



***Federal Railroad Administration  
Office of Railroad Safety  
Accident and Analysis Branch***

***Accident Investigation Report  
HQ-2016-1139***

***CSX Transportation (CSX)  
Baltimore, MD  
June 13, 2016***

***Note that 49 U.S.C. §20903 provides that no part of an accident or incident report, including this one, made by the Secretary of Transportation/Federal Railroad Administration under 49 U.S.C. §20902 may be used in a civil action for damages resulting from a matter mentioned in the report.***

**SYNOPSIS**

On June 13, 2016, at approximately 4:00 a.m., EDT, CSX Transportation (CSX) mixed freight Train Q37312, operating west by timetable direction, at a recorded speed of 24 mph, with 8 head-end locomotives, 18 loads and 106 empties, 6,708 tons, and 8,341 feet in length, derailed 13 cars in Baltimore City, Maryland. There were no reports of injuries, evacuations, or hazardous materials leaks. The initial derailment occurred at Milepost (MP) BAK 93.5 on CSX's Baltimore Division, Baltimore Terminal Subdivision, in Baltimore City and continued 1.17 miles west to MP BAK 94.67 at the east portal of the Howard Street Tunnel. At this point, began a chain reaction, accordion type, and general pile up of 13 cars, track and related components from the east portal and inside the tunnel.

The method of operation in this area is signal indication of a traffic control system, with freight train operation on single main track at maximum authorized speed of 25 mph.

Damages resulting from the accident for track, signal, way, and structure were estimated to be \$108,237 and equipment damages about \$1,065,295. Total Federal Railroad Administration (FRA) reportable costs were \$1,173,532. At the time of the derailment, the weather conditions were clear and it was approximately 61 °F, in early morning darkness. This accident was not PTC-preventable. This is not a passenger train route.

FRA's hazardous materials investigation identified train document and accident response information non-compliances. These instances of non-compliance were not contributing factors in the cause of derailment.

FRA's investigation determined the probable cause was a combination of track geometry involving the alignment and cross level in the 8-plus degree curve on the heavy downgrade of the track resulting in wheel climb over the high rail. FRA's Factual Railroad Accident Report will list the cause code T199 – Other Track Geometry defects.

**TRAIN SUMMARY**

1. Name of Railroad Operating Train #1 CSX Transportation	1a. Alphabetic Code CSX	1b. Railroad Accident/Incident No. 000160487
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**GENERAL INFORMATION**

1. Name of Railroad or Other Entity Responsible for Track Maintenance CSX Transportation	1a. Alphabetic Code CSX	1b. Railroad Accident/Incident No. 000160487
2. U.S. DOT Grade Crossing Identification Number	3. Date of Accident/Incident 6/13/2016	4. Time of Accident/Incident 4:00 AM
5. Type of Accident/Incident Derailment		
6. Cars Carrying HAZMAT 71	7. HAZMAT Cars Damaged/Derailed 13	8. Cars Releasing HAZMAT 0
	9. People Evacuated 0	10. Subdivision Baltimore Terminal
11. Nearest City/Town Baltimore	12. Milepost (to nearest tenth) BAK93.5	13. State Abbr. MD
		14. County BALTIMORE
15. Temperature (F) 61 °F	16. Visibility Dark	17. Weather Clear
		18. Type of Track Main
19. Track Name/Number Single	20. FRA Track Class Freight Trains-25, Passenger Trains-30	21. Annual Track Density (gross tons in millions) 37.9
		22. Time Table Direction West

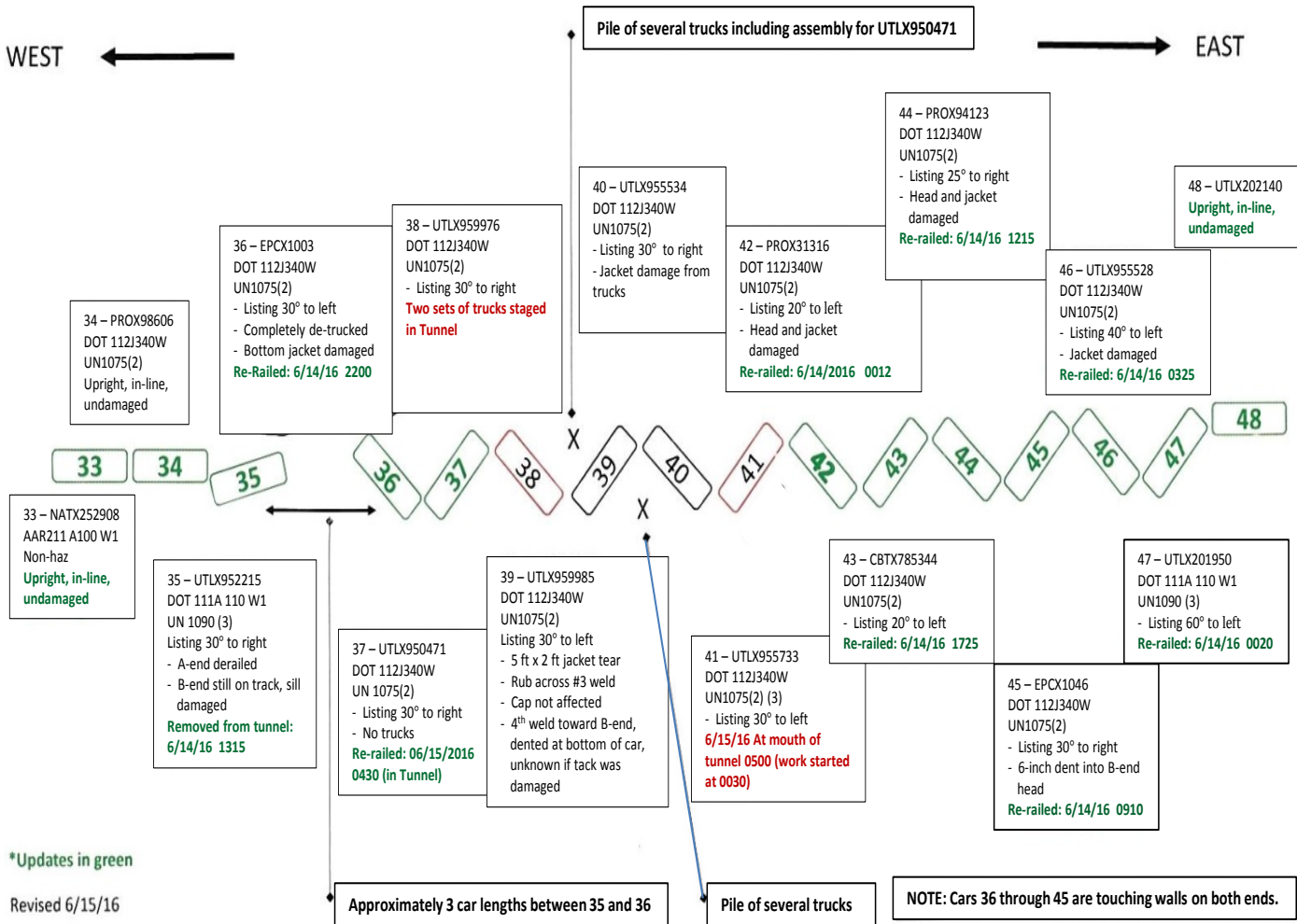
**OPERATING TRAIN #1**

1. Type of Equipment Consist: Freight Train					2. Was Equipment Attended? Yes		3. Train Number/Symbol Q37312				
4. Speed (recorded speed, if available) R - Recorded 24 MPH E - Estimated		Code R	5. Trailing Tons (gross excluding power units) 6708		6a. Remotely Controlled Locomotive? 0 = Not a remotely controlled operation 1 = Remote control portable transmitter 2 = Remote control tower operation 3 = Remote control portable transmitter - more than one remote control transmitter					Code 0	
6. Type of Territory Signalization: <u>Signaled</u> Method of Operation/Authority for Movement: <u>Signal Indication</u> Supplemental/Adjunct Codes: <u>D</u>											
7. Principal Car/Unit		a. Initial and Number		b. Position in Train		c. Loaded (yes/no)		8. If railroad employee(s) tested for drug/alcohol use, enter the number that were positive in the appropriate box		Alcohol	Drugs
(1) First Involved (derailed, struck, etc.)		EPCX 1003		36		no					
(2) Causing (if mechanical, cause reported)								9. Was this consist transporting passengers?			No
10. Locomotive Units (Exclude EMU, DMU, and Cab Car Locomotives.)	a. Head End	Mid Train		Rear End		11. Cars (Include EMU, DMU, and Cab Car Locomotives.)	Loaded		Empty		e. Caboose
		b. Manual	c. Remote	d. Manual	e. Remote		a. Freight	b. Pass.	c. Freight	d. Pass.	
(1) Total in Train	8	0	0	0	0	(1) Total in Equipment Consist	18	0	106	0	0
(2) Total Derailed	0	0	0	0	0	(2) Total Derailed	1	0	12	0	0
12. Equipment Damage This Consist 1065295			13. Track, Signal, Way & Structure Damage 108237								
14. Primary Cause Code T199 - Other track geometry defects (Provide detailed description in narrative)											
15. Contributing Cause Code N/A - N/A											
Number of Crew Members						Length of Time on Duty					
16. Engineers/Operators		17. Firemen		18. Conductors		19. Brakemen		20. Engineer/Operator		21. Conductor	
1		0		1		0		Hrs: 1 Mins: 17		Hrs: 1 Mins: 17	
Casualties to:		22. Railroad Employees		23. Train Passengers		24. Others		25. EOT Device?		26. Was EOT Device Properly Armed?	
Fatal		0		0		0		Yes		Yes	
Nonfatal		0		0		0		27. Caboose Occupied by Crew?			N/A
28. Latitude 39.319079000				29. Longitude -76.619505000							

**SKETCHES**

**Diagram CSX Howard Street Tunnel Derailment Reconstructed**

**Westbound CSX Train Q37312 - June 13, 2016**  
**Howard Street Tunnel Derailment**  
(Directions noted per CSX Timetable)



In the effort to provide a better quality image this diagram has been partially reconstructed from the field marked-up document provided by CSX.

## NARRATIVE

**Circumstances Prior to the Accident**

CSX Transportation (CSX) westbound Train Q37312 originated in Philadelphia, Pennsylvania, and included an en route set-out and pick-up of equipment in Wilmington, Delaware. At the time of the derailment, the train consisted of 8 head-end locomotives, 18 loads and 106 empties, with various commodities including hazardous materials. The total axle count was 538 axles.

The method of operation in the area of the derailment is signal indication of a traffic control system. CSX timetable direction was east/west and general geographical direction was north/south respectively. CSX timetable direction will be referenced throughout this report.

There was a crew change at CSX Bayview in Baltimore, Maryland. The crew operating the train at the time of the derailment consisted of an engineer and a conductor and both went on-duty on June 13, 2016, at 2:45 a.m., in Baltimore. Both received their statutory rest period before reporting to duty. The train's destination was Cumberland, Maryland.

The train passed the last defect detector at Waverly in Baltimore, at 3:55 a.m., Milepost (MP) BAK 92.0, approximately 1.5 miles prior to the initial point of derailment (POD). No defects were detected.

The train traveled west from CSX Bayview towards the initial POD at MP BAK 93.5 on CSX's Baltimore Division, Baltimore Terminal Subdivision, in Baltimore. The train operated towards the Howard Street Tunnel from CSX Bayview on double Main Track No. 1 and Single Main Track where there are a succession of tangents and curves. At MP BAK 91.7, Main Tracks 1 and 2 converge into a single track at control point (CP) Clifton Park. The descending grade approaching the initial POD was -0.67 percent to -0.70 percent.

The Dispatcher's event log shows the train occupied the westbound approach circuit to CP Huntingdon Avenue at 3:53:26 a.m. The log then shows that the train occupied the track circuit inside CP Huntingdon Avenue and that 4 Signal at CP Huntingdon Avenue indicated stop at 3:58:10 a.m. The ElectroLogIXS download shows the train entered the interlocking with No. 1 Switch lined normal and a clear signal aspect.

With the Conductor in the cab and Engineer positioned at the control stand of the lead locomotive, the train traveled at a recorded speed of 24 mph and had been in idle for 30 seconds when the Engineer gradually increased his dynamic braking for 49 seconds as the car in the thirty-sixth position reached the initial POD at MP BAK 93.5.

The Dispatcher's event log also shows that No. 1 switch at CP Huntingdon Avenue stopped indicating normal and went out of correspondence at 4:00:07 a.m.

**The Accident**

As the thirty-sixth car from the head-end locomotives of the train reached MP BAK 93.5, the car experienced a lift of its right, number one-wheel derailing the leading wheels of the car. Event recorder and investigative information show the derailed car traveled in the train approximately 1 mile under routine train handling procedures with no indication of unusual occurrence. The train successfully negotiated tangent and curved track and a railroad overpass until the point where the car contacted the switch frog at MP BAK 94.67, at the east portal of the Howard Street Tunnel.

As a result of the derailed car contacting the switch frog, a chain reaction derailment began causing an accordion type, general pile up of 13 cars, track, and related components. Car positions 35 through 47 from the head-end locomotives derailed and came to rest inside the tunnel. An undesired emergency brake application was recorded at approximately 4:02 a.m.

The head-end of the train had traveled approximately 484 feet before stopping from the undesired brake application.

The train's Engineer shut down the locomotives from the operating cab multiple unit to prevent excessive accumulation of diesel exhaust in the tunnel.

The train's Conductor gathered an air hose and a wrench from the locomotive and began to inspect the train for cause of the undesired emergency brake application. He walked from the head-end, through the tunnel inspecting the train until he reached the location of the thirty-sixth car from the head-end. At this point, the Conductor observed that Car 35 was derailed and missing one truck. He found a separation between Car 35 and Car 36 and the remaining visible cars were derailed in the tunnel.

At approximately 4:22 a.m., a CSX dispatcher attempted communications with the crew concerning its status. The attempts were hampered due to damaged communication equipment in the tunnel caused by the derailment.

At 4:51 a.m., there was a radio communication between a CSX trainmaster in the tunnel and the train's Engineer discussing the actions of the crew up to that point.

At approximately 5:10 a.m., following radio communications between both members of the train crew, the Engineer had restarted the locomotives and the Conductor had uncoupled the eight locomotives from the first car from the head-end. Communications with the Dispatcher and a CSX trainmaster for procedures to depart were in place and the Engineer began movement out from the tunnel continuing in a westward direction.

Baltimore City Fire Department (BCFD), Baltimore City Police Department (BCPD), CSX representatives and contractors, Federal Bureau of Investigation (FBI), Federal Railroad Administration (FRA), Maryland Department of Labor, Licensing and Regulation - Railroad Safety and Health (State inspectors), Maryland Transit Police, and utility representatives were among the responders to the derailment. Also responding were security personnel from the Maryland Institute College of Art, whose property abuts the rail line in the area of the derailment.

Initial information provided by CSX indicated there was no report of injury, evacuation, or hazardous materials leak. Cars from the train in positions 35 through 47 from the head-end derailed. The cars had derailed at and inside the Howard Street Tunnel after entering from the east tunnel portal. Thirteen tank cars were derailed with the forty-seventh car identified as a hazardous material load containing Acetone, Flammable Liquid UN 1090. The acetone car was leaning and visible outside the east portal.

Emergency responder and law enforcement protocols to identify, secure, and verify safety and security on the scene were underway and would continue for several hours after FRA arrival.

At approximately 7:45 a.m., BCFD and CSX representatives approached FRA concerning uncoupling and pull-back of the non-derailed cars east of the tunnel portal to allow for more effective response and to aid investigative work. FRA took no exception to moving the non-derailed cars.

An FRA hazardous materials inspector was notified by the Battalion Chief of the BCFD that fire department emergency hazardous responders had encountered placarded hazardous material cars

derailed in the tunnel that were not identified as hazardous on CSX train documents initially provided to BCFD.

At 9:10 a.m., FRA formally requested train documents from CSX managers on-scene. The FBI field representative released the scene for accident investigation at approximately 10:30 a.m.

At 11:05 a.m., FRA, CSX and State inspector mechanical representatives inspected the trailing cars of the train located east of the Howard Street Tunnel. A car wheel bearing adapter was identified approximately 1 ½ car-lengths west of the milepost marker for MP BAK 94. The bearing adapter was near the north rail, gage side, approximately ½-mile after the initial POD.

At approximately 4:45 p.m., temporary access was granted to an inspection team to enter from the east portal of the tunnel. The team included FRA inspectors from the Track and Motive Power and Equipment disciplines overseen by the Deputy Regional Administrator and representatives from CSX and State inspectors working in conjunction with Baltimore City emergency responders.

Additional information gathered from CSX and emergency responders was reviewed prior to entering the tunnel. This information noted 12 of the 13 derailed tank cars were reported derailed in an accordion manner, end-to-end, wall-to-wall in the tunnel. The derailed cars were reported listing sideways at 20- to 60-degree angles, with truck components scattered, as well as piled up at several points in the tunnel.

Tunnel lighting and radio communications in the area were reported disrupted by the derailment. Radio relay persons stationed near and inside the east tunnel portal entrance were placed in the effort to provide portable radio communication continuity.

FRA began its investigation by walking into the tunnel from the east portal heading west. Progress through the tunnel was arduous and provided extremely limited accessibility. Entry to the tunnel allowed an initial, brief and partial view of the forty-seventh through forty-first cars from the head-end, before the inspection team was recalled from the tunnel at approximately 5:15 p.m.

Investigation efforts outside of the tunnel identified the initial POD and confirmed the thirty-sixth freight car from the head-end as the primary car in the derailment. ECPX 1003, a DOT112J340W tank car, was the initial car to derail at MP BAK 93.5.

At 5:54 p.m., CSX formally provided FRA copies of the original and updated train documents for Train Q37312 that FRA's Hazardous Materials inspector had requested earlier.

At approximately 11:30 p.m., on June 13, 2016, CSX hi-rail vehicle access from the west-end of the tunnel provided FRA, CSX and state inspectors an opportunity to observe Cars 34, 35, and 36 from the head-end of the train. FRA observed heavy damage to ECPX 1003 and access to inspect the car was very limited.

With equipment removal taking place from both ends of the tunnel, it would be nearly 2 days from the time of the derailment before the equipment was cleared from the tunnel. After necessary repairs to the railroad infrastructure, CSX re-opened the Howard Street Tunnel for train operations on June 17, 2016, at 7:55 p.m. The investigation continued to ascertain a probable cause.

### **Analysis and Conclusions**

Analysis - Toxicology Testing: Post-accident toxicology testing was not conducted on the train crew.

CSX, based on good faith initial estimates of total damages, predicted the amount to be under \$1 million on the day of the derailment.

Conclusion: Engineering costs were less than expected at \$108,237; however, damages to freight car



equipment exceeded CSX original predictions of \$650,000, actuals were \$1,065,295. FRA total reportable costs were \$1,173,532. The differences can be attributed to the inability to fully view the extensive damages to equipment and track in the tunnel.

Analysis – Fatigue: FRA uses an overall effectiveness rate of 77.5 percent as the baseline for fatigue analysis. At or above this baseline, FRA does not consider fatigue as probable for any employee.

Software sleep settings vary according to information obtained from each employee. FRA used the sleep information provided by the train crew.

FRA obtained fatigue-related information, including a 10-day work history, for both the Engineer and the Conductor assigned to this train.

Conclusion: Based on a review of fatigue-related information, FRA concluded fatigue was probable for the Conductor or Engineer but was not a contributing factor to the derailment.

Analysis - Locomotive Engineer Train Operating Performance: The locomotive was equipped with a speed indicator and event recorder as required by Federal regulations. The relevant event recorder data was downloaded by CSX officials and analyzed by FRA and CSX representatives.

Conclusion: The Engineer complied with all applicable FRA regulations, railroad operating, and train handling rules and requirements. FRA concluded train handling was not a contributing factor to the derailment.

Analysis - Signal and Train Control: The ElectroLogIXS download shows the train entered the interlocking with No. 1 Switch lined normal and a clear signal aspect. The Dispatcher's event log also shows that No. 1 switch at CP Huntingdon Avenue stopped indicating normal and went out of correspondence at 4:00:07 a.m. The POD was approximately 100 feet east of the switch and the derailed cars dragged across the switch knocking the switch out of correspondence.

Conclusion: This event indicates that the initial derailment occurred at approximately 4:00 a.m.

Analysis – Signal and Train Control: On June 13, 2016, at approximately 9:30 a.m., an FRA inspector met with CSX's Manager of Signals to perform a signal inspection to determine if the signal system was working properly at the time of the derailment. The locations inspected included CP Huntingdon Avenue and CP Clifton Park. All signal aspects for the route that was lined at the time of the derailment were tested. Additionally, ElectroLogIXS application software was verified, all signal equipment was visually inspected and ground and shunt tests were performed.

An FRA inspector requested and obtained a package from CSX management which included signal test records and data recorder downloads from the two locations listed above; a data recorder download from the Waverly Defect Detector (the last defect detector passed prior to the derailment); CSX's Dispatcher's event log; and the last 12 months of trouble tickets from the two locations.

The download log from the Waverly Defect Detector showed no warnings or alarms for Train Q37312.

The Dispatcher's event log shows the train occupied the westbound approach circuit to CP Huntingdon Avenue at 3:53:26 a.m. The log then shows that the train occupied the track circuit inside CP Huntingdon Avenue and that 4 Signal at CP Huntingdon Avenue indicated stop at 3:58:10 a.m.

Conclusion: No signal equipment was damaged during this derailment. The signal equipment was found to be working as intended with only minor exceptions taken for track leads that had excessive slack and were not protected from damage. No exceptions were taken for the test records reviewed. FRA found the signal system to be in compliance with Federal regulations and did not contribute to the accident.

Analysis - Hazardous Materials (Shipper Pre-Transportation Assessment): Shipping documents and Bills-of-Lading (BOL) provided by the shipper were reviewed.

Conclusion: FRA concluded that the shipper properly classified the material, selected the proper package, and prepared the shipments for rail transportation. The shipper functions were compliant with Federal regulations and were not a contributing factor to the derailment.

Analysis - Hazardous Materials (Train Documents Review): During the investigation, CSX provided FRA with documents including the original train documents that were issued to the crew. CSX provided updated train documents that were created after the derailment. Findings are as follows:

- PROX 98606's origin: New Hope, Pennsylvania; destination: Lansing, Michigan, with Bill of Lading entered in CSX system May 12, 2016, at 12:34 p.m., located 34 cars from locomotives in the train. The original train documents describe the car as – empty non-hazardous. Bill of Lading in updated train documents describes the car as one tank residue: last contained UN1075 petroleum gases, liquefied 2.1. The car was not derailed.
- UTLX 952215's origin: New Hope; destination: Baltimore/Sparrows Point, Maryland, with Bill of Lading entered in CSX system May 12, 2016, at 12:38 p.m. was located 35 cars from locomotives in the train. The original train documents describe cars as – empty non-hazardous. Bill of Lading in updated train documents describes the car as one tank residue, last contained UN1075 petroleum gases, liquefied 2.1. The car was derailed, leaning 30 degrees to right, A-end derailed, B-end still on track, sill damaged.
- UTLX 950471's origin: New Hope; destination: Natrium, West Virginia, with Bill of Lading entered in CSX system May 17, 2016, at 5:58 p.m. was located 37 cars from locomotives in the train. The original train documents describe cars as – empty non-hazardous. Bill of Lading updated train documents describes the car as one tank residue, last contained UN1075 petroleum gases, liquefied 2.1. The car was derailed, leaning 30 degrees to right, with no trucks under car.
- PROX 31316's origin: New Hope; destination: Baltimore/Sparrows Point, with Bill of Lading entered in CSX system May 12, 2016, at 12:36 p.m. was located 42 cars from locomotives in the train. The original train documents describe the car as – empty non-hazardous. Bill of Lading updated train documents describes the car as – one tank residue, last contained UN1075 petroleum gases, liquefied 2.1. The car was derailed, leaning 20 degrees to the left, head and jacket damaged.
- CBTX 785344's origin: New Hope; destination: Lansing, with Bill of Lading entered in CSX system May 12, 2016, at 12:34 p.m. was located 43 cars from locomotives in the train. The original train documents describe the car as – empty non-hazardous. Bill of Lading updated train documents describes the car as – one tank residue, last contained UN1075 petroleum gases, liquefied 2.1. The car was derailed, leaning 20 degrees to left.
- PROX 94123's origin: New Hope; destination: Hanna, Ohio, with Bill of Lading entered in CSX system May 12, 2016, at 12:37 p.m., was located 44 cars from locomotives in Train Q37312. The original train documents describe the car as – empty non-hazardous. Bill of Lading updated train documents describes the car as – one tank residue, last contained UN1075 petroleum gases, liquefied 2.1. The car was derailed, leaning 25 degrees to right, head and jacket damaged.

Conclusions: On June 13, 2016, CSX placed six tank cars containing a hazardous material into transportation in Train Q37312 in Wilmington without hazardous materials shipping descriptions,

including emergency response information, in violation of Title 49 Code of Federal Regulations (CFR) Section 174.26(b). In addition, by placing the six tank cars containing a hazardous material into transportation without providing the train crew with a document identifying the current positions of the hazardous materials shipments in the train, CSX was in violation of Title 49 CFR § 172.26(a).

Analysis: Train documents for Q37312 were requested from CSX on June 13, 2016, at 9:10 a.m. CSX provided the copies of the original and updated train consists to FRA at 5:54 p.m.

Conclusion: On June 13, 2016, CSX failed to provide timely Emergency Response Information for the 71 cars containing hazardous materials in the train to a FRA Railroad Safety Inspector immediately upon request; the requested documents were not provided for over 8 hours, in violation of Title 49 CFR § 172.600(c)(2).

One civil penalty request was recommended regarding CSX violation of Title 49 CFR § 172.600(c)(2), which requires emergency response information, including the emergency response telephone number, required by this subpart is immediately available to any person who, as a representative of a Federal, State, or local government agency, responds to an incident involving a hazardous material, or is conducting an investigation which involves a hazardous material. FRA's hazardous material investigation identified non-compliant train document and emergency response information for which eight civil penalties were recommended. The non-compliances were not contributing factors in the derailment.

Analysis – Mechanical (Locomotives): CSX Train Q37312 consisted of eight head-end locomotives with no distributed power in the train at the time of the derailment. Inspection and records review found the following locomotive information.

The lead locomotive, CSXT 5460, operated on-line as a 4,000 horsepower (hp), six-axle, two-truck design, General Electric model ES40DC. It was built in 2007 and was equipped with CCB2 type air brake equipment, and the last 33-day mechanical inspection was June 10, 2016, in Philadelphia. The last calendar day inspection was June 12, 2016, in Philadelphia. Form FRA 6180-49A indicates the previous periodic inspection was performed on January 28, 2016, at Cumberland.

The second locomotive, CSXT 5265, operated on-line as a 4,400 hp, six-axle, two-truck design, General Electric model ES40DC. It was built in 2005 and was equipped with CCB2 type air brake equipment, and the last 33-day mechanical inspection was June 10, 2016, in Philadelphia. The last calendar day inspection was June 12, 2016, in Philadelphia. Form FRA 6180-49A indicates the previous periodic inspection was performed on May 6, 2016, in Selkirk, New York.

The third locomotive, CSXT 2552, operated on-line as a 2,000 hp, four-axle, two-truck design, General Motors Electro-Motive Division (EMD) model GP38-2. It was built in 1973 and was equipped with 26CN type brake equipment. The last calendar day inspection was June 12, 2016, in Philadelphia. Form FRA 6180-49A indicates the previous periodic inspection was performed on April 2, 2016, in Cumberland.

The fourth locomotive, CSXT 5372, operated off-line as a 4,000 hp, six-axle, two-truck design, General Electric model ES40DC. It was built in 2006 and was equipped with CCB2 type air brake equipment, and the last 33-day mechanical inspection was June 11, 2016, in Philadelphia. The last calendar day inspection was June 12, 2016, in Philadelphia. Form FRA 6180-49A indicates the previous periodic inspection was performed on December 17, 2015, in Russell, Kentucky.

The fifth locomotive, CSXT 5253, operated on-line as a 4,000 hp, six-axle, two-truck design, General

Electric model ES40DC. It was built in 2005 and was equipped with CCB2 type air brake equipment, and the last 33-day mechanical inspection was June 11, 2016, in Philadelphia. The last calendar day inspection was June 12, 2016, in Philadelphia. Form FRA F6180-49A indicates the previous periodic inspection was performed on March 2, 2016, in Russell.

The sixth locomotive, CSXT 6414, operated off-line as a 3,000 hp, four-axle, two-truck design, General Motors EMD model GP40-2. It was built in 1978 and was equipped with 26L type air brake equipment.

The last calendar day inspection was June 12, 2016, in Philadelphia. Form FRA F6180-49A indicated the previous periodic inspection was performed on March 14, 2016, in Cumberland.

The seventh locomotive, CSXT 2312, operated off-line as a four-axle, two-truck design, General Motors EMD model Road Slug. It was built in 1963 and was equipped with 26L air brake equipment. The last calendar day inspection was June 12, 2016, in Philadelphia. The previous periodic inspection was performed on March 14, 2016, in Cumberland.

The eighth locomotive, CSXT 8707, operated off-line as a 3,800 hp, four-axle, two-truck design, General Motors EMD model SD60. It was built in 1989 and was equipped with 26L air brake equipment. The last calendar day inspection was June 12, 2016, in Philadelphia. The previous periodic inspection was performed on March 31, 2016, in Waycross, Georgia.

Conclusion: No exceptions were noted to locomotive conditions. FRA concluded the mechanical condition and operating status of the locomotives were not contributing factors in the derailment.

Analysis: FRA's review of locomotive event recorder data identified an undesired emergency brake application occurred on Train Q37312 at 4:02 a.m.

Conclusion: The undesired brake application was attributed to the derailing cars and was not a contributing factor in the accident.

Analysis – Mechanical (Pre-Accident Railroad Inspection of Cars): Records reviewed included inspection testing and maintenance records. The last records prior to the derailment indicated the equipment had received inspection and Class I brake tests that were performed by qualified mechanical inspectors at CSX yards in South Philadelphia, Pennsylvania, and Wilmington. The train traveled west and passed the last defect detector at Waverly in Baltimore, at 3:55 a.m., MP BAK 92.0, approximately 1.5 miles prior to the initial POD.

Conclusion: A comprehensive review of the available documentation and records was conducted. This review found no indications of defective equipment in CSX Train Q37312 prior to the derailment. No defects were detected on the train consist as it operated past the last defect detector prior to derailment.

FRA concluded the railroad pre-accident inspection and testing of the cars were not contributing factors in the derailment.

Analysis - Mechanical (Post Accident Inspection): Wheel bearing adapter identified at MP BAK 94 near the north rail, gage side located approximately ½-mile after the initial POD.

Conclusion: The investigation concluded that the bearing adapter was attributed to the thirty-sixth and initial car to derail, EPCX1003. It was determined the bearing adapter was likely forced out of place from continued impact after the derailment and was not identified as a contributing factor to the cause of the initial derailment.

Analysis – Mechanical (Post Accident Inspection): FRA conducted inspections of all equipment independently and in conjunction with CSX mechanical department personnel and the State of Maryland

inspector as parties to the investigation. Initial inspections and re-inspections were conducted on several days and over several weeks. The process included inspections extending outside to the east and west and inside of the Howard Street Tunnel, at temporary equipment spotting locations outside of the tunnel and at surrounding CSX yards in Baltimore where equipment was held for detailed inspection.

On July 5, 2016, FRA arranged a close-out inspection, final review, and discussion with representatives from CSX and the State of Maryland concerning mechanical contributing factors. CSX had reconstructed cars of interest for review, utilizing best available information and components gathered from the tunnel derailment where possible. The review was conducted on-scene at CSX's New Yard in Baltimore of the cars and related components held for investigation at this yard. Inspection included the initial car derailed, ECPX 1003, the thirty-sixth car from the head-end, and equipment components identified as being from the ECPX 1003.

Conclusion: Upon completing all inspections and reviewing the available documentation, no probable cause or contributing factor related to the equipment could be determined in the derailment.

Analysis – CSX Track Inspections and Track Data Reports: CSX performed a twice-weekly track inspection on Sunday, June 12, 2016, across the track segment where the accident occurred. There were no exceptions noted on CSX's track inspection report. A check of CSX's track inspection records dated between May and June 2016 revealed that the Main Track in the accident location had been inspected in accordance with the Federal Track Safety Standards. A check for CSX Track Disturbance Report, dated May and June 2016, revealed the carrier performed no track disturbance work within the specified milepost location of the accident. An FRA Automatic Track Inspection Program (ATIP) survey using the DOT-218 Geometry car, dated October 10, 2013, and an ATIP survey using Geometry Car DOT-220, dated March 17, 2015, identified no geometry deviations or defects within the specified milepost of the POD. A CSX Critical Exception Report generated from CSX's GRMS 2 geometry car dated May 5, 2016, identified no geometry deviations reported within the specified milepost location where the derailment occurred.

Conclusion: Based on the required track inspections that were conducted and periodic geometry tests that were performed concerning the track structure, CSX maintained the track in accordance with Title 49 CFR Part 213 and Federal Track Safety Standards.

Analysis – FRA Track Inspection: Approaching the accident site from the east, FRA conducted a walking track inspection from MP BAK 93.0 to MP BAK 94.0. Track speed in this location is 25 mph, FRA Class 2. The subdivision consists of the Single Main Track, and a turnout at Huntingdon Avenue.

In this location, the track structure consists of 136-pound continuous welded rail (CWR). The crossties were installed in the track in 2015, which were determined to be structurally sound and in good condition. Track gage measurements taken throughout these locations measured between 56 ½ inches to 57 inches. Cross level on the Single Main Track measured between 0 inches to ¼ inches on tangent and +- 3/8 to ½ inches on curves. The turnout components at Huntingdon Avenue were found to be tight, intact, and properly maintained.

Within the area of the derailment, the track structure consisted of wood crossties laid at 24-inch centers, 136-pound CWR, using a resilient fastening system. During the inspection, the crossties and rail fastening system throughout these locations were found to be structurally sound and in good condition.

CSX timetable speed at this location is 25 mph, FRA Class 2. The descending grade approaching the

POD is -0.67 percent to -0.70 percent. The last recorded FRA main line track inspection conducted in the accident location prior to the derailment was January 19, 2016, from MP BAK 89.60 to BAK 96.50. During that inspection, there were seven exceptions noted.

On June 13, 2016, FRA, along with CSX Baltimore Division and System track managers and the State of Maryland track safety inspector, jointly inspected the track 15 stations east of POD and 4 stations west of the POD at MP BAK 93.5.

Conclusion: All FRA track measurements taken during the post-accident investigation indicate the track structure was maintained in accordance with Title 49 CFR Part 213.

### **Overall Conclusion**

With the exception of the hazardous materials documents in the train consist, the railroad was otherwise in full compliance with CSX and all applicable Federal standards. The train crew members were the only witnesses to the accident. They could not give information that could be used to determine any type of failures other than the abrupt undesired application of the train brake while the train was moving through the east end of the Howard Street Tunnel.

Although there were no conditions that exceeded FRA's defect threshold, the inspection/investigation team believed that the combination of the track geometry (alignment and cross level) in the 8-plus degree curve on the heavy down grade were the primary causes of the derailment.

The 14-foot, 10-inch "long mark" caused by a wheel flange that climbed over the high rail points to a track geometry or mechanical condition. After a careful inspection of the primary car, the results of which excluded mechanical defects as contributing to the derailment, existing track conditions were the only fact-based information to consider when evaluating this evidence.

The team found no defects or conditions that pointed to human factor, signal, hazardous materials, or mechanical issues that were identified as contributing factors to the derailment.

### **Probable Cause**

After a comprehensive review of all evidence and available information, FRA's investigation of CSX Train Q37312 derailment determined that the probable cause was a combination of track geometry involving the alignment and cross level in the 8-plus degree curve on the heavy downgrade of the track resulting in wheel climb over the high rail. FRA's Factual Railroad Accident Report will list the cause code T199 – Other Track Geometry defects.