Federal Railroad Administration
Office of Railroad Safety
Accident and Analysis Branch

Accident Investigation Report
HQ-2014-4

CSX Transportation (CSX)
Lynchburg, VA
April 30, 2014

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.

U.S. Department of Transportation
Federal Railroad Administration

FRA FACTUAL RAILROAD ACCIDENT REPORT

FRA File #HQ-2014-4

TRAIN SUMMARY

1. Name of Railroad Operating Train #1	1a. Alphabetic Code	1b. Railroad Accident/Incident No.
CSX Transportation	CSX	000129247

GENERAL INFORMATION

1. Name of Railroad or Other Entity Responsible for Track Maintenance	1a. Alphabetic Code	1b. Railroad Accident/Incident No.
CSX Transportation	CSX	000129247
2. U.S. DOT Grade Crossing Identification Number	3. Date of Accident/Incident	4. Time of Accident/Incident
	4/30/2014	1:54 PM

5. Type of Accident/Incident
Derailment

6. Cars Carrying HAZMAT	7. HAZMAT Cars Damaged/Derailed	8. Cars Releasing HAZMAT	9. People Evacuated	10. Subdivision
104	17	1	400	Huntington East

11. Nearest City/Town	12. Milepost *(to nearest tenth)*	13. State Abbr.	14. County
Lynchburg		VA	LYNCHBURG

15. Temperature (F)	16. Visibility	17. Weather	18. Type of Track
53 °F	Day	Rain	Main

19. Track Name/Number	20. FRA Track Class	21. Annual Track Density *(gross tons in millions)*	22. Time Table Direction
No. 2	Freight Trains-25, Passenger Trains-30	50	East

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OPERATING TRAIN #1

1. Type of Equipment Consist:	2. Was Equipment Attended?	3. Train Number/Symbol
Freight Train	Yes	K08227

4. Speed (recorded speed, if available) R - Recorded E - Estimated	Code	5. Trailing Tons (gross exluding power units)	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
24 MPH	R	14107		0

6. Type of Territory

Signalization:

Signaled

Method of Operation/Authority for Movement:

Signal Indication

Supplemental/Adjunct Codes:

Q, D

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.)*	CTCX 742045	35	yes		0	0
(2) Causing *(if mechanical, cause reported)*	0	0	no	9. Was this consist transporting passengers?		No

10. Locomotive Units (Exclude EMU, DMU, and Cab Car Locomotives.)	a. Head End	Mid Train b. Manual	Mid Train c. Remote	Rear End d. Manual	Rear End e. Remote	11. Cars (Include EMU, DMU, and Cab Car Locomotives.)	Loaded a. Freight	Loaded b. Pass.	Empty c. Freight	Empty d. Pass.	e. Caboose
(1) Total in Train	2	0	0	0	0	(1) Total in Equipment Consist	105	0	0	0	0
(2) Total Derailed	0	0	0	0	0	(2) Total Derailed	17	0	0	0	0

12. Equipment Damage This Consist	13. Track, Signal, Way & Structure Damage
1047491	176500

14. Primary Cause Code

T207 - Broken Rail - Detail fracture from shelling or head check

15. Contributing Cause Code

T222 - Worn rail

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: 4 Mins: 42	Hrs: 4 Mins: 42

Casualties to:	22. Railroad Employees	23. Train Passengers	24. Others
Fatal	0	0	0
Nonfatal	0	0	2

25. EOT Device?	26. Was EOT Device Properly Armed?	27. Caboose Occupied by Crew?
Yes	Yes	N/A

28. Latitude	29. Longitude
37.411381000	-79.136133000

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CROSSING INFORMATION

Highway User Involved		Rail Equipment Involved
1. Type N/A		5. Equipment N/A
2. Vehicle Speed *(est. mph at impact)* 0	3. Direction *(geographical)* N/A	6. Position of Car Unit in Train 0
4. Position of Involved Highway User N/A		7. Circumstance N/A
8a. Was the highway user and/or rail equipment involved in the impact transporting hazardous materials? N/A		8b. Was there a hazardous materials release by N/A
8c. State here the name and quantity of the hazardous material released, if any.		

9. Type of Crossing Warning	10. Signaled Crossing Warning	11. Roadway Conditions
1. Gates 4. Wig wags 7. Crossbucks 10. Flagged by crew 2. Cantilever FLS 5. Hwy. traffic signals 8. Stop signs 11. Other *(spec. in narr.)* 3. Standard FLS 6. Audible 9. Watchman 12. None N/A		N/A

12. Location of Warning	13. Crossing Warning Interconnected with Highway Signals	14. Crossing Illuminated by Street Lights or Special Lights
N/A	N/A	N/A

15. Highway User's Age	16. Highway User's Gender	17. Highway User Went Behind or in Front of Train and Struck or was Struck by Second Train	18. Highway User
0	N/A	N/A	N/A

19. Driver Passed Standing Highway Vehicle	20. View of Track Obscured by *(primary obstruction)*
N/A	N/A

Casualties to:	Killed	Injured	21. Driver was	22. Was Driver in the Vehicle?
			N/A	N/A
23. Highway-Rail Crossing Users	0	0	24. Highway Vehicle Property Damage *(est. dollar damage)* 0	25. Total Number of Vehicle Occupants *(including driver)* 0

26. Locomotive Auxiliary Lights?	27. Locomotive Auxiliary Lights Operational?
N/A	N/A
28. Locomotive Headlight Illuminated?	29. Locomotive Audible Warning Sounded?
N/A	N/A

10. Signaled Crossing Warning

1 - Provided minimum 20-second warning
2 - Alleged warning time greater than 60 seconds
3 - Alleged warning time less than 20 seconds
4 - Alleged no warning
5 - Confirmed warning time greater than 60 seconds
6 - Confirmed warning time less than 20 seconds
7 - Confirmed no warning
N/A - N/A

Explanation Code

A - Insulated rail vehicle
B - Storm/lightning damage
C - Vandalism
D - No power/batteries dead
E - Devices down for repair
F - Devices out of service
G - Warning time greater than 60 seconds attributed to accident-involved train stopping short of the crossing, but within track circuit limits, while warning devices remain continuously active with no other in-motion train present
H - Warning time greater than 60 seconds attributed to track circuit failure (e.g., insulated rail joint or rail bonding failure, track or ballast fouled)
J - Warning time greater than 60 seconds attributed to other train/equipment within track circuit limits
K - Warning time less than 20 seconds attributed to signals timing out before train's arrival at the crossing/island circuit
L - Warning time less than 20 seconds attributed to train operating counter to track circuit design direction
M - Warning time less than 20 seconds attributed to train speed in excess of track circuit's design speed
N - Warning time less than 20 seconds attributed to signal system's failure to detect train approach
O - Warning time less than 20 seconds attributed to violation of special train operating instructions
P - No warning attributed to signal systems failure to detect the train
R - Other cause(s). Explain in Narrative Description

SYNOPSIS

On April 30, 2014, at 1:54 p.m., EST, CSX Transportation (CSX) unit crude oil train, K08227, traveling eastbound from Clifton Forge, Virginia, to Yorktown, Virginia derailed on the James River Subdivision. The derailment occurred on Number 2 track at Milepost (MP) CAB 146.45. The train was traveling at a recorded speed of 24 miles per hour. CSX Train K08227 was a unit crude oil train consisting of 2 locomotives, 1 loaded buffer car, and 104 loaded tank cars with a total length of 6,426 feet, and having 14,107 trailing tons.

MP CAB 146.45 is located on the CSX Huntington Division and within the city limits of Lynchburg, Virginia. In the subject location there are two main tracks. The annual volume of rail traffic is approximately 50 million gross tons (MGT). Train movements on the James River Subdivision are governed by operating rules, timetable instructions and the signal indications of a traffic control system.

A total of 17 cars derailed; Cars 35 through 51 in the train consist. Three of the derailed tank cars ended up partially submerged in the James River. Of the three tank cars in the river, one was breached, caught fire, and released contents into the river. The derailment resulted in a local evacuation of approximately 6 city blocks effecting about 400 residents and 20 businesses in the derailment area. This is not an Amtrak passenger route.

The double main tracks were destroyed in the derailment. The following damage costs were reported by CSX investigating personnel: 1) equipment $1,047,491; 2) track $176,500. Total damages reported $1,223,991.

Due to the crude oil lading, rerailing efforts required a substantial amount of time. Both Number 1 and Number 2 main tracks were restored to service on Saturday, May 3, 2014, at 9:30 p.m.

The weather at the time of derailment was 53 degrees Fahrenheit with cloudy skies and light rain.

The probable cause of the derailment was rail failure under the moving train listed as FRA cause code T207, “broken rail - detail fracture from shelling or head crack.” A contributing cause of the derailment was the worn rail condition and resulting lip on the high rail caused by the abrasive action and cold working of the rail metal from the accumulated passing traffic. This secondary contributing cause will be listed in the FRA investigative report as FRA cause code T222, “worn rail.”

NARRATIVE

Circumstances Prior to the Accident

Train K08227 originated in Minot, North Dakota, and was traveling east to Yorktown, Virginia. The operating CSX train crew went on duty at 9:15 a.m., on Wednesday, April 30, 2014, in Clifton Forge, Virginia. The final destination for this train was Yorktown. CSX Train K08227 was a unit train and consisted of two locomotives, one loaded hopper car (buffer car), and 104 tank cars loaded with petroleum crude oil. Both locomotive units were located at the front of the train and arranged for multiple-unit operation. The lead locomotive, BNSF 7485, was configured to be the controlling unit. The crew consisted of a conductor and an engineer, and each had the required statutory rest period before reporting to duty.

After collecting necessary paperwork, the train crew was transported to the train at CSX's Clifton Forge fuel pad. The Clifton Forge fuel pad is located at Milepost (MP) CA 277.8 on CSX's Alleghany Subdivision. The crew departed Clifton Forge at 09:59 a.m. The train traveled on the Alleghany Subdivision to Control Point (CP) JD Cabin, MP CA 276.0. At JD Cabin they entered the James River Subdivision at MP CAB 229.4; they traveled 83 miles on the James River Subdivision prior to the derailment. In route from Clifton Forge, Train K08227 was met by two trains. Both train meets were "rolling meets," as the K08227 did not stop and only slowed down. The first meet was at CP Waugh MP CAB 165.0. The next meet was at CP Pearch MP CAB 160.2.

Approaching the accident area, Train K08227 received a clear signal at CP Southern Crossing MP CAB 147.4. While on the James River Subdivision, the train passed over seven mechanical defect detectors. The crew stated that each defect detector reported a proper axle count and no defects were reported on the train.

As the train entered the downtown area of Lynchburg, Virginia, the Engineer was using dynamic brake, with the dynamic lever in the Number 1 notch, the automatic and independent brakes released, and traveling at 24 miles per hour (mph). The train experienced an undesired emergency brake application at MP 145.9 and the train speed decreased, dropping to 23 mph, and slowing to 0 mph. The head-end of the train came to a stop 463 feet east (direction of travel) at MP 145.8.

CSX track profile and alignment, from the perspective of eastward movement of the subject train (opposite of track chart data), was as follows. Beginning at MP 147.05 to MP 146.6 the train was on level grade. From MP 146.6 to MP 146.5, a 0.85 percent ascending grade exists. From MP 146.5, a descending grade of 0.31 percent (averaged) to MP 146.0 exists. In terms of track alignment, beginning at MP 146.8, the train entered a 2.9-degree left hand curve with one inch of super-elevation. Upon exiting that curve, the train traversed a short tangent and entered a 5.67-degree right hand curve, then a 5.23-degree left hand curve. At MP 146.56 the train entered a 6.51-degree left hand curve, then the accident curve, a 7.24 -degree right hand curve with 0.82 inches of super-elevation. The locomotives of the accident train came to a stop at MP 145.8, east of CP Washington Street.

The method of operation on the James River Subdivision is by signal indications of a Traffic Control System. In the accident location, the trackage is double main track and the authorized freight train speed is 25 mph. The Engineer was at the controls of the locomotive when they departed at approximately 10:00 a.m. eastward (train movement direction). Timetable direction for the train was east, train movement direction will be used throughout this report.

The Accident

As the train approached the vicinity of the accident (MP CAB 146.45) on Number 2 main track, the locomotive event recorder indicates that the train was operating in Number 1 dynamic brake with the automatic and independent brakes in the released position. As the train approached CP Washington Street at MP 146.1, the train experienced an undesired emergency brake application. The recorded speed of Train K08227 in the moments leading up to the derailment was 24 mph (maximum authorized speed of 25 mph). After the initiation of the undesired emergency application of the train-line (automatic) brakes, the Engineer then made an emergency radio announcement on CSX's road channel (008-008). The train dispatcher came on the radio, and the Engineer informed the dispatcher of the emergency brake application and that the train was on fire. The two-member train crew departed the locomotive concerned with their safety and walked to the nearest highway-rail grade crossing. At this grade crossing, a CSX signal maintainer who heard the emergency radio transmission, transported them to CSX's Yard Office approximately 0.5 miles away.

During the derailment, three loaded tank cars in line positions 43 (GATX 286291), 44 (CBTX 741712), and 46 (CBTX 741672) departed the tracks and traveled down the river embankment. These cars ended partially submerged (no more than 1/3 of the car) in the James River. The tank car in position 45 (CBTX 741720) came to rest on the river bank. Tank car CBTX 741712 was breached at the shell, released product, and caught fire. The tank cars in Train K08227's consist were all loaded with, UN 1267, Crude Oil, Class 3, PG 1.

Following the emergency radio transmission initiated by the operating train crew, CSX's train dispatcher notified CSX Public Safety Command Center (PSCC). The PSCC then contacted Lynchburg emergency services. The train crew was later contacted by a Lynchburg animal control warden to secure the train consist information and relay it to the Lynchburg Fire Department. As a result of the derailment, a total of 17 cars derailed, Cars 35 through 51 in the train consist. Three of the derailed tank cars ended up partially submerged in the James River. Of the three tank cars in the river, one was breached, caught fire, and released contents into the river. All 17 cars derailed were general service specification DOT-111 tank cars that contained petroleum crude oil from the Bakken region of North Dakota. As a result of the derailment, the Lynchburg Fire Department ordered a local evacuation of approximately 6 city blocks effecting about 400 residents and 20 businesses in the derailment area.

According to the First Responders' Incident Commander, at approximately 1:57 p.m. on April 30, 2014, the fire department was dispatched to the accident scene to address a vehicle fire. While first responders were in route, additional information was obtained that identified the incident as a train derailment. An incident command post was quickly established near 9th Street and Jefferson Street. The Hazardous Materials Captain was given command of operations. Based on the tank car placard information, fire personnel determined that they were dealing with a petroleum crude oil incident. There was a very large fire along the embankment of the James River, in front of the Depot Grille Restaurant.

The fire department did not receive a copy of the train consist for approximately 2 hours. The Incident Commander did not send anyone to meet the train crew to obtain a copy of the train consist. A review of the City of Lynchburg Computer Aided Dispatch (CAD) report indicates that the call from CSX's PSCC occurred at 2:20 p.m. The City of Lynchburg is an incorporated jurisdiction that borders three counties. Due to the location of the accident, several initial 911 calls were received by the Campbell County Communications Center due to cell phone tower locations. Campbell County also provided the National Transportation Safety Board with 911 calls received after the train derailment and fire and police radio communications during the emergency response. One of the 911 calls received by the City of Lynchburg Communications Center was from CSX's PSCC. The caller reported that the derailed train was carrying petroleum crude oil. He requested a fax number to send the train's consist. The operator provided him with a fax number. A review of the City of Lynchburg CAD report indicates that the call from CSX's PSCC occurred at 2:20 p.m. It took approximately 45 minutes to an hour for a CSX Trainmaster to arrive at the Incident Command Post. When the Incident Commander requested the train consist, the trainmaster contacted the crew to provide a copy.

The fire department determined that they would let the fire burn, while cooling the tank cars near the fire. Approximately 2 hours into the incident, the fire began to subside. At approximately 5:00 p.m., the evacuation was lifted and residents were allowed to return to their homes.

No train crew members sustained injuries; however, there were two civilians that received medical attention for coughing symptoms they experienced during the local evacuation.

During the crude oil trans-loading operation, five contractor employees were exposed to crude oil when a transfer hose was separated. Residual oil was removed from the affected employees' clothing and all five were cleared to return to work with no injuries.

Responding to the accident scene were the following groups:

First Responders:
- City of Lynchburg Fire
- City of Lynchburg Police
- City of Danville Regional Hazmat
- Roanoke Fire Regional Hazmat
- Salem Fire Regional Hazmat

Re-railing Operations:
• Crane Masters
• Donahue Brothers
• RJ Corman

Environmental:
• CSX Hazmat/Remediation/Environmental
• HEPACO
• WEL Incorporated
• Specialized Professional Services Inc.
• Arcadis
• Enviro Science
• CTEH
• Xcon3
• Test America

Government Agencies:
• Federal Railroad Administration (FRA)
• National Transportation Safety Board
• United States Environmental Protection
• Virginia State Corporation Commission
• Virginia Department of Emergency Management- Hazmat
• Virginia Department of Environmental Quality
• Transportation Security Administration

Other:
• James River Association
• Tri-State Bird Rescue
Analysis and Conclusions

Analysis – Toxicology Testing

Toxicology testing was conducted because the expected damage amount was predicted to exceed one million dollars. The crew on Train K08227 submitted to drug and alcohol testing under the requirement of 49 Code of Federal Regulations (CFR) 219, Subpart C.

Conclusion:

Test results were negative for the Engineer and the Conductor.

Analysis – Fatigue

FRA obtained fatigue-related information for the 10-day period preceding the derailment including the 10-day work history (on duty/off duty cycles for the Engineer and the Conductor).

Conclusion:

FRA concluded that fatigue of the train crew was not a contributing factor in 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's Road Foreman of Engines and analyzed by CSX officials.

Conclusion:

The Locomotive Engineer was in compliance with all applicable FRA regulations, railroad operating and train handling rules and requirements.

Analysis – Signal and Train Control

On May 1, 2014, a representative from FRA and CSX signal personnel conducted a field inspection, testing and investigation of the railroad signal system in the immediate area west of the derailment site. These tests included operational testing of CP EE Reusens (MP CAB 149.5), and CP Southern Crossing, (MP CAB 147.4). CP Southern Crossing is the last CP passed by Train K08227 prior to the derailment. The post-accident inspection found the signal cases locked and secured with no indications of tampering or vandalism to any of the signal equipment at the two CP locations. The operational testing included eastbound train movement simulation, 2-year route, timing and indication locking tests, switch operation and obstruction tests, track circuit shunt integrity tests and ground tests. The eastbound train movement simulation and 2-year locking tests were accomplished utilizing a Union Switch and Signal (US&S) MicroLok Track circuit simulator to represent the broken track circuit east of CP Southern Crossing at the derailment site. This operational testing of the signal system revealed it to be operating properly, as intended, and in accordance with Federal regulation with no exceptions taken.

On May 2, 2014, a representative from FRA and CSX signal personnel conducted a review, inspection and analysis of the required Periodic Signal System test records, US&S MicroLok Event recorder downloads, three Defect Detector (DD) downloads and the Dispatch Control Operators logs. This review, inspection and analysis revealed them to be proper with no exceptions taken. Detailed review of the three involved DD event logs in eastward movement sequence for Train K08227 revealed the following:

• SD Cabin DD – MP CAB 173.6 – No defects reported with proper direction and axle count recorded. This indicates the DD was functioning as intended.

• Big Island DD – MP CAB 163.00 – Review of this event log revealed an unintentional power on reset under the involved train. This resulted in the DD not fully recording the involved train. Research revealed this power reset was the result of a loose power connection on the P2 plug. Signal forces made repair upon discovery, May 2, 2014. Further repair to mitigate this from re-occurring in the future was effected on May 3, 2014. This repair consisted of installation of a manufacturer-supplied retainer clip.

• Reusens DD – MP CAB 150.80 – No defects reported with proper direction and axle count recorded. This indicates the DD was functioning as intended.

Conclusion:

The signal system was not determined to be a contributing factor in this derailment. The unintentional power on reset at the Big Island DD was not contributory as the previously encountered SD Cabin DD reported properly with no defects and the following EE Reusens DD reported properly with no defects. T horough inspection and testing of the signal system and inspection of pre-derailment test records revealed the signal system to be operating properly and as intended and FRA found no exceptions with the signal equipment.

Analysis – Mechanical

Train Consist/Pre-Accident Testing and Inspections

CSX Train K08227 consisted of two locomotives, one buffer car and 104 tank cars loaded with Bakken crude oil. The train weighed 14,107 tons and was 6,426 feet in length.

CSX Train K08227 consisted of two locomotives, one buffer car and 104 tank cars loaded with Bakken crude oil. The train weighed 14,107 tons and was 6,426 feet in length. The locomotives were located at the lead of the train, in relation to the direction of travel, arranged in multiple-unit operation and there was no use of distributive power at the time of the derailment.

The lead locomotive was BNSF 7485, a General Electric model ES44DC built in 2008 having a CCBII airbrake system. This locomotive is a six axle, two truck unit. It is designated as a 4400 horsepower diesel-electric locomotive. The last periodic inspection was recorded on form FRA 6180-49A (Blue Form) as being performed at Kansas City, Kansas on 12/19/2013. The previous calendar day inspection was conducted at Clifton Forge on April 30, 2014.

The trailing locomotive was BNSF 7658, a General Electric model ES44DC built in 2005 having a CCBII airbrake system. This locomotive is a six axle, two truck unit. It is designated as a 4400 horsepower diesel-electric locomotive. The last periodic inspection was recorded on form FRA 6180-49A (Blue Form) as being performed at Kansas City, Kansas on 12/02/2013. The previous calendar day inspection was conducted at Clifton Forge on April 30, 2014.

The first freight car was a covered hopper car, BNSF 808360, being used as a buffer car. Exterior stenciling also indicated that the car was designated as a Maintenance of Way car (MW) and "BUFFER SRV ONLY Do Not Load." All car locations are in the direction of movement, unless otherwise noted.

The remaining 104 cars were all DOT-111A and -111S tank cars which were loaded with Bakken crude oil in North Dakota. Train K08227 was designated by CSX, and reported to FRA, to be an Extended Haul Train. As CSX's Extended Haul information reported to FRA indicated, Train K08227 received a Class I brake test and Initial Terminal Inspection at or about the train's' origination point of Minot, and an additional 1,500-mile Class I brake test and Inspection was conducted at Columbus, Ohio. Both inspections were performed by mechanical personnel, as required by FRA, and there were no noncomplying/defective conditions observed.

Post-Accident Testing/Inspection/Observations

The initial observation of the derailment scene found 17 DOT-111A or -111S tank cars derailed. The fire had been extinguished and the Emergency Response Incident Commander allowed the site to be reviewed by State, Federal, and railroad personnel. Further review found Tank Cars 43, 44, and 46 partially submerged in the James River. Tank car 44 (CBTX 741712), had been breached and was still steaming in the water from the heat produced from being on fire.

Shortly after the accident, the locomotives and first 34 cars were moved a short distance from the derailment site to keep them clear of the fire. The operating crew involved in that movement made a Class I air brake test prior to moving the cars. No brake pipe leakage was reported and the air brakes set and released on each car.

The following day, May 1, 2014, qualified CSX mechanical inspectors inspected the locomotives and first 34 cars where they had been positioned after being moved away from the fire. Another Class I air brake test was performed and the results paralleled those of the previous day; no leakage was observed and the air brakes set and released on each car.

Car 34 (CTCX 735749) was placed in CSX's Lynchburg Yard for inspection. On May 2, 2014, the mechanical group inspected the car. Significant abrasion was observed on the left number one (L1) wheel. The abrasion was pronounced from the top of the flange to the tread. Metal had been extruded from the score marks and was curled around the edges at multiple locations. There was no corresponding mark on the right number one (R1) wheel. The number one axle was the trailing axle on the trailing truck in the direction of travel at the time of the derailment. Members of the mechanical group had inspected the car on the night of the accident; the L2 wheel had displayed a light horizontal abrasion across the tread. The car had been moved about 1-mile to CSX's Lynchburg Yard at the time the full mechanical group inspected it on May 2. Only minor evidence remained on the R2 tread at that time.

Cars 52 through 104 were pulled away from the fire shortly after the accident. CSX's operating personnel performed a Class 1 air brake test on the cars before they were moved. No brake pipe leakage was reported and the air brakes set and released. The next day, qualified CSX mechanical inspectors inspected the cars and performed another Class 1 air brake test. The results parallel those of the previous day. No brake pipe leakage was observed and the air brakes set and released.

Cars 35 (CBTX 742045) through 51 (CBTX 743221) were derailed in the accident. The mechanical group inspected the car bodies and underframe components at the accident site. The bolster side bearings, center plates, brake rigging, coupler arrangements, wheels, axles, draft gears, and yokes on all those cars failed to exhibit any damage that were not attributed to the accident. All the components that could be measured were within applicable Federal and Association of American Railroads' (AAR) standards and regulations.

Conclusion:

No Mechanical conditions were found to be a contributing factor to the derailment.

Analysis – Track Inspection Records

An audit of CSX track inspection records from January 1, 2014, to April 28, 2014, was conducted by the FRA investigative team following the accident. The track of CSX James River Subdivision is required to be inspected twice weekly with one calendar day interval between inspections. FRA took no exception to the inspection frequency. FRA's record inspection revealed that for the time period reviewed a total of nine defects were documented by railroad inspectors in the subject milepost, MP CAB 146.0 to MP CAB 147.0. These defects consisted of one bolt defect at MP CAB 146.8, one track profile defect at MP CAB 146.7, one adjustable rail brace defect at MP CAB 146.8, one missing cotter pin at MP CAB 146.8, insecure heel of switch at MP CAB 146.8, one bolt defect at MP CAB 146.3, one frog bolt defect at MP CAB 146.8, a defective frog point condition at MP CAB 146.8, and one center cracked joint bar at MP CAB 146.8. All defects were properly remediated upon discovery. FRA's review of CSX track inspection records was conducted for the entire James River Subdivision, FRA inspectors noted that CSX track inspectors were not documenting all deviations from FRA Track Safety Standards (TSS). In particular, areas of fouled ballast with geometry conditions were not being reported.

Conclusion:

All required track inspections of CSX's Huntington East Division, James River Subdivision were performed in accordance with the TSS for the designated class of track, in compliance with 49 CFR § 213.233. Proper remedial action was taken on all noted defects on CSX's track inspection reports. However, defects that were not properly reported were identified.

Analysis – Track

The James River Subdivision consists of single and double tracks, with track changes occurring at control points located at the following locations:
- JD Cabin CAB 229.4 to Iron Gate CAB 227.6 - double main
- West Haden CAB 219.8 to East Haden CAB 218.3 - passing siding
- West Eagle Rock CAB 213.5 to East Eagle Rock CAB 211.6 - passing siding
- JN Cabin CAB 200.2 to East Buchanan CAB 195.2 - double main
- West Alpine CAB 185.6 to East Alpine CAB 184.1- passing siding
- Natural Bridge CAB 178.2 to SD Cabin CAB 173.7- double main
- West Waugh CAB 165.0 to East Waugh CAB 163.3- passing siding
- West Pearch CAB 160.2 to East Pearch CAB 158.2 - passing siding
- West Reusens CAB 150.6 to East Reusens CAB 149.5 - passing siding
- Southern Crossing CAB 147.4 to Tyree CAB 143.1 - double main
- West Joshua Falls CAB 136.6 to East Joshua Falls CAB 135.1 - passing siding-
- Walkerford CAB 126.0 to Gladstone CAB 119.2 - double main

From Clifton Forge to the point of derailment (POD), MP CAB 146.45, is 82.95 miles. From the POD to the train destination, Yorktown is 184.2 miles. Clifton Forge to Yorktown is a total of 267.15 miles.

On April 30, 2014, track notes were taken from the location west of the derailment where the track was undisturbed. It was noted that after the derailment, cars started to accordion and the track was disturbed for a distance of approximately 160 feet west of the suspected POD. Measurements were taken at this undisturbed location, a total of 15 stations were marked at 15 feet, 6 inches apart. At each station lateral and vertical movement was noted and the loaded measurements were documented.

• Track Gage: The widest track gage measurement obtained was at station Number 0. The gage at this location measured 56-7/8 inches. Maximum gage for FRA Class 2 track is 57-3/4 inches, no exception was taken to track gage.

• Crosslevel: The greatest deviation in crosslevel was noted between station Number 10 and Station Number 6 leading up to the disturbed area. The maximum difference in crosslevel in 62 feet was 7/8-inch. Maximum allowable for FRA Class 2 track is 2-1/4 inches, no exception taken to crosslevel.

• Alinement: Due to the derailment, the subject area of track was disturbed. Geometry data collected from a CSX Geometry Survey conducted on April 3, 2014, was used to establish alinement. The alinement noted in the subject curve was 7.24 degrees. No exception was taken to alinement noted on April 3, 2014.

• Curve Elevation: Due to the derailment, the subject area of track was disturbed. Geometry data collected from a CSX Geometry Survey conducted on April 3, 2014 was used to establish elevation. The super-elevation, high rail over low rail was noted as 0.82 inches in the subject curve. No exception was taken to elevation noted on April 3, 2014.

• Maximum Allowable Curving Speed: CSX geometry data was used to calculate maximum allowable curving speed in the subject curve. In accordance with FRA (V-max), a 7.24 degree curve with 0.82 inches elevation is acceptable for speeds up to 27 mph using three inches unbalance. No exception was taken to curve speeds on April 3, 2014.

In the subject curve, the track is constructed with a mixture of 132 and 141 pound continuous welded rail (CWR). The branding manufacture label on the rail was 132-RE Nippon, 1990. Number 2 track is constructed with standard wooden crossties, spaced 20 inches on center (nominal). An average of 22 crossties were noted per 39-foot of track. No defective crossties were identified in the undisturbed portion of track near the accident site. The rail was fastened to the crossties with double shoulder Pandrol tie plates, fastened with cut spikes, hairpins, and screw lags. Pandrol elastics fasteners were applied uniformly to the gage and field sides of the rail.

CSX reported that the track had a tie replacement and surface program in 2011. CSX reported that several rail defects had been noted in the subject curve as well as a rail service failure that occurred in January 2014. Number 2 track was scheduled for curve rail replacement and surfacing in June 2014.

An analysis of track geometry car testing conducted on April 3, 2014, by CSX's geometry vehicle revealed no critical defects detected in the immediate area of the derailment, nor the confines of the curve at MP CAB 146.5.

CSX contracted Sperry Rail Service to conduct a test to detect potential internal rail defects on April 29, 2014. During this test a 20 percent detail fracture type defect was identified in the area of the POD. A review of the Sperry inspection data from the rail test vehicle that operated over the track on April 29, 2014, revealed that in the POD area the automated inspection system had identified two locations as potential rail defects. During the investigation, it was determined that progressing in an east direction, the car traversed over a barred service failure, in an additional 3 feet 5 inches, an indication of a potential rail defect was given, it then traveled another 8 feet 10 inches and over a field weld. Near the field weld the system alerted the operator to another potential rail defect. These areas were confirmed to be located on the high rail (north rail) of the curve. After stopping the car and backing into position, the operator exited the test vehicle and conducted a hand test using portable ultrasonic handheld scope. The operator subsequently identified a 20 percent detail fracture near the field weld. This defect location was marked in the field for identification by the railroad using orange paint and the defect information was marked on the rail. When the operator returned to the car, on the Sperry data report he noted the location of the identified defect in the location 3 feet 5 inches east of the barred defect, not the location of the field weld (12 feet 10 inches) east of the barred defect.

In response to this derailment, on June 27, 2014, CSX amended Maintenance of Way Instruction (MWI) 501-13 (Remedial Action for Defects identified by Rail Test Vehicles) to include more restrictive remedial action for transverse detail fracture (TDD) type defects. The changes to MWI instructions are as follows:

MWI 501-12: Additional remedial action required by CSX
• TDD 5 percent – 24 percent - Apply joint bars within 5 days. Replace rail within 30 days or; other weld repair method.
• TDD 25 percent – 59 percent - Apply joint bars within 24 hours. Replace rail within 30 days or; other weld repair method.
• TDD 60 percent – 99 percent - Apply joint bars within 24 hours. Replace rail within 30 days or; other weld repair method.
• TDD 100 percent - Apply joint bars within 24 hours. Replace rail within 30 days or; other weld repair method.

MWI 501-13: Required remedial action for main, sidings, and designated crude oil yard tracks, required by CSX (post-accident)
• TDD 5 percent – 24 percent- Limit speed to 10 mph until joint bars applied. Apply joint bars within 24 hours, thereafter limit speed to 50 mph or maximum for class, whichever is less. Replace/repair rail within 30 days or; other weld repair method.
• TDD 25 percent – 59 percent- Limit speed to 10 mph until joint bars applied. Apply joint bars within 24 hours, thereafter limit speed to 50 mph or maximum for class, whichever is less. Replace/repair rail within 30 days or; other weld repair method.
• TDD 60 percent – 99 percent- Limit speed to 10 mph until joint bars applied. Apply joint bars on the date found, thereafter limit speed to 50 mph or maximum for class, whichever is less. Replace/repair rail within 30 days or; other weld repair method.
• TDD 100 percent - Assign qualified person to supervise each movement over rail until joint bars applied. Apply joint bars within 24 hours, thereafter limit speed to 50 mph or maximum for class, whichever is less. Replace/repair rail within 30 days.

According to an agreement between Sperry Rail Service and CSX, the operator is only required to identify the largest and most restrictive defect in the event that multiple defects are identified by the automated inspection system within 15 feet distance of each other. This agreement expedites the test and in response the railroad affords repairs to all rail defects in the subject rail within the time period required by FRA TSS. However, in the subject location, the rail defects existed in separate rail segments. As such, according to CSX/Sperry's agreement the operator would have been required to assign an individual defect number to each potential defect.

Conclusion:

Preliminary cause determination focused on the failure mode for the 132 RE Nippon, 1990 rail. The derailment of Train K08227 occurred due to a sudden rupture of a rail originating from a reverse transverse detail fracture on the gage corner of the railhead of the high rail of a 7.15 degree curve.

FRA's investigative team conducted a review of the ultrasonic test data representing the failure location. The area was tested by Sperry Rail Service Car Number 931 on April 29, 2014, one day prior to the train accident occurring on April 30, 2014. The test data confirmed that the test equipment functioned properly and responded to known rail features that would normally offer a reflector to the ultrasonic test probes within the area of the failed rail. In the subject area, a 20 percent detail fracture rail defect was identified and noted as defect Number 151 on Sperry Report Number 119A, dated April 29, 2014.

Analysis – Hazardous Materials

Tank car CBTX 741712 was breached at the shell, released product, and caught fire. Tank car CBTX 741712 specifications and damage details are as follows:

• CBTX 741712—Loaded tank car at position # 44, tank car Tare Weight 75,200 lbs., Load Limit 210,800 lbs., Load Limit Capacity 31,820 lbs., Gross Rail Load/Weight 286,000 lbs., Gallons Loaded 29,916, Outage reading 13.2, Outage Conversion 1904.0, Load Date/Time 24 APR 14 at 09:45.
o Built ARIA 07-2012 (Design: DOT 11A100W1/Stenciled: DOT-111S100W1)
o Breached and In Water - releasing 29,916 gallons of product that ignited, creating a large fire
o Coupler still attached to A-End, along with mate and draft gear from trailing car (CBTX 741720).
• Damage:
o #1: 21.5"x18"x8.5" (Right Side)
o #2: 38"x2.5"x2.5" (Right Side)
o #3: 23"x38"x2-5/8" (Right Side)
o #4: 21"x26"x5/8" (Right Side)
o #5: 133"x 31.5"x3/4" to 1" (Right Side)
o #6: 111"x21"x7/8" (Right Side)
o #7: 72"x55"x9.5" (A-End)
o #8: 16"x71"x8.5" (Left Side)
o #9: 86"x129.5"x8.25" (Left Side)
o #10: 35.5"x16.75"x0.25" (Left Side)
o #11: 36.5"x16.75"x0.25" (Left Side)
o #12: 127"x29"x2.375" (Left Side)

o #12: 127”x29”x2.375” (Left Side)
o #13: 57”x153”x3.875” (Left Side)

• Head shield from A-End removed during impact, damage on shield matches damage at location #7. 1”x1.75” and 2-3/8”x5/8” Impact marks visible. Deflection In-head shield is around 0.5”
• Gash where breached measures around 8’ long and 9” wide located on the left side. Car appears to have been peeled open, with the B-End leading.

Conclusion:

Hazardous Materials were not found to be a contributing factor to the derailment.

Overall Conclusions

The investigation did not find any human factor, mechanical, nor signal issues that might have contributed to this accident. The train crew operated the locomotive and handled this train in compliance with all applicable federal regulations and their operating rules.

Based on a close examination, there were no mechanical issues with the locomotives or the freight cars that could have caused or contributed to this accident.

Probable Cause
The probable cause of the derailment was rail failure under the moving train listed as FRA cause code T207, “broken rail - detail fracture from shelling or head crack.”. The L2 wheel on the thirty-fourth car (CTCX 735749) had an impact mark on the tread and the L1 wheel of the same car had a distinctive impact mark on the wheel flange.

A contributing cause of the derailment was the worn rail condition and resulting lip on the high rail caused by the abrasive action and cold working of the rail metal from the accumulated passing traffic. This cold rolled metal in a down orientation (metal flow) manifested into an atypical lip extending from the parent metal at the bottom of the railhead on the gage side. A stress riser (notching condition) in the metal lip resulting from the rail wear initiated the primary cause, a sudden break of the rail. This “reverse” detail fracture was a progressive transverse fracture originating at the metal flow lip on worn rail at bottom corner of the gage side of the railhead. This secondary contributing cause will be listed in FRA’s investigative report as FRA cause code T222, “worn rail.”