National Transportation Safety Board

Office of Railroad, Pipeline and Hazardous Materials Investigations

Washington, D.C. 20594

Derailment of BNSF Grain Train G-RYLRGT9-26A and Subsequent Collision BNSF Oil Train U-FYNHAY4-05T

Casselton, North Dakota

December 30, 2013

Mechanical Group Factual

[redacted]

Accident

NTSB Accident Number:	DCA-14-MR-004
Date of Accident:	December 30, 2013
Time of Accident:	2:11p.m. (CDT[1])
Type of Trains:	BNSF Freight Trains, G-RYLRGT9-26A & U-FYNHAY4-05T
Railroad Owner:	BNSF Railroad
Train Operator:	BNSF Railroad
Fatalities:	0
Injuries:	0
Location of Accident:	Casselton, ND

Mechanical Group Members

National Transportation Safety Board-Group Chairman
Michael Hiller
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Washington, D.C. 20594
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Federal Railroad Administration
Brian Ramey
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Motive Power & Equipment
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BNSF Railroad
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Mechanical Superintendent Zone 2
[redacted]
Blaine, MN 55434
[redacted]

[1] Central daylight time

Accident Summary

On Monday, December 30, 2013, at 2:11 p.m. central standard time, a westbound BNSF Railway Company (BNSF) grain unit train derailed 13 cars at milepost 28.5 near Casselton, North Dakota. The grain train, operating on main track 1, consisted of 2 head-end locomotives, 1 rear distributive power unit (DPU) locomotive, and 112 cars. The 45th car from the head end of the grain train derailed onto main track 2, blocking the track.

An eastbound BNSF petroleum crude oil unit train, operating on main track 2, U-FYNHAY-05T, collided with the derailed grain train car that was blocking the track. The crude oil train consisted of 2 head-end locomotives, 1 rear DPU locomotive, and 106 cars. The 2 head-end locomotives and the first 21 cars of the crude oil train derailed during the collision, releasing nearly one-half million gallons of crude oil and fueling a fire. An estimated 1,400 people were evacuated from the town of Casselton. No injuries to the public were reported.

The eastbound train crew from U-FYNHAY4-05T, consisting of an engineer and a conductor, escaped from the rear door of the lead locomotives uninjured. The crew from train G-RYLRGT9-26A was not injured.

BNSF has estimated damages at $6.1 million, this does not include environmental remediation. The weather at the time of the accident was cloudy and -1 degrees Fahrenheit, winds north at 7 mph.

The parties to the investigation include the Federal Railroad Administration (FRA), the US Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA), the BNSF Railroad, the Brotherhood of Local Engineers and Trainmen (BLET), the International Association of Sheet Metal, Air, Rail and Transportation Workers (SMART)[2] , Trinity Rail Car and Standard Steel L.L.C.

[2] Formally the United Transportation Union (UTU)

Figure 1-Photograph of Exploding Tank Cars as a Result of a Collision of Two BNSF Freight Trains

Train Consist

G-RYLRGT9-26A consisted of two head end locomotives, 112 loaded grain covered hopper cars and one rear DPU. The train weighed 14,776 tons and was about 6,840 ft. in length. Individual car weights were assessed through examination of the train list records. The loaded grain cars ranged in weight between 131 and 132 tons.

U-FYNHAY4-05T consisted of two head-end locomotives, 104 loaded tanker cars, two buffer cars filled with sand (located at car positions one and 108) and one rear DPU. The train weighed 13,335 tons and was about 6536 ft. in length. Individual car weights were assessed through examination of the train list records. The loaded tanker cars hauling oil cars ranged in weight between 125 and 127 tons. The buffer cars (two cars) weight was listed at 122 tons.

Railroad Equipment Involved in the Derailment

Petroleum Train

The railroad equipment involved in the collision and derailment of U-FYNHAY4-05T, the eastbound train, consisted of two leading locomotives and cars 1 through 21 behind the leading units. The two locomotives involved in the derailment were BNSF 4934 (lead unit), BNSF 5958 second unit.

Locomotive BNSF 4934 is a model C44-9W, 4400 HP. Locomotive BNSF 5958 is a model ES-44AC, 4400 HP. Both locomotives are equipped with a network-based, electronic air brake system (CCB2. Both locomotives are equipped with fuel tanks having a capacity of about 5300 gallons. Fully loaded the locomotives weigh 420,000 lbs.

The first car in the eastbound train is BNSF 808314 a covered hopper. This is a AAR type C113,YHF plate C with 36 inch wheels. The car measures approximately 57 ft. 9 in. (length), by 10 ft. 6 in. This car is a buffer car filled with sand. The gross vehicle weight (GVW) for this type of covered hopper car is listed on BNSF specification documentation at 143 tons.

Train cars 2 and 3 are GATX 33119 and GATX 33123, AAR type T108, T5I plate C with 36 inch wheels. These are Department of Transportation (DOT) Specification 111-A100W1 (DOT-111) tank cars that measure approximately 59 ft. 5 in. (length), by 10 ft. 8 in. Lines 4 and 5 are the TAEX 1549 and the TAEX 1475, AAR type T108, T5I plate C, with 36 inch wheels DOT-111 tank cars. The cars measure approximately 59 ft. 5 in. (length), by 10 ft. 8 in. The gross vehicle weight (GVW) for this type of DOT-111 tank car is 143 tons.

Line 6 is ADLX 500176, AAR type T108, T5I plate C, with 36 inch wheels. These are DOT-111 tank cars that measure approximately 59 ft. 5 in. (length), by 10 ft. 8 in.

Line 7 is the TAEX 1472, AAR type T108, T5I plate C, with 36 inch wheels. These are DOT-111 tank cars that measure approximately 59 ft. 5 in. (length), by 10 ft. 8 in. Lines 8, 9, 10, 11 and 12 are the SHPX 208541, 208541, 208638, 206670 and 208536, AAR type T108, T5I plate C, with 36 inch wheels. These are tank cars that measure approximately 59 ft. 5 in. (length), by 10 ft. 8 in.

Lines 13 and 14 are the TAEX 1528 and TAEX 1602, AAR type T108, T5I plate C, with 36 inch wheels. These are DOT-111 tank cars that measure approximately 59 ft. 5 in. (length), by 10 ft. 8 in. Lines 15 and 16 are the SHPX 206708 and 206668, AAR type T108, T5I plate C, with 36 inch wheels. These are DOT-111 tank cars that measure approximately 59 ft. 5 in. (length), by 10 ft. 8 in.

Lines 17 and 18 are the GATX 33125 and 33139, AAR type T108, T5I plate C, 36 inch wheels DOT-111 tank cars. The cars measure approximately 59 ft. 5 in. (length), by 10 ft. 8 in. Line 19 is the TAEX 1630, model T108, T5I plate C, with 36 inch wheels. The DOT-111 car measures approximately 59 ft. 5 in. (length), by 10 ft. 8 in.

Grain Train

The equipment involved in the derailment from G-RYLRGT9-26A, the westbound train, consisted of lines 44 through 56 for a total of 13 cars. Lines 44-47 and 48 are BNSF 486480, 486653, 487137, 481970, 480263, AAR type C114, CXG plate C, with 36 inch wheels. These are covered hopper cars that measure approximately 58 ft. (length), by 10 ft. 8 in. The GVW for this type of covered hopper car is listed on BNSF specification documentation at 143 tons.

Line 49 is the AOK 65732, AAR type C114, CXG plate C, with 36 inch wheels. The covered hopper car measures approximately 58 ft. (length), by 10 ft. 8 in. Lines 50, 51, 52, 53, 54, 55 and 56 are the BNSF 478072, 485951, 486769, 485510, 487701,486563, 475068, AAR type C114, CXG plate C, with 36 inch wheels. These are covered hopper cars that measure approximately 58 ft. (length), by 10 ft. 8 in.

Wreckage Description

The two lead locomotives from the eastbound train derailed upright to the south of main track 2. The lead locomotive became uncoupled from the second locomotive and the distance between the separated units was about 150 feet. The lead unit traveled about 200 feet south of main track 2.

The next 20 cars from this train derailed in a general pile-up. The cars were overturned, smashed and left lying in a zigzag pattern. See figure 2. The trailing trucks from the 21st car derailed upright and undamaged. The 1st car in the line was a buffer car hauling sand. The next 20 cars were tank cars hauling petroleum crude oil. 18 of those cars tank cars breached as a result of the collision and released full loads of product resulting in a large fire.

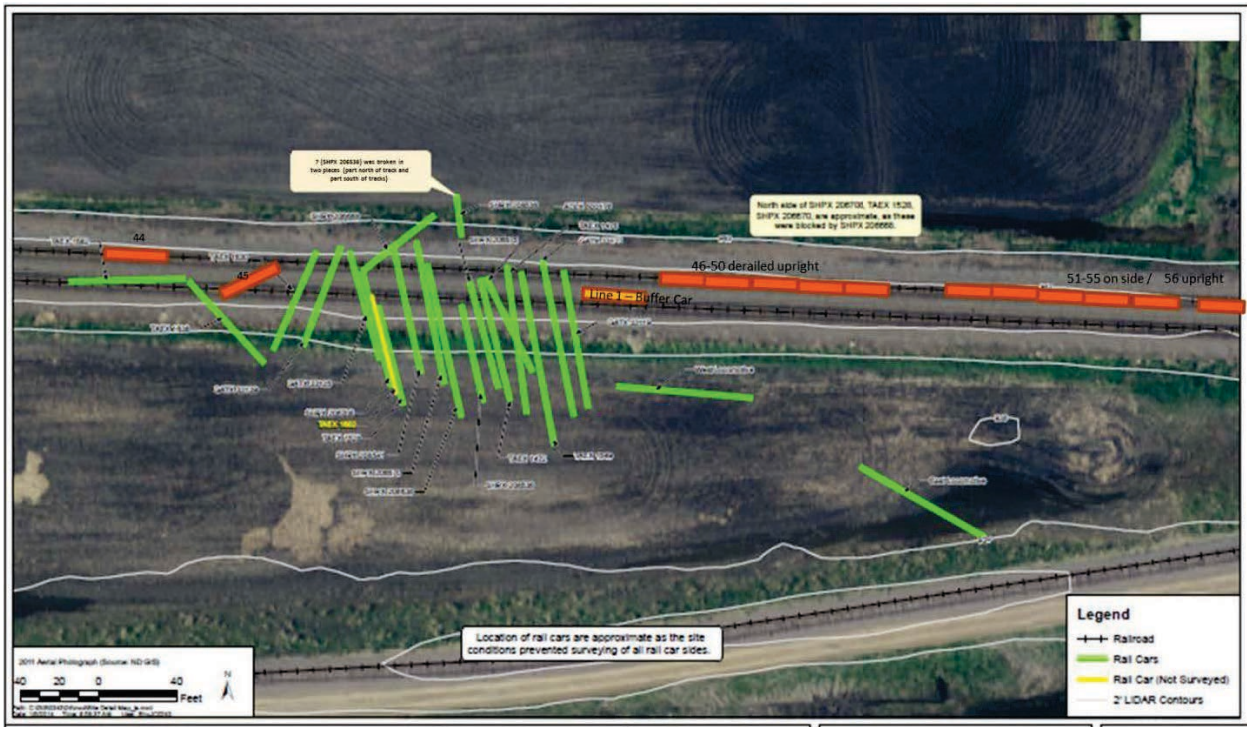

Figure 2-Accident Diagram

The 44th through 56th cars from the westbound train derailed. The trailing trucks from the 44th car derailed upright and undamaged. The 45th car was laying over on its side to the south of main track 2. The car was partially blocking the north rail of main track 1.

The 46th through the 51st cars derailed upright to the south of main track 2. The cars remained coupled together nearly straight in a relative linear alignment along the tracks. The 52nd car became uncoupled from the 51st and cars 52 through 56 derailed upright in a line.

Equipment Pre-Accident Inspection

Train U-FYNHAY4-05T originated in Fryburg, ND. The train was given a Class I Air Brake test and crew inspection by qualified personnel on December 29, 2013. No defects were noted. The train departed Fryburg at 12:20 p.m. on December 29. 2013.

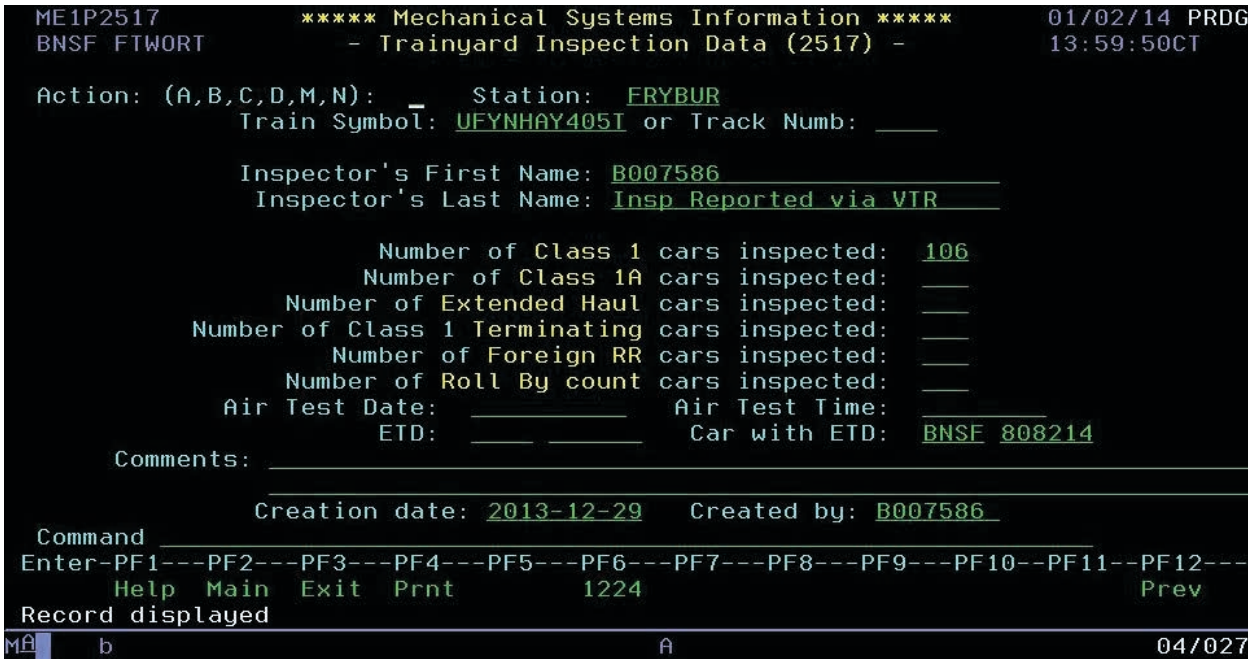

Figure 3-Electronic Air Brake Inspection Record for Train U-FYNHAY4-05T

Train U-FYNHAY4-05T arrived Mandan, ND on December 30, 2013 at 4:54 a.m. were a Class I Air Brake test and inspection was performed by qualified mechanical employees. Mandan mechanical records show the mechanical employees started their inspection on December 30, at 5:13 a.m. and finished at 5:41 a.m. No defects were noted. Train departed Mandan at 6:32 a.m. on December 30, 2013.

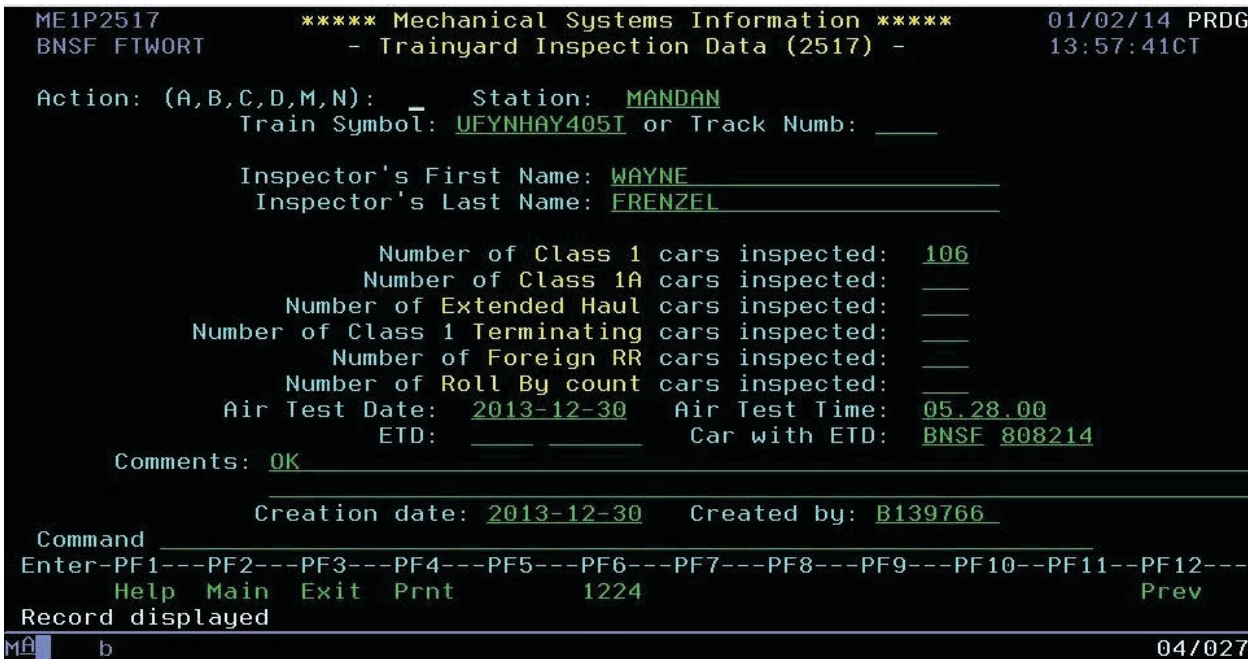

Figure 4-Electronic Air Brake Inspection Record for Train U-FYNHAY4-05T

Train G-RYLRGT9-26A originated at Royal, NE. The train consisted of 112 cars. A Class I Air Brake test and inspection was performed by the crew. No defects were noted.

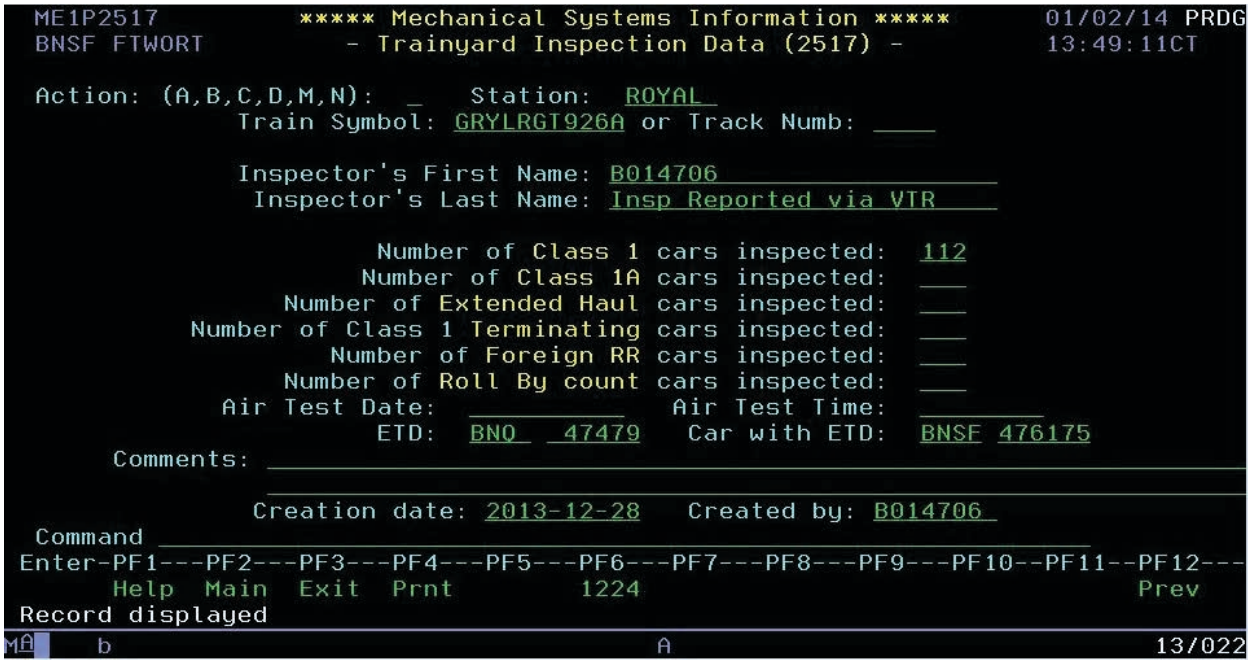

Figure 5-Electronic Air Brake Inspection Record for Train G-RYLRGT9-26A

Locomotive BNSF 4934, the lead locomotive on U-FYNHAY4-05T had its last daily inspection performed on December 30, 2013, at Mandan, ND at 6:54 a.m. by a qualified mechanical employee. No defects noted. A review of inspection records showed all scheduled maintenance activities are up to date.

Locomotive BNSF 5958, the second locomotive on U-FYNHAY4-05T had its last daily inspection performed on December 30, 2013, at Mandan, ND at 6:50 a.m. by a qualified mechanical employee. No defects noted. A review of inspection records showed all scheduled maintenance activities are up to date.

Equipment Post Accident Inspections

NTSB investigators formed a group of qualified mechanical inspectors to evaluate the mechanical condition of the un-derailed equipment.

On January 2, 2014, investigators completed an inspection of the remaining 85 tank cars off U-FYNHAY4-05T, the eastbound train. These cars were inspected in Nolan, ND. Investigators performed a Class I Air Break test and mechanical inspection. No defects were noted. All air brake equipment worked as intended. All equipment was inspected to current FRA standards and no exceptions were taken.

On January 2, 2014, investigators completed an inspection of the remaining 96 grain cars from the G-RYLRGT9-26A, the westbound train. These cars were inspected in Dillworth, MN. Inspectors performed a Class I Air Break test and mechanical inspection. The inspection identified four freight cars from the westbound train which failed the air brake test. The four defective freight cars are listed below.

- BNSF 483476, air brakes cut-out
- BNSF 481098, no brakes set
- BNSF 481164, no brakes set
- BNSF 483549, no brakes set

No other defects were noted. All air brake equipment on the remaining 92 cars worked as intended. All equipment was inspected to current FRA standards and no exceptions were taken.

On January 3, 2014, investigators inspected the mechanical condition of five grain cars, the 44th through the 48th, from the westbound train involved in the derailment. This group of cars were the first to derail. The cars were; BNSF 486480, 486653, 487137, 481970 and 480263 respectively.

BNSF 486480 derailed the trailing trucks and the car was upright and undamaged. Investigators took no exception with the mechanical condition of this car.

BNSF 486653, the 45th car was inspected after it was removed from the derailment area during emergency response actions. The car was assessed laying on its side. Investigators noted the damage present on the bottom of the car. All bottom outlet gates appeared to have been damaged as the result of raking or sliding across a surface. The damage originated at the A-End of the car, or the leading end of the car as it would have been oriented in the westbound train. See Figure 7.

Figure 6-BNSF 486653, the 45th Car With bottom Outlet Gate Damage

Investigators also identified a circular witness mark about 8-inches in diameter with smaller impressions located within the witness mark, triangularly displaced in an equidistant pattern. This impression was consistent with the end of an axle assembly. See Figure 8.

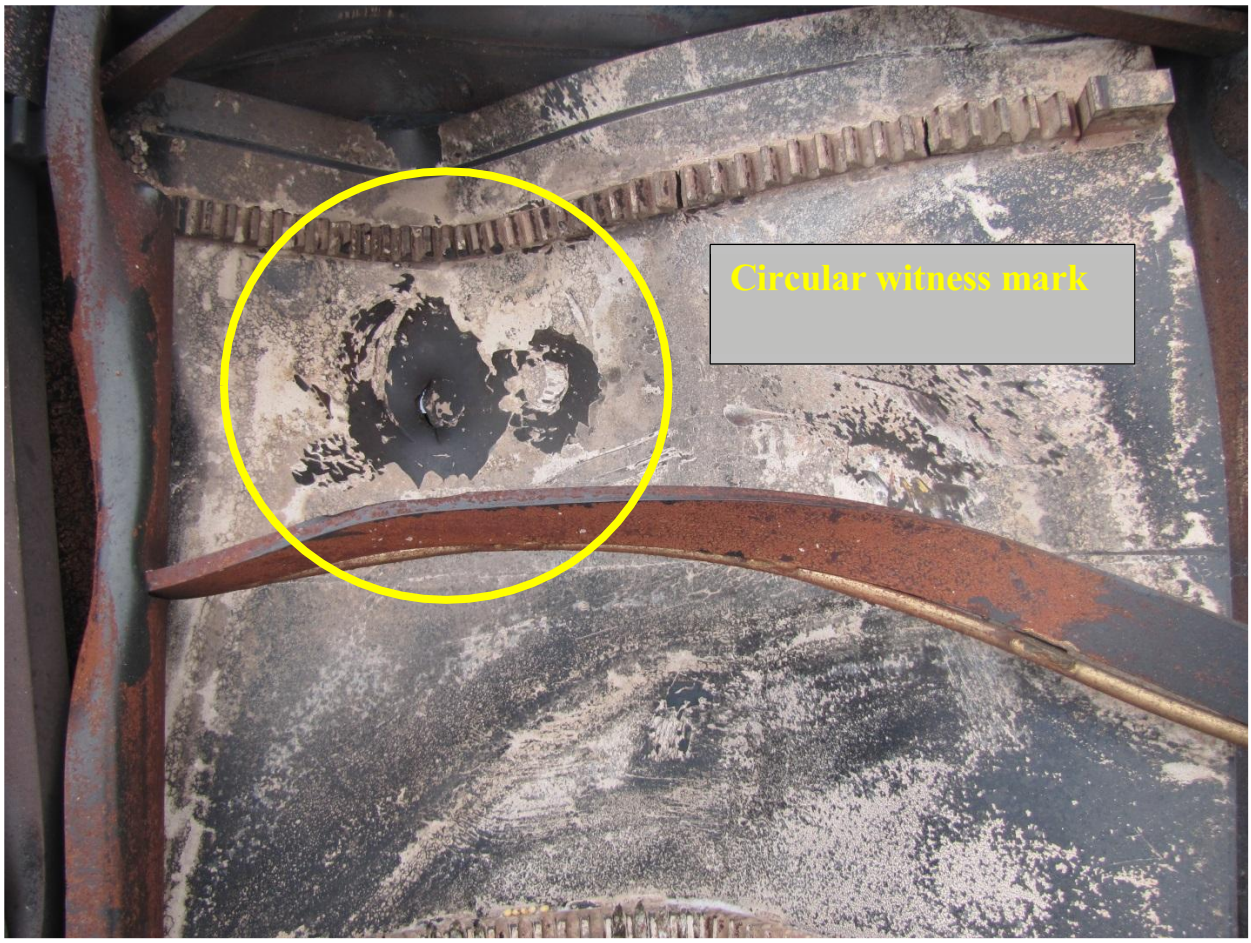

Figure 7-BNSF 486653, the 45th Car With 8-Inch Diameter Circular Witness Mark

Investigators also observed damage to the A-End, or leading end of the car structure. The car structure and end sill sustained severe longitudinal load collision damage resulting in tearing and shearing of the structure. The top of the car also exhibited severe collision damage along its entire length. See figure 9.

Figure 8-Figure 6-BNSF 486653, the 45th Car Showing Car Damage on the Top of the Car

BNSF 487137, the 46th car was inspected after it was removed from the derailment area during emergency response actions. The car was assessed laying on its side. Investigators noted the B-End of the car was relatively undamaged, this was the leading end of the car in the westbound train. Investigators also noted the car's structure did not exhibit collision damage.

Figure 9-BNSF 487137, the 46th Car Showing the Leading End Relatively Undamaged

Investigators also noted two circular witness marks about 8-inches in diameter with smaller impressions located with the witness mark, triangularly displaced in an equidistant pattern. This impression was consistent with the end of an axle assembly. See Figure 11.

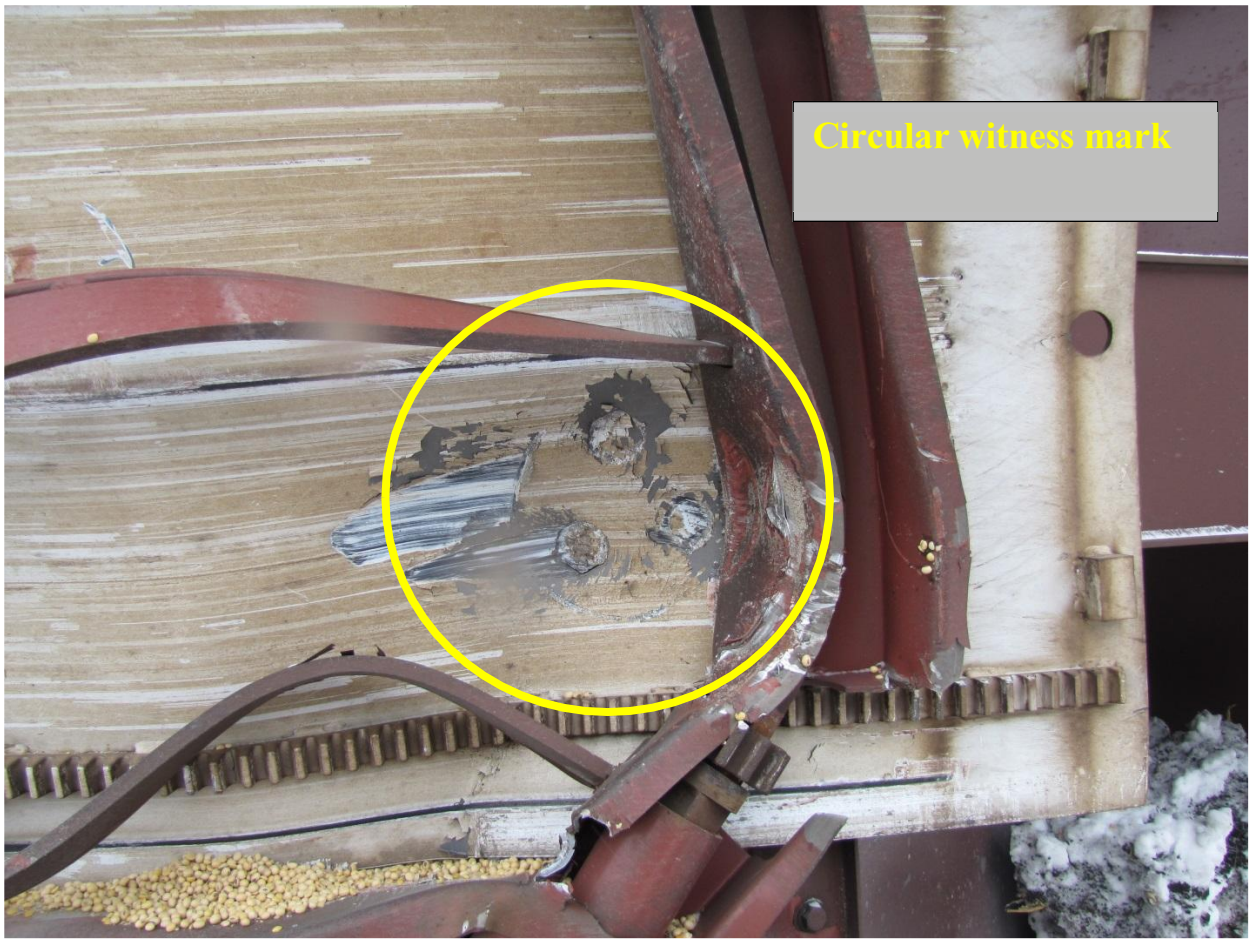

Figure 10- BNSF 487137, the 46th Car With 8-Inch Diameter Circular Witness Mark

BNSF 481970, the 47th car was inspected after it was removed from the derailment area during the emergency response actions. The car was assessed laying on its side. Investigators noted the A-End of the car was relatively undamaged, this was the leading end of the car in the westbound train. Investigators also noted the car's structure did not exhibit collision damage. Investigators inspected the underside of this car and noted no remarkable witness marks or damage.

BNSF 480263, the 48th car was inspected after it was removed from the derailment area during emergency response actions. The car was assessed laying on its side. Investigators noted the A-End of the car was relatively undamaged, this was the leading end of the car in the westbound train. Investigators also noted the car structure did not exhibit collision damage.

Investigators also observed one circular witness marks about 8-inches in diameter with smaller impressions located within the witness mark, triangularly displaced in an equidistant pattern. This impression was consistent with the end of an axle assembly. See Figure 12.

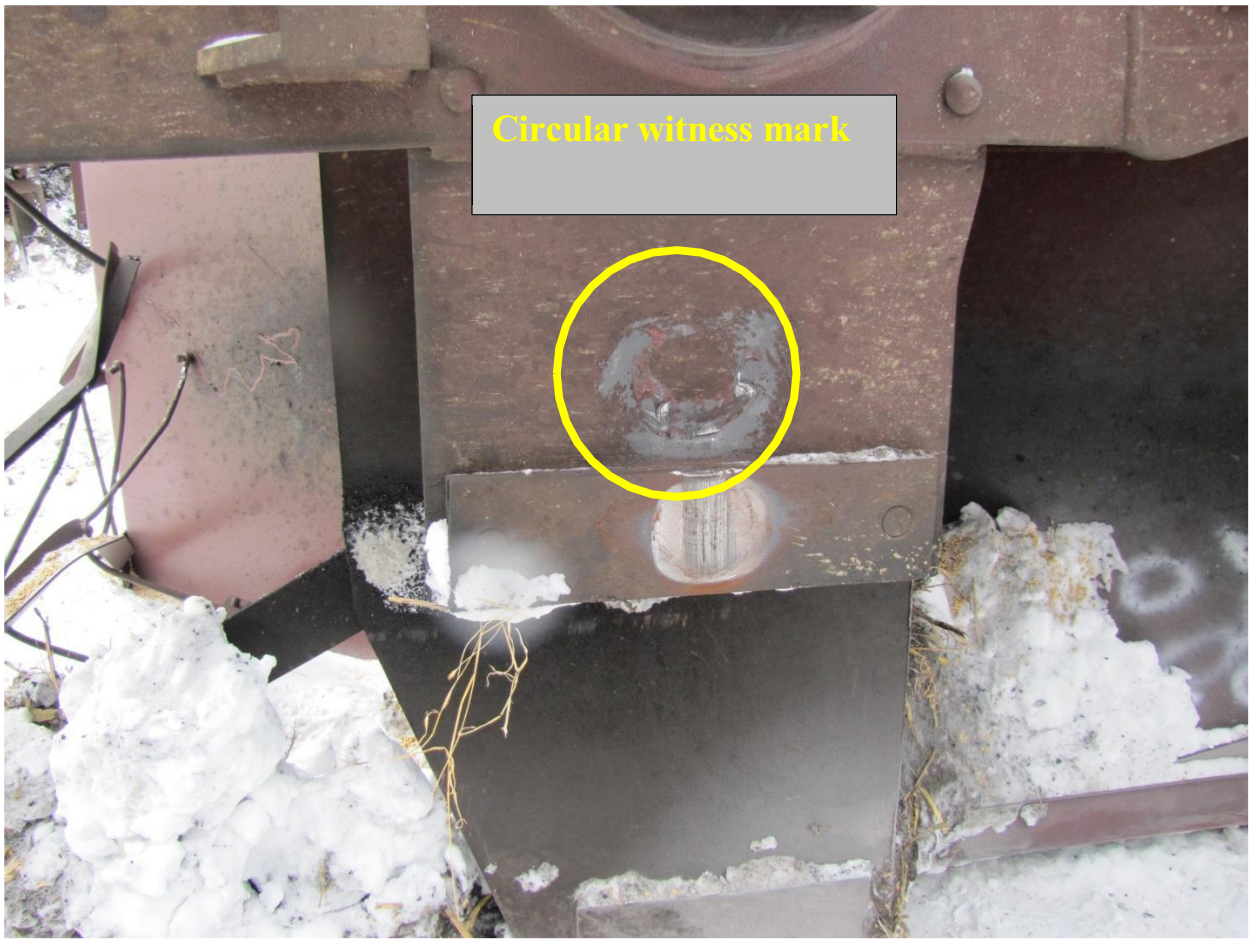

Figure 11-BNSF 480263, the 48th Car With 8-Inch Diameter Circular Witness Mark

During examination of the wreckage, investigators located an axle assembly broken in half. The axle is an AAR Class K (6 ½ X 9) manufactured for freight car service. The wheels mounted to the axle were 36-inch, AAR 1-B, wide flange with a 1:20 taper for freight car service. Each wheel was stamped with a manufacturing date of January 2010. The axle serial number stamped on the end of the broken axle is SSD 1102 7A1 E 0912 F[3]. The serial number indicates it was made by Standard Steel, L.L.C. (SS), in November 2002.

The NTSB Materials Laboratory received the broken axle from the Casselton derailment; however, initial indications are consistent with the axle having fractured from a void defect[4] along the longitudinal center axis of the axle.

[3]AAR serial number designations, specified in AAR Specification M-101, Appendix C (Manual of Standards and Recommended Practices, Wheels and Axles) contain a heat identification number which is stamped on the end of the axle. A heat number is similar to a lot number, which is used to identify production runs of any other product for quality control purposes. This axle's heat number is E0912.

[4] A void is a manufacturing defect in an otherwise solid material that can lead to premature failure of a component.

Research of BNSF documentation and maintenance history showed that two derailed cars from the grain train had recent wheel axle assembly change outs in the past four years. Records show the axle bearings and wheels on the broken axle were installed, or remounted, in April 2010, at the BNSF Havelock Wheel Shop, in Havelock, Nebraska.

Investigators were able to research BNSF documentation and maintenance history. Records indicated that of the five cars in lines 45 through 48, only two cars had recent wheel axle assembly change out in the past 4 years. Four years was chosen as a starting point because, records show the axle bearing was installed in April of 2010 at the Havelock Wheel Shop in Havelock, NE. the two cars were line 44 and 45.

Figure 12-Broken Axle Assembly; Serial number SSD 1102 7A1 E 0912 F

Event Recorders

While on scene, investigators and representatives from BNSF downloaded the event recorder data from the leading locomotives from the westbound train and the trailing locomotives from the eastbound train. data was collected from:

- BNSF 6990 leading locomotive from the westbound train
- BNSF 6833 second locomotive from the westbound train
- BNSF 6745 trailing DPU from the westbound train
- BNSF 6684 trailing DPU from the eastbound train

The files were captured via laptop, using a direct cable interface connection. Time stamps are checked for accuracy against the connected laptop's time. All time stamps appeared to have an accuracy of plus or minus one minute. Wheel sizes were collected from each locomotive and documented.

Results of the examination will be available in NTSB's Event and On-Board Image Recorders, Specialist's factual Report.