthiness of the Talgo equipment
- Survival factors
- Multi-agency emergency response
Operations and Human Performance Investigation

Stephen M. Jenner, Ph.D.
Focus of Operations and Human Performance Investigation

- Crew Performance
  - Failed to slow for curve at MP 19.8
- Training / Preparation
  - First trip in revenue service and unsupervised
Operating Crew

- Engineer
  - 4 years certified engineer
  - New territory
- Qualifying Conductor
  - 5 years certified conductor
  - Not qualified on territory / first trip
- Exclusions
- Inward-facing video
Safety Issue: Qualifying on New Territory

• Engineer did not observe critical signs
• Training
  • Observation rides
    • All taken at night
  • Throttle time
    • 3 total trips (2 north, 1 south)
Safety Issue: New Equipment Familiarization

- Engineer not completely familiar with locomotive features
- Training
  - Classroom
  - Qualification trips
  - Not exposed to overspeed alarm
Control Screens and Overspeed Alarm
Safety Issue: Systematic Training

- Formalize approach to training
  - Identify and address all challenges
    - New equipment, territory, limited combined experience
  - Devise strategic plan
Safety Issue: Maximize Crew Resources

- Trip had new challenges for both crewmembers
- Need for active participation even from inexperienced crewmembers
- Apply Crew Resource Management (CRM) principles:
  - Help identify signs; recognize clues that safety may be compromised; intervene if necessary
Safety Issue: Enhanced Signage

Advance Warning Sign – 2 miles from curve
Enhanced Signage

• Greater advantage to freight trains than passenger trains
• Supplemental signs / plaques
• Safety recommendation proposed
System Safety

Ryan J. Frigo
Overview

- Washington State Department of Transportation (WSDOT)
- Sound Transit
- Amtrak
- Federal Railroad Administration (FRA)
Operations Planning

• Sounder Commuter Rail Timetable
  • Timetable #1 (2015)
    • Crew focus zone at MP 3.4
  • Timetable #2 (2017)
    • Crew focus zone at MP 19.8 not included
Operations Planning

• Amtrak
  • Speed limit action plan
    • Crew focus zone
    • Did not include Lakewood subdivision
Sound Transit Project Safety Management Process

- Safety and Security Management Plan (SSMP)
  - Hazard management process for safety risk
    - Identify
    - Mitigate
    - Resolve
Preliminary Hazard Analysis

• Derailment in curves

• Proposed mitigations (2015):
  • Ensure curves and speed limitations meet federal regulations
  • Develop inspection and maintenance procedures to meet federal regulations
  • Implement positive train control (PTC) [future]
Integrated Testing

- Prerevenue operations testing incomplete
  - Simulated operations at track speeds
  - Conducted under various operating conditions
- Operating hazard analysis incomplete
  - Validated the effectiveness of mitigations
Safety Certification Verification Report

• Certifiable items list (CIL)
  • Mitigations developed through hazard management
  • Final verification tool
  • Timetable as a procedural control
Safety Certification Verification Report

- No operating hazard analysis
- No prerevenue operations testing
- Hazard of overspeed derailment in curves erroneously classified as “completed accepted”
WSDOT Project Oversight

• Review of safety and security verification report
  • Limited role in safety oversight
  • Lack of formalized process to validate Sound Transit’s safety certification activities
Federal Railroad Administration Oversight

- Grant oversight
  - SSMP required

- Safety oversight
  - No regulatory authority to approve or require changes to an SSMP
  - 34 field and compliance inspections
  - Missed opportunity
Amtrak Responsibility

- Operations on host railroads
  - Traditional acceptance of risk
- Risk assessments on host railroads
  - Proactive management of risk
Amtrak Safety Management

- System safety program plan
- Safety management system
  - National implementation
  - Beyond current minimum standards
Federal Railroad Administration System Safety Plan

• Failure of FRA to issue final rule
  • Six extensions since 2016
  • Continued postponement has led to delayed safety improvements
Summary

- Inconsistent permanent speed reduction location mitigations
- Coordination of prerevenue activities
- Initiation of operations prior to the completion of PTC
- Use of out-of-date operating documents
- Acceptance of high risk
- Continued delay to Part 270
Crashworthiness of Talgo Series VI Passenger Trainset

Michael Hiller
Overview

- Overview of the derailment kinematics
- Discussion of severely damaged cars and released rolling assemblies
- Talgo Series VI / crashworthiness design
- US passenger equipment safety requirements
- Grandfathering the Talgo Series VI
- Performance
- Safety issues
Damage Description-AMTK 7424 (8)
Damage Description-AMTK 7504 (7)
Rolling Assembly Detachment
Talgo Series VI

- Talgo, Inc. (Talgo Series VI)
- Introduced in the US for service in WA, 1998
- Introduced into service before CFR Part 238, Passenger Equipment Safety Standards
- Semi-permanently coupled to adjacent cars
- One rolling assembly between each car except the baggage car
Talgo Series VI

- Wheels mounted in a frame (rolling assembly)
- Towers include air suspension at top
- Rolling assembly attached to one end of the car
- Adjacent car is attached with weight bearing bars
- Guidance bars are primary attachment to the car body
Talgo Series VI Crashworthiness Design

• Designed to UIC-566, January 1990
• Static end strength 450,000 lbs.
• No structural strength requirement for anti-collision pillars at the car ends
• No collision or corner post on individual passenger cars
US Crashworthiness Passenger Safety Requirements 1999

- Static end strength - 800,000 lbs.
- Full height collision posts
- Full height corner posts
- Anti-climbing mechanism
- Truck to carbody retention strength
- Car to car coupler strength
US Crashworthiness Passenger Safety Requirements 1999

• FRA concerned with European passenger equipment structural standards
• Codifying assured high level of safety
Title 49 CFR 238.203(d) Grandfathering

- Permitted non-compliant equipment for passenger service
- Petition required (summarized)
  - Drawings
  - Specifications
  - Engineering analysis
FRA’s Grandfathering Approval

- Amtrak petitioned the FRA for approval
- Preliminary approval in September 2000
- Selected conditions required:
  - Install safety cables between cars
  - Install safety cables on rolling assembly tower assemblies
FRA’s Grandfathering Approval

- In the public interest and consistent with railroad safety
- Ensure adequate compatibility among units in the general railway system
- Concerned with performance in high energy event
  - Articulated connections were expected to fail
  - Unsupported car bodies fall to track with unknown result
  - Greater lateral displacement than conventional equipment
Performance of the Talgo Series VI

- Failure of the articulated connection in a high energy event
- Complex and uncontrolled behavior and secondary collisions with surrounding terrain with severe results
- Rolling assemblies prone to separation after the articulated coupler fails
Safety Issues

• Talgo Series VI trainset does not provide adequate protections to passengers in a high energy event
• Talgo Series VI trainset lacks structural protections proven to preserve survivable space
• Grandfathering is not in the public interest or consistent with railroad safety
Survival Factors

Sheryl Harley
Overview

• Train occupancy and injury
• Occupant protection-compartmentalization
• Seat rotation and seat latching mechanism
• Emergency lighting/HPPL signage
• Highway user injuries and causation
• Emergency response-communications
Train Occupants

- Total number of occupants: crew and passengers **83**
- Injuries
  - Fatal **3**
  - Serious **32**
  - Minor **10**
  - Not injured **31**
  - Injury Severity Unknown **7**
- Ejections
  - Full **7**
  - Partial **3**
Occupant Protection
Compartmentalization and Seat Securement
Compartmentalization and Seat Securement

[Image of a compartmentalized seating area with a red arrow pointing to a specific feature]
Emergency Lighting and Signage
Highway Users

- Vehicles involved 8
  - 2 Truck tractor in combination with semi-trailers
  - 6 passenger cars
- Occupants in vehicles 10
- Injuries
  - Serious 2
  - Minor 2
  - Not Injured 4
  - Injury Severity Unknown 2
Emergency Response

• Fire/Rescue-EMS Agencies
  • Joint Base Lewis McChord
  • Pierce County Fire Department
  • Thurston County Fire Department
  • EMS - Madigan Army Hospital, American Medical Response and Faulk Ambulance Services

• Law Enforcement Agencies
  • Pierce County Sheriff’s Department
  • Lakewood City Police Department
  • DuPont Police Department
  • Washington State Patrol
  • Steilacoom Police Department
  • Puyallup Police Department

• Emergency Management Agencies
  • Pierce County Emergency Management Agency
  • Pierce County Incident Management Team
Emergency Response Operations

• Agency Communications Center and Operating Frequency
  • JBLM- DoD radio frequency 450 MHz
  • Fire/Rescue and Law Enforcement 800 MHz
  • Pierce County Emergency Management Agency 700 MHz

• Incident Communications
  • Radio frequency incompatibility and lack of interoperability
  • Required face to face and runners to deliver communications
  • Effected timely and efficient communications between agencies
Summary

• Effectiveness of compartmentalization for occupant protection

• Securement of train seats designed to rotate

• Development of procedures for the safe transportation of children in car seats

• Adequacy of emergency lighting

• Improvement to interoperability of communications between DoD and civilian agencies
Figure 6. Risk Assessment Matrix

HAZARD RISK INDICES

<table>
<thead>
<tr>
<th>Frequency of Occurrence</th>
<th>Hazard Category</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
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<tr>
<td></td>
<td>4</td>
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<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td>1A, 2A, 3A, 4A, 5A</td>
<td>Catastrophic</td>
</tr>
<tr>
<td>1B, 2B, 3B, 4B, 5B</td>
<td>Critical</td>
</tr>
<tr>
<td>1C, 2C, 3C, 4C, 5C</td>
<td>Major</td>
</tr>
<tr>
<td>1D, 2D, 3D, 4D, 5D</td>
<td>Marginal</td>
</tr>
<tr>
<td>1E, 2E, 3E, 4E, 5E</td>
<td>Insignificant</td>
</tr>
</tbody>
</table>

Each hazard category in the Risk Assessment Matrix in Table 5 requires a specific level of action. Table 5 represents the decision authority for each category.

Table 5: Hazard Decision Matrix

<table>
<thead>
<tr>
<th>Hazard Risk Index</th>
<th>Risk Decision Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A, 1B, 1G, 2A, 2B, 3A</td>
<td>Unacceptable (Un)</td>
</tr>
<tr>
<td>1D, 2D, 3B, 3C, 4A, 4B, 5A</td>
<td>Undesirable (Ud)</td>
</tr>
<tr>
<td>1E, 2E, 3D, 3E, 4C, 4D, 5B, 5C</td>
<td>ELTR/SOAP concurrence required</td>
</tr>
<tr>
<td>4E, 5D, 5E</td>
<td>Acceptable with SSDCC review (Ar)</td>
</tr>
<tr>
<td></td>
<td>Acceptable without further review (Ac)</td>
</tr>
</tbody>
</table>