Federal Railroad Administration
Office of Railroad Safety
Accident and Analysis Branch

Accident Investigation Report
HQ-2015-1009

CSX Transportation (CSX)
Mount Carbon, WV
February 16, 2015

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-2015-1009

TRAIN SUMMARY

1. Name of Railroad Operating Train #1	1a. Alphabetic Code	1b. Railroad Accident/Incident No.
CSX Transportation	CSX	000141581

GENERAL INFORMATION

1. Name of Railroad or Other Entity Responsible for Track Maintenance	1a. Alphabetic Code	1b. Railroad Accident/Incident No.
CSX Transportation	CSX	000141581
2. U.S. DOT Grade Crossing Identification Number	3. Date of Accident/Incident	4. Time of Accident/Incident
	2/16/2015	1:15 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
107	27	20	1100	New River

11. Nearest City/Town	12. Milepost *(to nearest tenth)*	13. State Abbr.	14. County
Mount Carbon	CA424.4	WV	FAYETTE

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

19. Track Name/Number	20. FRA Track Class	21. Annual Track Density *(gross tons in millions)*	22. Time Table Direction
Main 2	Freight Trains-60, Passenger Trains-80	52.9	East

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OPERATING TRAIN #1

1. Type of Equipment Consist:	2. Was Equipment Attended?	3. Train Number/Symbol
Freight Train	Yes	K08014

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
33 MPH	R	14847		0

6. Type of Territory

Signalization:

Signaled

Method of Operation/Authority for Movement:

Supplemental/Adjunct Codes:

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.)*	5241 "Suspected/No	7	yes		0	0
(2) Causing *(if mechanical, cause reported)*	0	0	yes	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	109	0	0	0	0
(2) Total Derailed	0	0	0	0	0	(2) Total Derailed	27	0	0	0	0

12. Equipment Damage This Consist	13. Track, Signal, Way & Structure Damage
2871245	199832

14. Primary Cause Code

T221 - Broken Rail - Vertical split head

15. Contributing Cause Code

T499 - Other way and structure defect (Provide detailed description in narrative)

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: 5 Mins: 45	Hrs: 5 Mins: 45

Casualties to:	22. Railroad Employees	23. Train Passengers	24. Others	25. EOT Device?	26. Was EOT Device Properly Armed?
				Yes	Yes
Fatal	0	0	0	27. Caboose Occupied by Crew?	
Nonfatal	0	0	2		N/A

28. Latitude	29. Longitude
38.149710000	-81.293175000

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CROSSING INFORMATION

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

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		

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

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

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

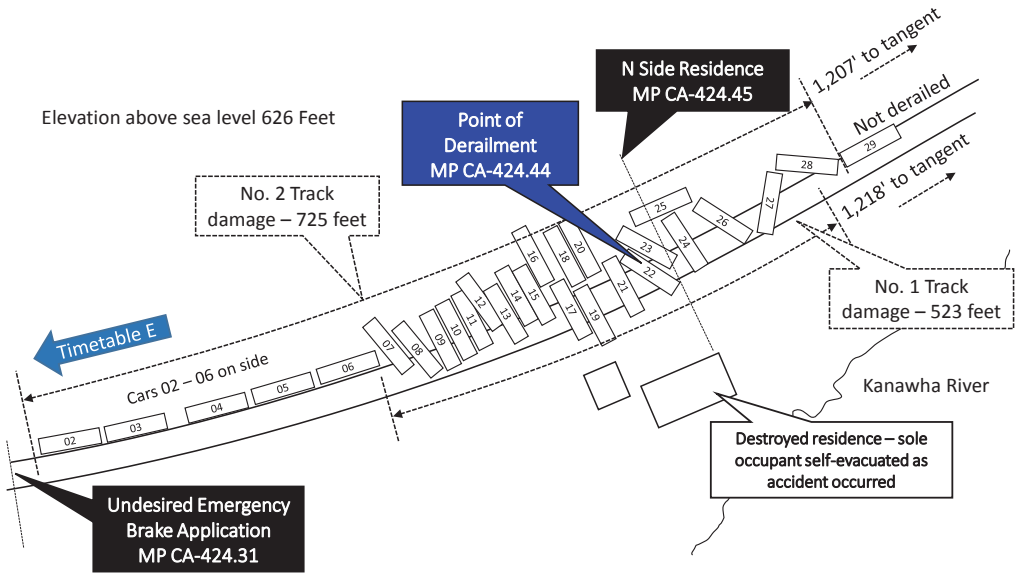
Casualties to:	Killed	Injured	21. Driver was	22. Was Driver in the Vehicle?
23. Highway-Rail Crossing Users			24. Highway Vehicle Property Damage *(est. dollar damage)*	25. Total Number of Vehicle Occupants *(including driver)*

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

SKETCHES

sketch

CSX Mt. Carbon, WV Crude Oil Train K08014 Derailment February 16, 2015



SYNOPSIS

On February 16, 2015, at 1:15 p.m. EST, an eastbound CSX Transportation (CSX) loaded crude oil Train Symbol K08014, traveling on double main track (track #2), at a recorded speed of 33 mph derailed 27 tank cars containing Bakken crude oil on the CSX Huntington Division, New River Subdivision in Mt. Carbon, WV in Fayette County. Train K08014 consisted of two locomotives, two buffer cars (located on each end of the train), and 107 tank cars loaded with Petroleum Crude Oil, with a total length of 6,575 feet and 14,847 trailing tons. The derailment occurred at Milepost (MP CA-424.44) which was approximately 30 miles east of Charleston, WV.

Train movement on the Huntington Division is governed by operating rules and Traffic Control System (TCS). An evacuation of approximately 1100 people was initiated. There were two reported injuries to local residents that included smoke inhalation and hypothermia. Each injury was non-life threatening and both residents were treated and released.

The double main track was destroyed in the derailment. Damage costs were $199,832 for track and $2,871,245 for equipment. The cost for the environmental clean-up is estimated at $20.4 million dollars (as of May 12, 2015). The annual volume of rail traffic over the New River Subdivision, which spans between Montgomery, WV and Hinton, WV, is 52.9 million gross tons.

At the time of the derailment there was approximately eight inches of snow on the ground. It was also snowing heavily, and a temperature of approximately 15 degrees Fahrenheit (F). This accident was not positive train control (PTC) preventable. This is a National Railroad Passenger Corporation (Amtrak) route (Amtrak train 50/51, the "Cardinal," operates three times a week, in both directions, over this section of track). Eight Amtrak trains were cancelled due to this accident.

This Federal Railroad Administration (FRA) investigation determined that the probable cause of the derailment was a broken rail-vertical split head (VSH) piece of track.

FRA has also concluded that several contributing causes occurred. The first contributing factor was that Sperry Rail Service (SRS) had digital rail test data records of vertical split head indications in the two rail tests prior to the derailment. SRS had failed to hand test these areas to validate those indications.

The second contributing factor was a seam found in the railhead that was a prime factor in the degradation of the structural integrity of the rail. Specifically, with the rail tread worn vertically 19/32 of an inch (0.59375), a very small amount of contiguous railhead remained across the tread surface. This structural deficiency caused a vertical split head.

A third contributing factor was the rocking motion of the railhead caused by the sweeping motion of the wheel treads on the railhead under an overbalance condition. This was too much super-elevation for the typical train movement, which further induced the split web as well as secondary head web separation.

A fourth contributing factor was the rail failed to meet required hardness, as it contained a slightly elevated sulfur content corresponding to out of specification cleanliness. This is based on an analysis by an independent laboratory contracted by CSX to determine compliance with American Railway Engineering and Maintenance-of-Way Association specifications for rail steel.

NARRATIVE

Circumstances Prior to the Accident

CSX Train K08014 originated in Manitou, ND. The train crew consisted of an engineer and a conductor and went on duty at 7:30 a.m. at Russell, KY on February 16, 2015. Both the engineer and conductor received their statutory rest period before reporting for duty. The final destination for this train was the Plains Marketing facility in Yorktown, VA. Train K08014 consisted of two locomotives, two buffer cars (located on each end of the train), and 107 tank cars loaded with Petroleum Crude Oil.

A review of the train documents found that the train crew reported for duty at 7:30 a.m. and took possession of Train K08014. Train K08014 reportedly departed Russell, KY at 9:20 a.m. and traveled on the Kanawha Subdivision through to the New River Subdivision.

Just prior to the accident, Train K08014 was met by, Train E51215 a westbound empty coal train traveling on Track #1. As Train E51215 passed Train K08014 on the adjacent track, there were no defects observed or reported by the train crew of Train E51215. In addition, K08014 had passed over six defect detectors from Russell, KY enroute to the Mt. Carbon, WV accident scene with no defects reported and proper axle counts at all six detectors.

Just prior to eastbound Train K08014 approaching the accident scene, the crew of train K08014 was leaving the limits of a 30 mph permanent speed restriction in Montgomery, WV that ended at MP CA-426.9. Their throttle position was then reportedly increasing from throttle position #7 to throttle position #8 in an attempt to return the train to the track speed of 40 mph. The engine consist remained in throttle position # 8 until the train reached the accident scene at MP CA-424.31 (location of lead locomotive). Maximum authorized track speed is 50 mph (however, the maximum authorized weather-restricted speed at the time of the accident was 40 mph) and the train was traveling at 33 mph approaching the accident scene. As the train approached the accident location, the engineer was sitting at the controls of the locomotive on the south side and the conductor was sitting on the north side of the lead locomotive.

The method of operation on the New River Subdivision is by signal indication in a traffic control system. Timetable direction was east and geographical direction was also east. Since both timetable direction and geographical direction are the same, train movement of east will be used throughout this report.

The topography in area and near the point of derailment was a 1.15 degree middle segment of a compound curve (2.15 degrees east end and 2.15 degrees west end). The lead 42% of the train was on an average 10% descending grade, the middle 35% level, and the rear 22% on an average .10% ascending grade.

The Accident

As CSX Train K08014 approached the accident scene (MP CA 424.31 location of lead locomotive), the locomotive event recorder reported the engineer had the throttle in the #8 position for 2 minutes 53 seconds traveling at 33 mph. The train crew then received an undesired brake application and then traveled a total distance of 636 feet to a complete stop.

As soon as the train came to an immediate stop, the engineer then made an emergency radio transmission indicating that his train went into emergency. The train dispatcher then came on the radio and conversed with the engineer. At that time, the conductor had dismounted the locomotive and began walking back to inspect his train. He quickly returned to the lead locomotive to inform the engineer that the train had derailed and was on fire. The engineer relayed the train's condition to the dispatcher. The crew then moved the two locomotives and the one buffer car 999 feet east to MP-CA-424.2. This movement was a total of 1,636 feet from derailment. The conductor reported seeing fire shortly after the derailment; emergency responders recorded the third and fourth thermal tear releases occurring at 2:21 p.m., about an hour after the derailment occurred. Witnesses reported observing tank cars releasing due to thermal tears throughout the day, with the last tank car releasing at 11:26 p.m., approximately 10 hours after the derailment occurred.

A total of 27 tank cars containing Bakken crude oil derailed (7 with no breaches or thermal tears, 3 minimum damage with leakage, 4 with heavy fire damage, and 13 with fire damage and thermal tears). They were located at position #2 through #28 in the train. Twenty of the derailed tank cars released approximately 378,000 gallons of crude oil (CSX estimates 284,987 lost to atmospheric burn and 77,361 lost to pool fires and ground). The product immediately ignited. Up to six explosions were reported. State Route 61 was closed due to the fire.

Emergency responders from both Montgomery and Fayette County were called and arrived on the incident scene initially. They met with the train crew, exchanged information about the contents of the train, and retrieved the train consist paperwork. At the time of the derailment, approximately eight inches of snow had accumulated, it was snowing heavily, and the temperature was approximately 15 degrees F. Due to the weather and frigid temperatures, emergency responders handled the fires by letting them burn out. On February 17, 2015, at 8:00 p.m., 30.5 hours after the derailment, emergency responders authorized the re-railing to begin.

Some of the crude oil from the damaged tank cars entered the Kanawha River. Downstream water treatment intakes on the river were closed as a precaution. A one half mile evacuation zone was established around the derailment, involving approximately 1100 people. One house, located on the north side of the right-of-way, was destroyed by fire. There were two reported injuries to non-railroad personnel.

One of the two injures was the occupant of a house located in the accident area. The resident injured himself during his self-evacuation as the house was being engulfed in flames. He was transported by his son to a local hospital for smoke inhalation. He was treated and released.

The second injury was an elderly female resident who refused to evacuate her home (not within the evacuation zone) after the area had lost power. Due to the frigid temperatures, emergency workers checked on her the next day and found her unresponsive and suffering from hypothermia. She was transported to a local hospital.

On February 17, 2015, West Virginia American Water issued a precautionary boil water advisory for all customers served by the company's Montgomery Water System. The system serves approximately 2,000 customers in the following West Virginia communities: Montgomery, Smithers, Cannelton, London, Handley, and Hughes Creek. The Montgomery treatment plant was shut down as a precaution at approximately 2:30 p.m. on February 16, 2015. West Virginia American Water restarted the water treatment plant February 17, 2015 in the afternoon, following three rounds of water quality testing. Multiple water samples taken at different locations in the river and at the plant showed non-detectable levels of the components of crude oil. Bottled water distribution sites were established at Montgomery Town Hall and Valley High School.

The derailment site is along Armstrong Creek, a tributary for the Kanawha River. On February 17, 2015, in the evening hours a minimal amount of crude oil was detected in the creek, but was trapped by ice and booms and was vacuumed out. Material that had pooled on the ground was also vacuumed up. On February 18, 2015, a containment trench was made at the derailment site, and an additional boom was installed on the river. The ignited cars were allowed to burn off and the pumping of remaining crude to highway tankers commenced on February 19, 2015.

All of the 27 derailed tank cars contained Bakken crude oil. They were described on shipping documents as UN1267, Petroleum Crude Oil, Class 3, Packing Group I. All 27 tank cars were destined to the Plains Marketing (former Amoco), bulk terminal located in Yorktown, VA. All of the tank cars were built to the newer industry standard as written in the Association of American Railroad (AAR) industry standard Casualty Prevention Circular (CPC) 1232 letter. These 1232 type DOT 111A tank cars in train K08014 were equipped with external end head shields, bottom skid, and dome protection. In addition, the CPC 1232 tank cars in this train were non-jacketed and non-insulated.

On February 20, 2015, the evacuation order was lifted. During the evening of February 25, the wreckage was completely cleared and track panels were installed. Approximately 1,000 feet of track panels were installed on Main Track #2 and approximately 600 feet of track panels were installed on Main Track #1. On February 26, 2015, both #1 and #2 main tracks were restored with the initial train service at 5:00 p.m.

The track is constructed with wood crossties, double shoulder tie plates, cut spikes, and continuous welded rail box anchored every other tie. The rail is 136 lb. RE in the accident vicinity. The track was last visually inspected by CSX on February 13, 2015, with no exceptions noted in the derailment area.

The closest hotbox defect detector prior to the derailment site is at MP CA-436.6 at East Bank, WV (approximately 12 miles west of derailment site). No defects were noted on the train. There was no dragging equipment detectors on the prior subdivision (Kanawha Subdivision) or the New River Subdivision, up to the derailment site.

When Train K08014 derailed at 1:15 p.m. on February 16, 2015 blocking double main track on the New River Subdivision at Mt. Carbon, WV, train traffic was rerouted away

When Train K08014 derailed at 1:15 p.m. on February 16, 2015 blocking double main track on the New River Subdivision at Mt. Carbon, WV, train traffic was rerouted away from and around the New River Subdivision, which is a part of the I-64 corridor. The following plan of action was initiated until the line was reopened:

Crude Oil Trains – Total Detoured: 6

Niobrara Shale Oil Trains – Tampa, CO. to Yorktown, VA (Series K120 trains) –

Trains are normally received at interchange in Smithsboro, IL and are routed to Avon, IN, Columbus, OH, Russell, KY, Clifton Forge, VA, and Richmond, VA, into Yorktown, VA. These trains were detoured over the NS railroad at Columbus, OH and received back at interchange in Collier, VA. Empty trains were routed back via Cumberland, MD.

Bakken Shale Oil Trains – North Dakota to Yorktown, VA (Series K080 type trains) –

Trains are normally received at interchange in Chicago, IL and are routed to Garrett, IN, Columbus, OH, Russell, KY, Clifton Forge, VA, and Richmond, VA, into Yorktown, VA. These trains were detoured over the NS Railroad at Columbus, OH and received back at interchange in Collier, VA. Empty trains were routed back via Cumberland, MD.

Merchandise Trains – Total Adjusted: 15

Service between Russell, KY and Richmond, VA (AACA) – Trains affected Q302/Q303 –

Q302/Q303 operates between Russell, KY and Richmond, VA serving customers on the I-64 corridor. Most noted customer Mead Westvaco at Covington, VA. Trains were adjusted to operate between Richmond, VA and Hinton, WV to service the customers on the east side of the derailment and Train L302 was established to service the customers on the west side of the derailment. Long haul freight traffic on each side of the incident site had been routed around the I-64 corridor via Hamlet, NC, to keep customer traffic current.

Intermodal Trains – Total Rerouted: 12

Q135/Q136 operates between Northwest OH and Portsmouth, VA. All trains diverted via Cumberland, MD between Portsmouth, VA and North Baltimore, MD.

Newport News Export Coal – Total Trains: 21

Trains loaded in the West Virginia coal fields were detoured via NS at Columbus, OH receiving them back at Collier, VA

Trains loaded in the Kentucky coal fields were rerouted south via Hamlet, NC to Richmond, VA.

Empty trains from Newport News, VA were routed back south via Hamlet, NC

Service was restored at 5:00 p.m. on February 26, 2015.

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 K08014 submitted to drug and alcohol testing under the requirement of Title 49 Code of Regulations (CFR) Part 219, Subpart C.

Conclusion:

The test results were negative for the engineer and conductor on Train K08014 and were not a contributing factor in the derailment.

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 conductor and engineer of Train K08014.
FRA obtained fatigue-related information, including a 10-day work history, for both the locomotive engineer and the conductor assigned to this train.

Conclusion:

FRA concluded fatigue was not probable for the conductor and engineer assigned to Train K08014. 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 the CSX Road Foreman of Engines and analyzed by FRA and CSX officials.

Conclusion:

The locomotive engineer of Train K08014 complied with all applicable FRA regulations, railroad operating, and train handling rules and requirements. Train handling was not a contributing factor in the derailment.

Analysis – Signal and Train Control

On February 26, 2015, a representative from the 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 Control Point (CP) Eagle (MP) CA 425.5. CP Eagle is the last CP passed by Train K08014 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 CP Eagle. The 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 February 27, 2015, a representative from the FRA conducted a review, inspection and analysis of the required Periodic Signal System test records, GE Electrologixs Event recorder downloads, two Defects/Hot Box Detectors (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 two involved DD event logs in eastward movement sequence for Train K08014 revealed the following:

• East Bank DD – MP CA 436.6 – No defects reported with proper direction and axle count recorded. This indicates the DD was functioning as intended.

• Owens DD – MP CA 450.0 – No defects reported with proper direction and axle count recorded. This indicates the DD was functioning as intended.

Conclusion:

The signal system was determined not to be a contributing factor in this derailment. Thorough 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. FRA found no exceptions with the signal equipment.

Analysis – Locomotive Consist (Mechanical)

Analysis – Locomotive Consist (Mechanical)

Train K08014 consisted of two head end locomotives, one head end buffer car, one rear end buffer car, and 107 loaded tank cars with a total length of 6,575 feet, and 14,847 trailing tons. These tank cars were all DOT 111A100W1 specification tank cars (CPC-1232 industry standard type cars), loaded with Petroleum Crude Oil. The first head car (BNSF 808704) was a covered hopper loaded with sand at position #1 and positioned between the first tank car at position #2 and the trailing locomotive as a buffer car. No distributed power was assigned to this train at the time of the derailment.

The lead locomotive (CREX 1349) was a six axle, two truck design, 4400 horsepower, General Electric model ES44AC. It was built in 2013 and was equipped with CCB2 type air brake equipment. This locomotive had its last periodic inspection performed on the BNSF December 12, 2014, at Kansas City, KS, as recorded on the FRA Form F 6180.49A (blue card). The previous required 33 day mechanical calendar day inspection was dated January 17, 2015 and listing Minot, ND as the location where the inspection was performed. The last calendar day inspection recorded on the locomotive's on-board record was dated February 15, 2015 was performed at Fostoria, OH. No defects were noted on the report.

The trailing locomotive (CSX 5243) was a 4000 horsepower General Electric model ES40DC. It was built in 2005 and was equipped with CCB2 type air brakes, six axle and two truck assembly design. The last periodic inspection on the FRA Form F 6180.49A was dated October 23, 2014 and was performed at Waycross, GA. The previous required 33 day mechanical calendar day inspection was dated February 13, 2015. The last calendar day inspection recorded on the locomotive's on-board record was dated February 15, 2015 and was performed at Fostoria, OH. No defects were noted on the report.

Conclusion:

The mechanical condition of the locomotives did not contribute to this accident.

Analysis Pre-Accident Inspection (Mechanical)

The train originated at Manitou, ND with 106 cars and is listed on the CSX extended haul train list (Line 581 on the February 20, 2015 CSX Extended Haul List Revision) for testing and inspection purposes. Three loaded tank cars were added to the head-end of the train at Hamler, OH (making 109 total cars, with 107 tank cars) and the train continued to Columbus, OH.

Records reviewed indicated that Train K08014 received a Class I Brake Test, extended haul train mechanical inspection performed by three qualified mechanical inspectors at Columbus, OH on February 15, 2015. The inspection was completed at 8:50 p.m. listing 109 cars inspected with no bad order cars noted.

As the train neared the derailment site, Train K08014 passed six defect and clearance detectors on the CSX Kanawha Subdivision starting from MP CA 508.1 near Huntington, WV. The first detector was located about 84 miles west of the derailment site and the remaining detectors spaced about 15 miles apart. Records reviewed regarding the last two detectors indicated no defects recorded with a total mean wheel temperature reading of 40 degrees Fahrenheit above ambient temperature. The last detector was located about 12 miles west of the derailment at MP CA 436.6 near East Bank, WV. Records reviewed resulted in no exceptions noted.

Train K08014 traveling eastward, met a westward empty coal train, Train E51215, near MP CA 426 at 1:12 p.m. about 1.5 miles west of the derailment. The K08014 crew reported that the E51215 crew stated that the train looked good passing by. The head end video of Train K08014 as well as Train E51215 were viewed and did not identify any irregular details (sparks, cars rocking, hot box issues etc.). No train handling issues were noted by the train crew.

Conclusion:

None of the pre-accident inspections including the extended haul inspections, visual observations from crewmembers on passing trains, or detectors contributed to this accident.

Analysis Post-Accident Inspection (Mechanical)

The undesired emergency brake application (UDE) occurred when the lead locomotive on Train K08014 was at MP CA 424.31. The lead locomotive then travelled 636 feet to a stop. The train crew discovered the details of the incident and then moved the engines and one coupled buffer car on Train K08014 999 feet east to MP CA 424.2 (which is a total of 1636 ft. from the UDE location). On February 17, 2015 at about 3 a.m., the rear 79 cars, (which are in positions #30 through #109 in the train consist), were brake tested and moved to MP CA 431.7. This was a distance of about seven miles west, located in Pratt, WV. No exceptions were noted regarding these rear cars.

The head end buffer car BNSF 808704 was shifted off center with the B end coupler shank broken or twisted off, which was caused by the trailing tank cars rolling over. As a result of the derailment, the head five tank cars, which were in positions #2 through #6 in the train consist, stopped on their side in a string-line effect. This was caused by extreme train axial tension in the curve forcing the cars into a tangent lying on the south side of main track #2. There was a separation of about 25 foot between the cars in position #3 and #4. The main pile up of 19 tank cars involved cars in positions #7 through #25 of the train consist. Most of these tank cars suffered heavy fire damage, with 3 tank cars in positions #26 through #28, found in an upright position angled across the tracks.

A detailed mechanical investigation was performed to identify or discover any non-compliant conditions that may have contributed to or caused the derailment. During the wreck clearing process, all equipment involved was thoroughly inspected for any identifiable non-compliant condition or evidence that may relate to the cause of the derailment. Each wheel and truck component removed from under the wreckage was inspected at the site to the extent possible to insure that evidence could be marked for further evaluation. Broken wheels and other damage discovered was identified as impact damage.

After wheels, trucks, and associated components were collected from the wreck site, these items were transported to CSX Handley Yard facility in Handley, WV for further analysis and inspections. As requested, rail car wheel serial numbers were provided by the car owners and used to match with the car numbers to allow a more complete inspection of the tank cars, which eliminated other possible contributing factors.

An extensive review and series of inspections were performed at the CSX Handley Yard. This inspection concentrated on tank car components including wheels, axles, and truck assemblies. A reinforced effort was placed on specific tank cars located near the estimated point of derailment, which included tank cars in positions #6 through #10 in the train consist. No relevant findings were noted.

A variety of records were requested for review regarding the entire movement of the train from origin including: car movement records, Automatic Equipment Identification (AEI) print outs, repair history records, Class I brake test records, and any equipment detector information available.

A variety of wayside detector information and records were reviewed from various defect detector sites throughout the routes traveled by the locomotives and tank cars involved in the derailment. The defect detector information reviewed included: wheel bearing temperature trending, wheel impact detector readings, truck hunting index readings, wheel profile data, wheel bearing acoustic data, and car weight readings. The defect detector information was reviewed from September 2014 to February 2015. Information from each car involved in the derailment was analyzed with additional focus on cars at or near the point of the derailment. No exceptions were noted.

Records reviewed by FRA indicated that CSX did not comply with a Class I brake test after picking up three tank cars en-route. Although FRA recommended a civil penaltiy, this non-compliance was not a contributing factor in this accident. Title 49 CFR, 232.213(a)(5)(i) which states in part; cars added to the train enroute shall be inspected pursuant to the requirements contained in paragraphs (a)(2) through (a)(5) of this section at the location where they are added to the train. The three tank cars added to the extended haul Train K08014 at Hamler, OH did not receive the required Class I brake test performed by a qualified mechanical inspector (QMI) at the location where they were added to train K08014.

The required freight car mechanical inspection as listed in CFR Section 232.213(a) (3) was performed at Hamler, OH by qualified mechanical inspectors; however, only a set and release of the air brakes was conducted.

Conclusion:

After completing all inspections and reviewing the available documentation, no items were identified that would be considered a mechanical or equipment cause or contributing cause factor to the CSX crude oil train derailment near Mt. Carbon, WV.

Analysis-Tank Car Damage Assessment (Hazmat)

FRA conducted an inspection of the 27 tank cars in the derailment. Thirteen tank cars were found to have thermal tears; two tank cars had mechanical tears (one from an unknown cause and the other from a coupler impact confirmed by FRA during re-railing). Three tank cars had bottom outlet valve failures (two partially open one seat damage due to fire) and two dislodged liquid line valves (pushed upward). The remaining seven derailed tank cars had no structural tank damage.

As the result of the 20 tank car that structurally failed, an estimated 378,000 gallons of product was lost, (284,987 lost to atmospheric burn and 77,361 lost to pool fires and ground) and the product immediately ignited. FRA identified and marked three tank cars for coupons/metallurgical testing and two whole cars to be sent to Transportation Technology Center, Inc. (TTCI) for side impact testing.

As a result of the impinging flames, the following 13 tank cars suffered thermal tears; GATX 286232 (position #8), GATX 286214 (position #9), GATX 286292 (position #10), CBTX 741512 (position #12), CBTX 741926 (position #13), CBTX 742035 (position #14), CBTX 741944 (position #17), CBTX 741431 (position #18), CBTX 741516 (position #20), CBTX 741651 (position #21), CBTX 742087 (position #22), CBTX 741946 (position #23) and CTCX 743002 (position #25).

The two tank cars listed below were breached, released product, and caught fire as a result of mechanical tears.

The breach in tank car CTCX 743030 (position #16) was the result of a coupler impact from CBTX 741431 (position #18) to the right side, A-end of the car. The entire contents of tank car CTCX 743030 released and ignited, which created a large fire. Tank car CTCX 742778 (position #19) was breached in two locations. The first and larger breach was located in the center of the right side and was the result of unknown impact. The second breach was on the B-end of the tank car and was the result of an apparent coupler impact. As a result, 21,223 gallons of product was released, ignited, and created a large fire. An estimated 8,300 gallons remained in the tank car and was trans-loaded.

There were three Bottom Outlet Valve (BOV) failures:

Tank cars GATX 286241 (position #7) and GATX 286274 (position #11) both had the BOV handles sheared off. The BOV valves were opened slightly on both tank cars, allowing a total of approximately 29,773 gallons of product to release, (8,490 gallons from GATX 286241 and 21,283 gallons from GATX 286274). Tank car GATX 286233 (position #5) suffered impact damage to the flange area of the BOV, which resulted in the valve seat to shift. This created only a minimal amount of product loss.

The flange bolts were sheared off of the liquid line valves on tank cars CBTX 741926 (position #13) and CBTX 741702 (position #15). This resulted in 20,866 gallons of product being released. In addition, CBTX 741926 suffered a thermal tear.

All of the tank cars involved was built to DOT 111standards by Trinity and American Railcar Inc. (ARI). All cars were built post 2011 to a CPC 1232 standard.

All of the tanks cars involved in the accident were dedicated crude oil service, in like new condition. Each of the tank cars had head shields, enhanced bottom outlet valve skid, and top fittings protection. None of the cars were thermally protected or jacketed. While conducting the damage assessment, evidence of head shields being struck was founded. However, only one of the tank cars was breached in the tank head area of the car.

Conclusion:

FRA concluded that although the tank cars received severe damage, that included thermal and mechanical tears, none of the tank cars' conditions contributed to the cause of this accident. All tank cars were properly classed, billed and marked as containing Petroleum Crude Oil, UN 1267, Class 3, PG I.

Analysis Shipper Pre-Transportation Assessment (Hazmat)

Shipping documents, Bills-of-Lading (BOL) provided by the shipper were reviewed. A chemical analysis of the product was also conducted. Cars that were not involved in the derailment were inspected in order to verify the proper securement of closures.

Conclusion:

FRA concluded that the shipper properly classified the material, selected the proper package, and prepared the shipments for rail transportation. It was concluded that the shipper functions had no bearing on the outcome of this derailment.

Analysis Hazardous Materials review of the train documents

FRA reviewed the original work order for Train K08014 and all of the applicable train documents relating to the description of the tank cars, their standing order in the train, and the emergency response information.

Conclusion:

It was concluded that after a detailed review of the train documents, the carrier was in compliance with hazardous materials regulations in regards to shipping documentation, hazardous materials description and train placement. FRA determined the carrier's documentation had no effect on the derailment or emergency response.

Analysis – Track Inspection Records

An audit of CSX track inspection records from December 1, 2014 to February 13, 2015 was conducted by the FRA investigative team following the accident. The track of the CSX New River Subdivision is required to be inspected twice weekly with one calendar day interval between inspections. FRA took no exceptions to the inspection frequency. The FRA records inspection revealed that for the time period reviewed a total of two track defects were documented by the railroad inspectors between the subject mileposts relevant to this accident, MP CA 424.0 to MP CA 425.0. These track defects consisted of two joint bolt defects. All defects were properly remediated upon discovery.

Conclusion:

All required track inspections of CSX Huntington Division, New River Subdivision were inspected in accordance with the Federal Track Safety Standards (TSS) for the designated class of track, in compliance with FRA CFR 213.233. Proper remedial action was taken on all noted defects listed on CSX track inspection reports.

Analysis – Track

On February 19, 2015, 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 300 feet west of the suspected point of derailment. Measurements were taken at this undisturbed location and, a total of 15 stations were marked at 15' 6" apart. At each station, lateral and vertical movement was noted and the loaded and unloaded measurements were documented.

Track Gage: The widest track gage measurement obtained was at stations #7, #9, and #11. The gage at these locations measured 56-5/8 inches. Maximum gage for FRA Class 4 track is 57-1/2 inches, so no exceptions were taken with track gage.

Crosslevel: The greatest deviation in crosslevel was noted between station #1 and station #4 at the west end of the undisturbed track. The maximum difference in crosslevel in 62 feet was 3/8 inch. The maximum allowable for FRA Class 4 track is 1-3/4 inches, no exceptions were taken with the tracks crosslevel.

Alignement: An analysis of track geometry car testing conducted on October 20, 2014 by CSX geometry vehicle revealed that no critical defects were detected in the immediate area of the derailment, or in the confines of the curve at MP-CA424.5.

Curve Elevation: The curve in the immediate area of the derailment is a compound curve that runs west to east by the direction of the train. It begins with a 2 degrees 15

Curve Elevation: The curve in the immediate area of the derailment is a compound curve that runs west to east by the direction of the train. It begins with a 2 degrees 15 minutes right hand segment with 4 inches elevation. It then transitions to a 1 degree 15 minutes right hand segment with 1-1/2 inch elevation and finally to a 2 degree 15 minute right hand segment with 4 inch elevation.
Maximum Allowable Curving Speed: Per the CSX Huntington Division, New River Subdivision's Special Instructions, 65 mph is the maximum passenger train speed and 50 mph is the maximum speed for a freight train. In the subject curve, the track is constructed of 136-pound continuous welded rail (CWR). The branding manufacture label on the suspect rail was 136-RE Beth Steelton, 1994. Number two track is constructed with standard wooden crossties, that are spaced 20 inches on centers with an average of 22 crossties per 39-foot of track. No defective crossties were identified in the undisturbed portion of the track near the accident site. The rail was fastened to the crossties with double shoulder tie plates, fastened with cut spikes and box anchored every other tie.

Testing for Internal Rail Flaws

CSX contracted Sperry Rail Service (SRS) to conduct tests to detect potential internal rail flaw defects on January 12, 2015. CSX has previously contracted SRS to conduct rail testing on previous occasions. During the January 2015 test, SRS did not conduct any hand test to verify any defects in the identified area of the Point of Derailment (POD). SRS had conducted nine tests for CSX during the past year over #2 track between MP CA423.5 and CA426.0 with the monthly cycle starting in July 2014. Based on the foregoing, CSX had exceeded the number of annual searches for internal rail defects required in 49 CFR 213.237.

An inspection for internal rail flaws was performed on January 12, 2015, 34 days prior to the derailment. The SRS test conducted December 17, 2014 had a boxed indication of a vertical response and a strong induction wavelength at the POD. A stronger induction signature wavelength occurred at the POD, during the test conducted on January 12, 2015

During the test conducted for internal rail flaws on January 12, 2015, the rail test responded with "noise" (a high amount of machine response due to rail surface anomalies) high up in the railhead with a boxed indication on the computer screen display. During the forensic rail reconstruction slight slivers were observed only on the gage side of the railhead. If the railhead has shelling, spalling, or corrugation (SSC) where there is ultrasound noise high in the railhead, the test operator would consider the rail dirty as he did during his interview. If the SSC covers the entire railhead where there isn't a good induction response, the rail is painted yellow, and CSX has to obtain a good test within six months (or change the rail, or reduce the speed) as this wouldn't be considered a complete test. The SSC's on a railhead can be removed by rail grinding (rail profiling) in some cases. The carrier did rail grinding on August 3, 2014. The rail wasn't marked as having SSC's as noted above because there were only slivers on half of the railhead on the gage side for approximately 36 inches in the vicinity of the POD.

The SRS operator has 15 years on this CSX territory. He didn't receive the same training as new employees because he was grandfathered in as a SRS operator as in 49 CFR, 213.238 (f). His training consisted of on-line training every year, and check rides by his supervisors.

When the SRS operator was interviewed, he was asked if he had both screens to view the difference in the wavelengths if it would help. He said it would be too much information to effectively monitor. Then when asked why he did not stop to check the induction indication, the operator stated that he looked out the window of the machine, and the rail "looked dirty," and he thought that it caused a false indication. The operator also said if the rail was clean he would have rerun it. During the forensic rail reconstruction, only the gage side of the railhead had slivers, the field side was absent of these surface conditions. With the railhead in this condition, and such a strong wavelength on the induction channel at this location, the SRS operator should have verified this location with a hand test.

Conclusion:

The derailed loaded eastbound crude oil train was in "overbalance" (leaning toward the low rail) due to travel speed of 33 mph, which is below the maximum authorized speed of 40 mph (due to weather restrictions) for freight trains. This method of operation caused the solid axle wheels to bind when traversing the curve. While not excessive, a significant number of trains in this area on #2 Track are in overbalance in the subject curve because of eastbound trains holding for the interlocking ahead (east) at MP CA-424.50 where the track merges into single track. This is the functional equivalent of tonnage (force) above the anticipated million gross tons.

The rail failure occurred due to a combination of vertical rail wear, wheel loading (overbalance), and a vertical seam in the railhead. This resulted in a failure of the low rail originating from the VSH culminating in a head web separation. This caused the derailment of Train K08014. The rail was made in March 1994 by Bethlehem Steel Company in Steelton, PA. The markings indicate 136-pound rail (every three feet weighs 136 pounds when new). The rail markings are (136 – 10 CC Beth Steelton 1994 III). The three marks behind 1994 indicate the month the rail was made. The rail was rolled (made) during Bethlehem Steel Company's transition from ingot casting to continuous casting. The branding indicates this rail was controlled cooled for hydrogen gas elimination (CC in branding) and not vacuum treated (VT in stamping).

The forensic rail reconstruction revealed that segment of the railhead 5'2" broke out with a 2'6" long VSH on the west end. This segment of railhead dropped off the web as a wheel departed the west end containing the VSH, and then striking the gage corner of the intact railhead.

In 2011, only the high rail was replaced with new rail. When the rail was changed and gaged, it repositioned the vertical wheel load contact point on the 1994-136 RE low rail (asymmetrical loading and twisting at the head/web interface). This coupled with rail worn almost to the CSX limit, and a vertical seam in the railhead, caused the rail to fail.

The low rail wheel action causes the wheel flange to pull away from low rail with opposite wheel flanging (crowding) the high rail. However, some trucks can rotate with trailing axle shifted toward low rail. This wheel action causes asymmetric wheel loading (rocking motion of the railhead). With a seam within the railhead causing the VSH, and the rocking motion inducing the head web separation, this describes the rail at the POD. This also explains the additional VSH specimens found at the derailment site and the numerous rail test equipment responses indicative of vertical discontinuities recorded by SRS. Specifically, rail tests consisting of ultrasound, and induction channels occurred on December 17, 2014, and January 12, 2015.

Based on the foregoing, FRA concluded that a broken rail-vertical split head (VSH) is the probable cause of this derailment.

Conclusion:

Based on the above information, FRA Region 2 is recommending civil penalties for a VSH that should have been verified, thereby resulting in a catastrophic 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

FRA investigation determined the probable cause of the derailment as a broken rail-vertical split head (VSH).

FRA has concluded that several contributing causes occurred: The first contributing factor was that SRS had digital rail test data records of vertical split head indications in the two rail tests prior to the derailment. SRS had failed to hand test these areas to validate those indications.

The second contributing factor was a seam found in the railhead that was a prime factor in the degradation of the structural integrity of the rail. Specifically, with the rail tread worn vertically 19/32 inch (0.59375), a very small amount of contiguous railhead remained across the tread surface. This structural deficiency caused a vertical split head (VSH).

A third contributing factor was the rocking motion of the railhead caused by the sweeping motion of the wheel treads on the railhead under an overbalance condition. This was too much super-elevation for the typical train movement, which further induced the split web as well as secondary head web separation.

A fourth contributing factor was the rail failed to meet required hardness, by containing a slightly elevated sulfur content corresponding to out of specification cleanliness. This is based on an analysis by an independent laboratory contracted by CSX to determine compliance with American Railway Engineering and Maintenance-of-Way Association specifications for rail steel.