



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

***Accident Investigation Report  
HQ-2019-1323***

***BNSF Railway (BNSF) Derailment  
Cloquet, Minnesota  
February 16, 2019***

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



**SYNOPSIS**

On February 16, 2019, at 11:25 a.m., CST, BNSF Railway (BNSF) freight train C-BTMCOB0-13B (Train 1), derailed near Cloquet, Minnesota. The derailment occurred as Train 1 operated westbound on the Lakes Subdivision at Milepost (MP) 45.49.

A total of 39 cars derailed, positions 14-52, all of which were loaded hoppers of coal. Six cars derailed upright while the balance of 33 cars derailed onto their sides. Two of the derailed cars penetrated the ice on the St. Louis River causing some coal to be released into the water.

There was no release of hazardous materials and no evacuations ordered.

Damage from the derailment was \$2,184,224 to equipment and \$116,918 in track and signal, totaling \$2,301,142.

At the time of the accident it was cloudy with an easterly wind of 5 mph. The temperature was 18° F.

The Federal Railroad Administration (FRA) determined the probable cause of the derailment was E61C – Broken rim.

Additionally, FRA determined a possible contributing cause was T111 – Wide gage due to defective or missing spikes or other rail fasteners.

**TRAIN SUMMARY**

1. Name of Railroad Operating Train #1 BNSF Railway Company	1a. Alphabetic Code BNSF	1b. Railroad Accident/Incident No. HQ-2019-1323
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**GENERAL INFORMATION**

1. Name of Railroad or Other Entity Responsible for Track Maintenance BNSF Railway Company		1a. Alphabetic Code BNSF		1b. Railroad Accident/Incident No. HQ-2019-1323	
2. U.S. DOT Grade Crossing Identification Number		3. Date of Accident/Incident 2/16/2019		4. Time of Accident/Incident 11:25 AM	
5. Type of Accident/Incident Derailment					
6. Cars Carrying HAZMAT 0	7. HAZMAT Cars Damaged/Derailed 0	8. Cars Releasing HAZMAT 0	9. People Evacuated 0	10. Subdivision BNSF RAILWAY COMPANY -	
11. Nearest City/Town Cloquet		12. Milepost ( <i>to nearest tenth</i> ) 45.5	13. State Abbr. MN	14. County ST LOUIS	
15. Temperature (F) 18 °F	16. Visibility Day	17. Weather Cloudy		18. Type of Track Main	
19. Track Name/Number Main		20. FRA Track Class Freight Trains-40, Passenger Trains-60		21. Annual Track Density ( <i>gross tons in millions</i> ) 21.98	22. Time Table Direction West
23. PTC Preventable No		24. Primary Cause Code [E61C] Broken rim		25. Contributing Cause Code(s) T111	

**OPERATING TRAIN #1**

1. Type of Equipment Consist: Freight Train					2. Was Equipment Attended? Yes		3. Train Number/Symbol C-BTMC0B0-13B						
4. Speed (recorded speed, if available)  R - Recorded 39.0 MPH E - Estimated		Code  R	5. Trailing Tons (gross excluding power units)  16949		6a. Remotely Controlled Locomotive? 0 = Not a remotely controlled operation 1 = Remote control portable transmitter 2 = Remote control tower operation 3 = Remote control portable transmitter - more than one remote control transmitter					Code  0			
6. Type of Territory  Signalization: <u>Signaled</u>  Method of Operation/Authority for Movement: <u>Signal Indication</u>  Supplemental/Adjunct Codes: <u>Q</u>													
7. Principal Car/Unit		a. Initial and Number		b. Position in Train		c. Loaded (yes/no)		8. If railroad employee(s) tested for drug/alcohol use, enter the number that were positive in the appropriate box		Alcohol		Drugs	
(1) First Involved (derailed, struck, etc.)		BNSF 670375		14		yes				0		0	
(2) Causing (if mechanical, cause reported)		FURX 963762		16		yes		9. Was this consist transporting passengers?				No	
10. Locomotive Units (Exclude EMU, DMU, and Cab Car Locomotives.)		a. Head End		Mid Train		Rear End		11. Cars (Include EMU, DMU, and Cab Car Locomotives.)		Loaded		Empty	
				b. Manual		c. Remote				a. Freight		b. Pass.	
				d. Manual		e. Remote				c. Freight		d. Pass.	
										e. Caboose			
(1) Total in Train		2		0		0		0		1		(1) Total in Equipment Consist	
		121		0		0		0		0		0	
(2) Total Derailed		0		0		0		0		0		(2) Total Derailed	
		39		0		0		0		0		0	
12. Equipment Damage This Consist 2184224				13. Track, Signal, Way & Structure Damage 116918									
Number of Crew Members						Length of Time on Duty							
14. Engineers/Operators 1		15. Firemen 0		16. Conductors 1		17. Brakemen 0		18. Engineer/Operator Hrs: 2 Mins: 20		19. Conductor Hrs: 2 Mins: 20			
Casualties to:		20. Railroad Employees		21. Train Passengers		22. Others		23. EOT Device? Yes		24. Was EOT Device Properly Armed? Yes			
Fatal		0		0		0		25. Caboose Occupied by Crew?				N/A	
Nonfatal		0		0		0							
26. Latitude 46.774330000				27. Longitude -92.484950000									

SKETCHES

Sketch - Sketch

Report No. HQ-2019-1323

BNSF Single Main Track Derailment (Lakes Sub)

Near Cloquet, Minnesota

Approximate Milepost (MP) 45.49

Lat: 46.77433, Long: -92.484950

Train Symbol: C-BTMCBO-13B

Class 3 Track 40 Mile Per Hour (MPH)

Not an Amtrak Route

Weather Saturday night partly cloudy, low 7

October 26, 2018 FRA's ATIP DOTX-220

Survey identified the following defects 439-feet of railroad east from the (POD).

- 46.773637 -92.486423 (Wide Gage 57.70)
- 46.773637 -92.486423 (LG Safety)
- 46.773619 -92.486453 (PLG24)
- 46.773516 -92.486625 (PLG24)
- 46.773270 -92.487010 (PLG24)
- 46.773224 -92.487077 (PLG24)
- 46.773107 -92.487242 (PLG24)
- 46.772955 -92.487448 (PLG24)
- 46.772851 -92.487584 (PLG24)
- 46.772793 -92.487657 (PLG24)
- 46.772758 -92.487701 (PLG24)
- 46.772691 -92.487783 (PLG24)



**Total 39 Coal Cars Derailed on BNSF's Single Main Track**  
An Estimated 34 Cars Spilled Coal alongside or into the St. Louis River  
Pre-Accident Repairs BNSF install 880-Feet of track panels and 30-Feet of new rail

- |  |  |  |
|--|--|--|
| 14. BNSF 670375 (Upright B-End Derailed)     | 27. BNSF 670727 (Onside and Spilled Product) | 40. PNJX 50050 (Onside and Spilled Product)  |
| 15. BNSF 671468 (Onside and Spilled Product) | 28. BNSF 670441 (Onside and Spilled Product) | 41. BNSF 669159 (Onside and Spilled Product) |
| 16. FURX 963762 (Onside and Spilled Product) | 29. BNSF 668707 (Onside and Spilled Product) | 42. GGPX 7053 (Onside and Spilled Product)   |
| 17. BNSF 671016 (Onside and Spilled Product) | 30. BNSF 671839 (Onside and Spilled Product) | 43. BNSF 672021 (Onside and Spilled Product) |
| 18. BNSF 671445 (Onside and Spilled Product) | 31. BNSF 671282 (Onside and Spilled Product) | 44. BNSF 672339 (Onside and Spilled Product) |
| 19. BNSF 671824 (Onside and Spilled Product) | 32. BNSF 672424 (Onside and Spilled Product) | 45. WFRX 970561 (Onside and Spilled Product) |
| 20. BNSF 672047 (Onside and Spilled Product) | 33. BNSF 672225 (Onside and Spilled Product) | 46. BNSF 670712 (Onside and Spilled Product) |
| 21. BNSF 672631 (Onside and Spilled Product) | 34. BNSF 671372 (Onside and Spilled Product) | 47. BNSF 672297 (Onside and Spilled Product) |
| 22. BNSF 670225 (Upright Both Ends Derailed) | 35. WFRX 975262 (Onside and Spilled Product) | 48. BNSF 672305 (Onside and Spilled Product) |
| 23. BNSF 669308 (Onside and Spilled Product) | 36. BNSF 671801 (Onside and Spilled Product) | 49. BNSF 669234 (Upright Both Ends Derailed) |
| 24. BNSF 672300 (Onside and Spilled Product) | 37. BN 535623 (Onside and Spilled Product)   | 50. BNSF 668130 (Upright Both Ends Derailed) |
| 25. BNSF 671005 (Onside and Spilled Product) | 38. BNSF 669764 (Onside and Spilled Product) | 51. BNSF 699216 (Upright Both Ends Derailed) |
| 26. BNSF 672207 (Onside and Spilled Product) | 39. BNSF 670028 (Onside and Spilled Product) | 52. BNSF 669984 (Upright B-End Derailed)     |

\*DRAWING NOT TO SCALE

**NARRATIVE**

**Circumstances Prior to the Accident**

The crew of BNSF Railway Company (BNSF) freight train C-BTMC0B0-13B (Train 1) included an Engineer and a Conductor. They reported for duty on February 16, 2019, at 9:05 a.m., CST, at BNSF's 28th Street Yard Office in Superior, Wisconsin. Prior to reporting for duty on this day, the Conductor and Engineer last went off-duty on February 15, 2019, at 2:20 p.m., CST. Both crew members received more than the required statutory off-duty period prior to reporting for duty. Superior is the home terminal for both crew members.

Train 1 consisted of 2 head-end locomotives, 121 loaded hopper cars of coal, and 1 distributed power unit (DPU) locomotive at the rear of the train. The total length of the train was 6,423 feet with 16,949 trailing tons. The train had 140 tons per operative brake. Train 1 was scheduled to make a round trip between Black Thunder Junction, Wyoming, and Superior, and last received a Class 1 terminal train air brake test on February 14, 2019, at 5 p.m., at Mandan Yard in Mandan, North Dakota. The railroad timetable direction of the train was west. Timetable directions will be used throughout this report.

The crew was picked up at the Yard Office and brought to where its train was secured in the yard. The Conductor released the hand brakes and the Engineer performed a set and release brake test. Train 1 departed Superior 28th Street Yard on signal indication at approximately 9:35 a.m., CST. The train operated on the authority of signal indications throughout the entire trip. Beginning at Milepost (MP) 44.0, the track is tangent before entering a 2.00-degree right-hand curve at MP 44.2, then becomes tangent again at MP 44.4. The approach to the derailment site at MP 45.49 from the east is single main track and the St. Louis River runs adjacent to the track on the north side. The maximum authorized speed for freight trains is 45 mph, as designated in BNSF's Twin Cities Timetable No. 8.

As Train 1 approached the accident area, the Engineer was seated at the controls on the north side of the lead locomotive, and the Conductor was seated on the south side of the lead locomotive.

At the time of the accident it was cloudy with an easterly wind of 5 mph. The temperature was 18° F.

**The Accident**

Train 1 was being operated at a recorded speed of 39 mph when the derailment occurred. The train was operating westbound on BNSF's Lakes Subdivision when the Engineer and Conductor felt a gentle run-in. Moments later, an undesired emergency application of the air brakes occurred and the train came to a stop. The Conductor immediately announced "emergency" on the radio and walked toward the rear of the train to determine the cause of the emergency application. The Conductor reported the derailment to the Engineer over the radio. The Conductor returned to the locomotive and the Engineer reported the information to the train dispatcher.

A total of 39 cars derailed, positions 14-52, all of which were loaded hoppers of coal. Six cars derailed

upright while the balance of 33 cars derailed onto their sides. Two of the derailed cars penetrated the ice on the St. Louis River causing some coal to be released into the water.

There was no release of hazardous materials and no evacuations ordered.

Damage from the derailment was \$2,184,224 to equipment and \$116,918 in track and signal, totaling \$2,301,142.

### **Post-Accident Investigation**

The Federal Railroad Administration (FRA) performed an investigation of the derailment. The following analysis and conclusions represent the findings based on the FRA investigation.

### **Analysis and Conclusions**

*Analysis – Toxicological Testing:* This accident met the criteria for Title 49 Code of Federal Regulations (CFR), Part 219 Post Accident Toxicological Testing. The Engineer and Conductor were both tested for drugs and alcohol with negative results.

*Conclusion:* FRA determined drugs and alcohol did not contribute to the cause or severity of the derailment.

*Analysis – Fatigue:* FRA used a fatigue analysis software program to create an analysis model for each crew member's overall effectiveness rate at the time of the accident. This model was produced through calculations made using collected work/rest data from each of the crew members. 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. If an employee does not provide sleep information, FRA uses the default software settings.

FRA obtained fatigue-related information, including a 10-day work history, for two employees involved in this accident. The analysis indicated fatigue was not probable for either employee.

*Conclusion:* FRA determined fatigue did not contribute to the cause or severity of the derailment.

*Analysis – Event Recorder:* An FRA Chief Inspector analyzed the event recorder data provided by BNSF for lead locomotive of Train 1 (BNSF 7549). The event recorder data prior to the derailment suggested that train handling was in accordance with proper train-handling procedures. No exceptions were taken to the operation of Train 1.

*Conclusion:* FRA determined train handling did not contribute to the cause or severity of the derailment.

*Analysis – Mechanical:* A 1,500-mile Extended Haul air brake test was performed on February 14, 2019 at 5 p.m., CST, by BNSF mechanical inspectors at Mandan Yard in Mandan, North Dakota. Two cars were identified as bad orders and 30 in-train repairs were made prior to Train 1 departing Mandan.



FRA reviewed the relevant records for the equipment involved in the incident and took no exceptions with the records. During the on-site investigation of the derailment, the R3 wheel of hopper car FURX 963762 was found to have a significant portion plate and hub broken off. Upon further investigation, one piece of the wheel was found near the Point of Derailment (POD) at MP 45.49 and another piece was found at MP 45.5 at the derailment site. The wheel had a 33-inch break and signs of rust, which indicates that a defect had been developing for some time.

Poor wheel steel cleanliness and tensile residual stress fields are two potential root causes for broken hubs and plates. Oxides and sulfide inclusions and voids in the steel structure can act as stress risers and are generally undesirable. Tensile residual stresses can increase the mechanical stresses that occur during wheel-to-rail contact and increase the probability for crack initiation and propagation. Compressive residual “hoop” stresses are developed in the wheel rim both during manufacturing and when wheels contact the rail while in service. Heat input from braking can relieve the hoop stress or cause an undesirable tensile state of residual hoop stress in some cases.

Hopper car FURX 963762 had no actionable Wheel Impact Load Detector (WILD) or Hot Box detector (HBD) results in the 30 days prior to the accident. The highest WILD reading for the R3 wheel was 70.74 kips on February 13, 2019. At the time of the accident, BNSF policy was to remove wheels from service with kip readings of greater than 90. There were no open or closed alarms on freight car FURX 963762 from any BNSF wayside system.

The R3 wheel was a CH-36 cast steel 2-wear heat treated curved plate wheel (Class C) manufactured at the Griffin plant in Iowa (GK). This wheel was manufactured in May 2013. The serial number was 40803. The mate wheel, L3, was also a CH-36 cast steel 2-wear heat treated curved plate wheel (Class C) manufactured at the Griffin plant in Iowa (GK). This wheel was also manufactured in May 2013. The serial number was 41251. The wheel was mounted at Havelock Shop in Lincoln, Nebraska, (BNCX) on May 5, 2017.

A large enough portion of the wheel was broken off to allow the R3 wheel to fall to the inside of the north rail at the POD. Hopper car FURX 963762 was found on its side on the north side of the track west of the derailment site. After the R3 wheel of hopper car FURX 963762 fell into the gage of the single main track, it continued on the ground past the point of derailment and pulled the following 38 cars to the west of it off the track.

FRA requested a copy of the Technical Research & Development Report (TR&D Report) from BNSF. BNSF would not supply this request; however, they did send a summary and close out recommendation memo that was obtained from the information gathered in the TR&D Report.

Conclusion: FRA determined the broken wheel on car FURX 963762 was the probable cause of the derailment. (Cause code: E61C)

Analysis– Track Structure: The track structure at MP 45.49 derailment location consisted of a single



main track oriented in an east-west direction. The single main track on the Lakes Subdivision where the accident occurred is owned, inspected, maintained, and operated by BNSF, which designated it as Class 3 track. Train 1 was traversing the area at a recorded speed of 39 mph prior to the derailment. The maximum authorized speed for this freight train, while operating with greater than 100 tons per operative brake, is 45 mph at MP 45.49.

The rail is 136-pound continuous welded rail (CWR), rolled in 2015 and installed August 1, 2015 on a right-hand curve (No. 45) east and through the derailment site. Both high/low rails were fastened and seated into 14-inch double-shoulder tie plates to standard 8-foot wooden crossties with conventional 6-inch cut track spikes with an anchor pattern of every-other tie through the area, and rail blocks on the high rail of the curve. BNSF conducted a general tie maintenance program in the area to replace its defective tie groups in 2018.

The last ultrasonic rail detector inspection of the main track was conducted by Herzog No. 166 between MP 41.023 and MP 58.014 on January 7, 2019, with no defects reported. BNSF annual tonnage for 2018 was 21.98 million-gross-tons in this area.

The track at MP 45.49 point-of-derailment (POD) was last inspected on Wednesday, February 13, 2019, by a qualified BNSF track inspector conducting a hi-rail/walking inspection. The track inspector noted three defects between MP 35.101 and MP 58.100 during this inspection.

BNSF failed to provide FRA with a copy of its geometry car report for Curve No. 45 at the MP 45.49 derailment site. FRA did conduct a geometry car survey previously through the area on Friday, October 26, 2018, and during this inspection noted several Advisories (PLG-24) Project Loaded Gage through Curve No. 45, and one wide gage Advisory 439-feet east of the POD due to defective rail fasteners, which likely were a contributing cause. These advisories provided by the FRA DOTX-220 car showed that if conditions of multiple defects accrue in the same area, the gage would widen to over 58-inches and cause a wheel to drop into the gage. The broken wheel defect likely resulted in the L/V ratio's to be exceeded, pushing the rail outward over the 24,000-pound threshold causing the derailment at MP 45.49.

FRA investigation on February 16, 2019 showed gage and cross-level measurements east of the POD with an average gage measurement of 57-7/16 inches and an average cross-level measurement of 7/8 inches. FRA noted slight differential plate cutting on the low rail of the curve, which explains the advisories 439-feet east of the POD for PLG-24, and Wide Gage provided to BNSF on October 26, 2018, from FRA's DOTX-220 geometry car. FRA noted no measurements taken at the site on February 16, 2019, to require restricting BNSF to speeds lower than the maximum authorized speed in this area.

**Conclusion:** FRA determined the track condition may have contributed to the cause of the derailment. (Cause code: T111)

**Analysis – Signal:** The subdivision was controlled by a Traffic Control System. FRA analyzed the signal system test records between MP 44.3 and MP 46.7. No deficiencies were noted in BNSF testing of its

signal system at the derailment location.

Conclusions: FRA determined the signal system did not contribute to the cause or severity of the derailment.

### **Overall Conclusions**

The FRA investigation of this accident concluded the R3 wheel on FURX 963762 broke, with a significant portion of the wheel tread becoming separated from the wheel. This allowed the wheel to drop in, damaging the track structure, and causing the derailment.

FRA also concluded the previously discovered track defects in the area of the derailment may have contributed to the severity of the derailment.

### **Derailment Cause Conclusion**

FRA determined the probable cause of the derailment was E61C – Broken rim.

Additionally, FRA determined a possible contributing cause was T111 – Wide gage due to defective or missing spikes or other rail fasteners.