



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

***Accident Investigation Report
HQ-2015-1094***

***BNSF Railway Company (BNSF)
Alma, WI
November 7, 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.

TRAIN SUMMARY

1. Name of Railroad Operating Train #1 BNSF Railway Company	1a. Alphabetic Code BNSF	1b. Railroad Accident/Incident No. CH-1115-104
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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. CH-1115-104	
2. U.S. DOT Grade Crossing Identification Number		3. Date of Accident/Incident 11/7/2015	4. Time of Accident/Incident 8:45 AM	
5. Type of Accident/Incident Derailment				
6. Cars Carrying HAZMAT 20	7. HAZMAT Cars Damaged/Derailed 13	8. Cars Releasing HAZMAT 5	9. People Evacuated 75	10. Subdivision St. Croix
11. Nearest City/Town Alma		12. Milepost (<i>to nearest tenth</i>)	13. State Abbr. WI	14. County BUFFALO
15. Temperature (F) 37 °F	16. Visibility Dawn	17. Weather Clear		18. Type of Track Main
19. Track Name/Number Main Track One		20. FRA Track Class Freight Trains-60, Passenger Trains-80		21. Annual Track Density (<i>gross tons in millions</i>) 59.68
				22. Time Table Direction East

OPERATING TRAIN #1

1. Type of Equipment Consist: Freight Train				2. Was Equipment Attended? Yes		3. Train Number/Symbol H-NTWKCK-9-06					
4. Speed (recorded speed, if available) R - Recorded E - Estimated		Code E	5. Trailing Tons (gross excluding power units) 9726		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 (1) First Involved (derailed, struck, etc.)		a. Initial and Number CTTX 692394	b. Position in Train 10	c. Loaded (yes/no) no	8. If railroad employee(s) tested for drug/ alcohol use, enter the number that were positive in the appropriate box.			Alcohol 0	Drugs 0		
(2) Causing (if mechanical, cause reported)					9. Was this consist transporting passengers?			No			
10. Locomotive Units (Exclude EMU, DMU, and Cab Car Locomotives.)	a. Head End	Mid Train		Rear End		11. Cars (Include EMU, DMU, and Cab Car Locomotives.)	Loaded		Empty		
		b. Manual	c. Remote	d. Manual	e. Remote		a. Freight	b. Pass.	c. Freight	d. Pass.	e. Caboose
(1) Total in Train	3	0	0	0	0	(1) Total in Equipment Consist	58	0	54	0	0
(2) Total Derailed	0	0	0	0	0	(2) Total Derailed	16	0	9	0	0
12. Equipment Damage This Consist 1013716			13. Track, Signal, Way & Structure Damage 1096271								
14. Primary Cause Code H519 - Dynamic brake, too rapid adjustment (H011)											
15. Contributing Cause Code H504 - Buffing or slack action excessive, train make-up											
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: 7 Mins: 45		Hrs: 7 Mins: 45	
Casualties to:		22. Railroad Employees		23. Train Passengers		24. Others		25. EOT Device?		26. Was EOT Device Properly Armed?	
Fatal		0		0		0		Yes		Yes	
Nonfatal		0		0		0		27. Caboose Occupied by Crew?		N/A	
28. Latitude 44.352731278				29. Longitude -91.937509775							

CROSSING INFORMATION

Highway User Involved		Rail Equipment Involved	
1. Type		5. Equipment	
2. Vehicle Speed (<i>est. mph at impact</i>)	3. Direction (<i>geographical</i>)	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 1. Gates 4. Wig wags 7. Crossbucks 10. Flagged by crew 2. Cantilever FLS 5. Hwy. traffic signals 8. Stop signs 11. Other (<i>spec. in narr.</i>) 3. Standard FLS 6. Audible 9. Watchman 12. None		10. Signaled Crossing Warning	11. Roadway Conditions
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 (<i>primary obstruction</i>)	
Casualties to:	Killed	Injured	21. Driver was
23. Highway-Rail Crossing Users		24. Highway Vehicle Property Damage (<i>est. dollar damage</i>)	22. Was Driver in the Vehicle?
26. Locomotive Auxiliary Lights?		25. Total Number of Vehicle Occupants (<i>including driver</i>)	
28. Locomotive Headlight Illuminated?		27. Locomotive Auxiliary Lights Operational?	
		29. Locomotive Audible Warning Sounded?	

10. Signaled Crossing Warning

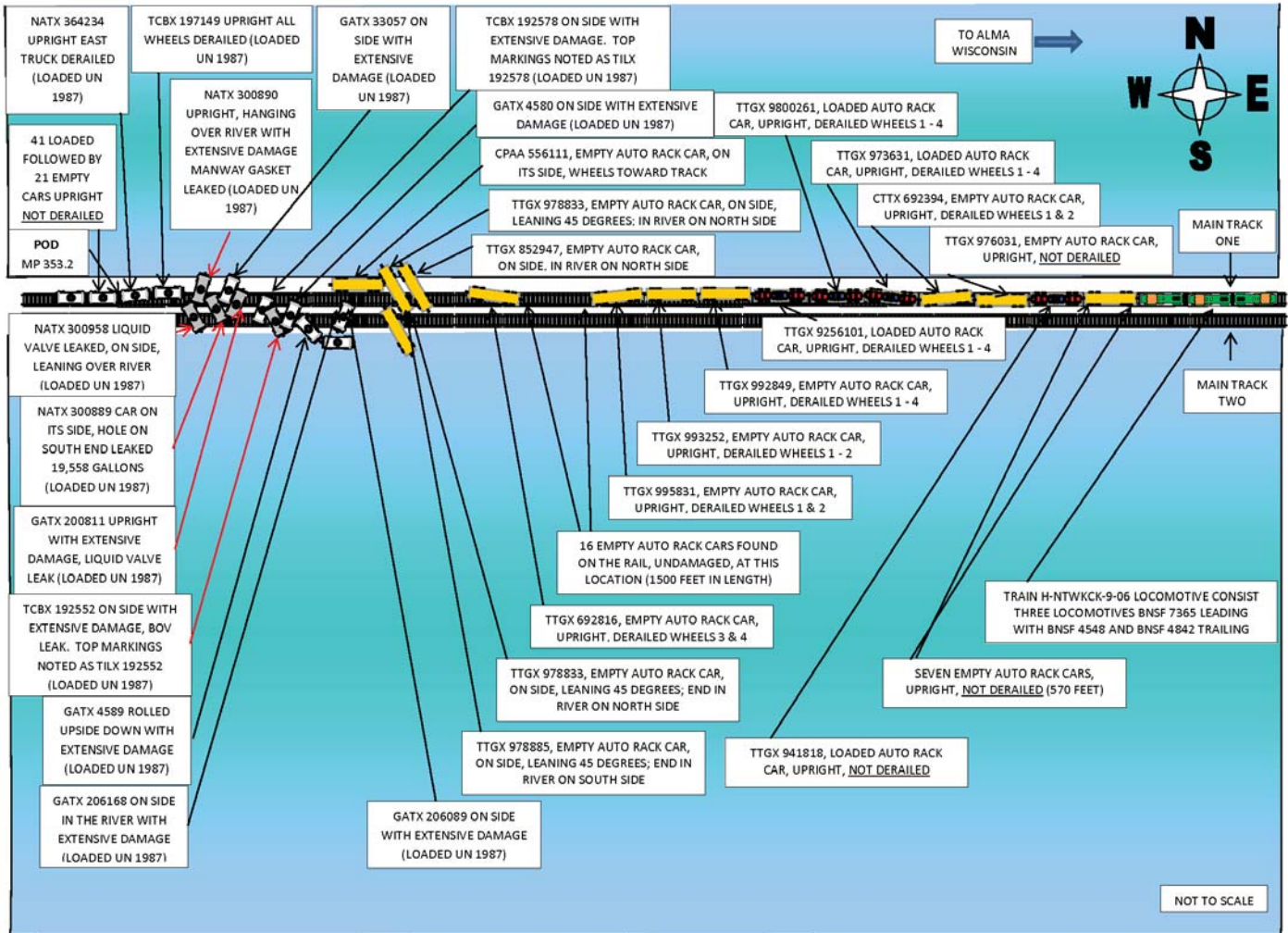
- 1 - Provided minimum 20-second warning
- 2 - Alleged warning time greater than 60 seconds
- 3 - Alleged warning time less than 20 seconds
- 4 - Alleged no warning
- 5 - Confirmed warning time greater than 60 seconds
- 6 - Confirmed warning time less than 20 seconds
- 7 - Confirmed no warning
- N/A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

Explanation Code

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

SKETCHES

Alma Derailment Scene



SYNOPSIS

On November 7, 2015, at 8:45 a.m., CST, eastbound BNSF Railway (BNSF) Mixed-Freight Train H-NTWKCK-9-06 derailed 25 cars while operating on BNSF's Chicago Division, St. Croix Subdivision, on Main Track 1. The train consisted of 58 loaded cars, 54 empty cars, and weighed 9,726 tons. The train was 8,188 feet in length. The derailment occurred at approximately Milepost 353.2, located near Alma, Wisconsin. Alma is approximately 50 miles north of La Crosse, Wisconsin. The derailment included 13 loaded tank cars containing Alcohols, Not Otherwise Specified (N.O.S.), Class 3 flammable liquid UN 1987. In addition, three loaded and nine empty automobile transport cars derailed. The Alcohol, N.O.S. Cars leaked approximately 20,413 gallons of product. The derailment location was through the back waters of the Mississippi River, which paralleled both sides of Main Track 1 and 2. An unknown amount of Alcohol, N.O.S. was leaked into the water. No fires resulted from the derailment, but as a precaution, the St. Croix County Sheriff's Department evacuated 75 residents located near the derailment site at 9:00 a.m. The evacuation was lifted at 1:05 p.m.

The maximum track speed was 60 mph. The maximum authorized train speed was 55 mph, due to a car in the train with a speed restriction. The train was operating on an approach medium signal indication at approximately 26 mph at the time of the derailment.

The weather was clear, calm, and 37 degrees.

The Federal Railroad Administration's investigation determined the probable cause was the rapid adjustment of the dynamic brakes, with an additional contributing factor identified as buffing action caused by the train makeup.

NARRATIVE

Circumstances Prior to the Accident

Train H-NTWKCK-9-06

The crew of eastbound BNSF Railway (BNSF) Train H-NTWKCK-9-06 consisted of a locomotive engineer and a conductor. They reported for duty at 1:00 a.m., CST, November 7, 2015, at BNSF's Northtown Yard, located in Fridley, Minnesota. This was the away from home terminal for the crew. The home terminal of the crew was La Crosse, Wisconsin. The Conductor and Locomotive Engineer each had a rest period of 13 hours and 15 minutes, including a statutory rest period of 10 hours of undisturbed rest, prior to reporting for duty. The timetable directions are east and west on BNSF's St. Croix Subdivision are used throughout the report.

Train H-NTWKCK-9-06 consisted of three locomotives with 58 loaded and 54 empty rail cars of mixed freight. The train weighed 9,719 trailing tons and was 8,188 feet in length. The train was rated at 86.8 tons per operating brake (TOB). Since the train was below 100 TOB, the train was eligible for track speed for freight trains of 60 mph on the St. Croix Subdivision. However, Train H-NTWKCK-9-06 contained a rail car, GTW 504122, which had a speed limit of 55 mph. This limited the train's speed to 55 mph. Locomotive BNSF 7365 was the leading and controlling locomotive throughout the trip with its short hood facing forward.

The train was made up with 37 auto transport cars, each 94 feet in length. Three of these cars were loaded, lines eight, eleven and twelve of the train's consist. The rest were all empty. Immediately behind these 37 cars were 54 loaded cars, followed by 21 empty cars.

At 11:46 p.m., November 6, 2015, the end-of-train device, BNQ 02599, was inspected and recorded as working and armed. The train received a Class 1 air brake test at Northtown Yard. The crew coupled the locomotive consist (three locomotives) onto the train at about 2:30 a.m., November 7, 2015. The train departed at 3:42 a.m. and was operated from Northtown Yard, eastbound on BNSF's St. Paul Subdivision and entered BNSF's St. Croix Subdivision near Hastings, Minnesota, at 6:38 a.m. The train was then operated eastbound on BNSF's St. Croix Subdivision on Main Track 1.

The Accident

Train H-NTWKCK-9-06

At approximately 8:44 a.m., at MP 352.55, the Locomotive Engineer was using dynamic and automatic brakes to control the train. The train experienced an undesired emergency application of the brakes while traveling at 26 mph. The train came to a stop and 25 cars were found to have derailed.

The derailed cars were found in two sections of the train. As the rail cars were noted on the train consist, lines 10 through 16 were derailed, coupled together and upright. Lines 17 through 32 were not derailed. Cars 33 through 50 were derailed. Line 33 had two wheels on the ground and was upright. Line 34 was derailed on its side with the north-end of the car in the river. Lines 35 and 36 were derailed across both main tracks leaning at a 45-degree angle. Line 37 was derailed on its side between Main Track 1 and the Mississippi River, which flows immediately west of the tracks. The 13 loaded Alcohol, not otherwise specified (N.O.S.) cars were Cars 38 through 50 from the head-end of the train. Lines 38 through 48 were derailed sideways across both main tracks, with five of these cars leaking product. Lines 49 and 50 were derailed but still upright and coupled to the rear of the train. Line 10, Rail Car CTTX 692394, an empty auto transport car, appeared to have been lifted up off the rail or rolled the rail over at Milepost (MP) 353.2 due to buff force. This action began the derailment.

There was a total of \$1,013,716 in equipment damage and \$1,096,271 in track, signal, and road bed reportable damage associated with this accident. There were no injuries as a result of this derailment.

Analysis and Conclusions

Analysis - Track, Wayside Signals, and Radio Communication Equipment: During interviews with the crew of BNSF's Train H-NTWKCK-9-06, it was determined that the signal system was working as intended. The train was operating on an approach-medium signal aspect, prepared to stop at the second signal. Also, during reports of interviews with the crew members, the radio communication equipment was determined to be functioning as intended at the time of the accident. Radio traffic between BNSF's dispatcher's base radio and mobile radio units did have the capability to be recorded and was recorded.

Conclusion - Condition of track, wayside signals, and radio communication equipment was not a factor.

Analysis - Locomotive and Train Air Brake Equipment of BNSF Train H-NTWKCK-9-06: Prior to the incident, BNSF Train H-NTWKCK-9-06 had received a satisfactory Class 1 brake test on November 6, 2015, at 11:46 p.m., at BNSF's Northtown Yard. The train crew took no exceptions to the condition of air brakes. The Federal Railroad Administration (FRA) took no exceptions to the Class 1 air brake test given to the train.

Conclusion: Condition of the locomotive and train air brake equipment of BNSF's Train H-NTWKCK-9-06 was not a factor.

Analysis - Inspection of BNSF Train H-NTWKCK-9-06, Lead Locomotive BNSF 7365, Middle Unit BNSF 4549, and Trailing Unit BNSF4843 showed all had a daily inspection completed at Northtown Yard, on November 6, 2015, by BNSF's locomotive service personnel. Each of the three locomotives in the consist were cut-in and operating the entire trip on November 6, 2015. The crew was found to be aware of this.

Conclusion- Condition of the locomotives within the consist of BNSF Train H-NTWKCK-9-06 was not a factor. FRA took no exception to the daily and periodic inspection history of the locomotives involved.

Analysis - BNSF Operating Crew Efficiency Testing Performance: Both crew members of the derailed train had efficiency tests recorded on the St. Croix subdivision, as well as other subdivisions over the preceding year.

- The Locomotive Engineer of BNSF Train H-NTWKCK-9-06 was observed on 18 different occasions, with 56 tests recorded. All but one of these tests was scored as passing. He was tested twice with tests that involved observations of proper signal compliance on the St. Croix subdivision. The observation tests on the St. Croix subdivision were 45 percent of all his observation tests over the preceding year. The observation test that was recorded as a failure involved BNSF Air Brake and Train Handling Rule 106.7, Speed Reduction for Fuel Conservation. The employee received verbal coaching as a result.

- The Conductor of BNSF Train H-NTWKCK-9-06 was observed on five different occasions, twice on the St. Croix subdivision, with 24 total tests recorded. All of these tests were scored as passing. He was tested one time on the St. Croix subdivision with a test that involved train speed over a temporary speed restriction. The tests conducted on the St. Croix subdivision accounted for 33 percent of all his tests over the preceding year. All 24 of these tests were recorded as passing.

Conclusion - Operating employees were observed often through conditions that required adherence to signal indications for their movements, during a 1-year period leading up to the accident. The application of the railroad's operational testing program was not a factor with this accident.

Analysis - Train Crew Operating Performance: The Engineer and Conductor of BNSF Train H-NTWKCK-9-06 stated that nothing was out of the ordinary with the function of the train prior to the accident. They also stated that they felt two occurrences of a run-in condition prior to the derailment. In addition to the locomotive event recorder evidence, interviews with the Locomotive Engineer revealed that he tried to stop the train aggressively to avoid fouling any crossings.

Review of the locomotive event recorder on BNSF 7365 indicated the following:

- 08:41:01: The throttle position was changed from T7 to T6 while traveling at 54 mph.
- 08:41:38: The throttle position was changed from T6 to T5 while traveling at 54 mph at this time.
- 08:43:08: The event recorder then captured a reduction of the throttle from position T5 to Idle over a 45-second period and a distance of 0.67 miles. The speed had reduced to 53 mph as the locomotive passed a location that was about 7,500 feet west of where the train would eventually come to a final stop and about 8,700 feet from the crew's target stop point.

target stop point.

- 08:43:17: The locomotive was set to dynamic brake set-up then placed into dynamic braking position DB2. Over the next 30 seconds the locomotive was operated in DB2 starting at a speed of 52 mph, with a traction effort of 0.
- 08:43:43: The Engineer made an air reduction of 1 psi. Six seconds later, he increased the dynamic brake from DB2 to DB3. Two seconds after that, he began a 5 psi reduction of the train brakes, followed 2 seconds later by an increase of dynamic brakes from DB3 to DB5. Seven seconds later, at 8:44:01: The Engineer made another train brake reduction of 2 more pounds, bringing the brake pipe down to 75 psi. At this time, the speed was 48 mph and they were 3,488 feet from their final stopping point.
- 08:43:49: Train speed was 50 mph with a traction effort of 3 kilopounds (K). At this time the dynamic brake was changed to position DB3 for 5 seconds and the traction effort increased to 8K. The dynamic brake was changed to position DB5 for 1-second then changed to DB8 immediately after that. Traction effort was at 10K at the time the dynamic brake was changed to position DB8.
- 08:43:57 through 08:44:07: The train experienced a run-out condition as the air brakes of the train applied which stretched the slack of the train and slowed the train. The run-out condition lasted for 11 seconds as the traction effort increased from 14K to 42K.
- 08:44:09: The head-end of the train experienced a run in as the slack of the train pressed against the locomotives as the dynamic brakes of the locomotives collected the bunched slack of the train and retarded the movement of the train. The run-in condition lasted for 5 seconds, ending as the locomotive passed by MP 352.99, at 46 mph, with a traction effort of 47K and the brake pipe at 74 psi.
- 08:44:54: The locomotive passed MP 352.55, as the train was being controlled with dynamic brakes and an automatic brake application. The brake pipe went into an undesired emergency application while the train traveled at 26 mph. The train air brake pipe was at 75 psi and the traction effort at 64K prior to the train going into emergency. The train came to a stop and 25 cars were found to have derailed.

The Locomotive Engineer of BNSF Train H-NTWKCK-9-06 was not in compliance with BNSF's Air Brake and Train Handling Rule 103.6.4, Stopping, 103.6.4 Stopping

A. Stopping, Level or Descending Grade with Dynamic Brakes Available, Slack Bunched

When stopping on level or descending grade with dynamic brakes available with slack bunched:

1. Gradually reduce the throttle to IDLE.
2. Wait 10 seconds.
3. Activate the dynamic brake and gradually bunch the slack.
4. Increase braking to the desired level.
5. At a sufficient distance from the stop, make a minimum brake pipe reduction and actuate.
6. Make further split reduction(s) as needed and actuate.
7. As speed drops below dynamic brake range, supplement with the independent brake.
8. Make a final brake pipe reduction and allow the locomotive brakes to apply.

With only minimum dynamic braking effort and slack not completely or gradually bunched before setting the automatic brake, train handling may have been a casual factor in the derailment. This is also not consistent with BNSF ABTH Rules. A few seconds after going from dynamic brake notch three to dynamic brake notch eight there is an indication of buff forces (run-out) followed by slight speed increase indicating a run-in before the derailment.

Conclusion – The Locomotive Engineer's operation of BNSF Train H-NTWKCK-9-06 was the primary cause of the derailment.

Analysis- Train Consist and Train Makeup - BNSF Train H-NTWKCK-9-06 consist was reviewed. FRA found that the train consisted of 112 rail cars. The head 37 cars consisted of three loaded rail cars and 34 empty rail cars weighing a total of 775 tons. The rear 75 cars consisted of 54 loaded rail cars and 21 empty rail cars weighing a total of 7,685 tons. The heavy loaded rail cars on the rear-end of the train behind the lighter empty rail cars on the head-end of the train would have contributed to buff force action and would have enhanced the run in movement experienced in the train.

Conclusion- FRA found train make-up to be a contributing cause of the derailment.

Analysis – Hazardous Material Spill of BNSF Train H-NTWKCK-9-06: Thirteen loaded tank cars containing Alcohol, N.O.S., (Class 3 Flammable Liquid) were derailed. Five derailed Alcohol N.O.S. cars leaked an estimated 20,113 gallons of product. The back waters of the Mississippi River parallel both sides of Main Track 1 and 2 at the site of the derailment. Five tank cars were observed to have leaked product directly after the derailment. One of the tank cars leaked about 15,555 gallons of Alcohol, N.O.S. into the water after suffering a puncture during the derailment. This car later additionally leaked about 4,003 gallons of product onto the railroad right-of-way during the re-railing process. Four other cars leaked an additional total of 858 gallons of Alcohol, N.O.S. due to damage from the derailment. No fires resulted from the derailment. The thirteen tank cars involved in the derailment were found to be extremely damaged, and in non-repairable condition. Six tank cars containing Alcohol, N.O.S. were found to be in, or partially in, the Mississippi River. Thirteen loaded Alcohol, N.O.S. (UN1987) cars were derailed, 10 of which were on their side. Five cars lost product; all were legacy DOT-111 tank cars. All product contained in these cars was UN1987 Alcohol, N.O.S., Flammable Liquid, Package Group II, Hazmat STCC Number 4909152. The thirteen damaged cars were transported to a location 5 miles west of the derailment site to the siding in Nelson, Wisconsin. This location is where BNSF finished trans-loading and tank cars were cleaned and purged of hazardous material residue. The rail cars are scheduled to be destroyed at the Nelson, Wisconsin, site.

Conclusion: FRA found the condition of the tank cars were not a factor.

Analysis - Toxicology Testing of Locomotive Engineer and Conductor of BNSF Train H-NTWKCK-9-06: The accident met the criteria for Title 49 Code of Federal Regulations Part 219, Subpart C, Post-Accident Toxicological Testing, and a total of two train crew members were tested. The results for all tests were negative.

Conclusion - Intoxication or impairment was not a causal factor.

Analysis - Fatigue analysis of train crew members: FRA uses an overall effectiveness rate of 77.5 percent as the baseline for fatigue analysis, which is equivalent to blood alcohol content (BAC) of 0.05. At or above this baseline, we do 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, including the Locomotive Engineer and Conductor assigned to the train involved.

Information for the train and engine service employees assigned to BNSF Train H-NTWKCK-9-06:

Fatigue Conclusions:

1. Locomotive Engineer: BNSF Train H-NTWKCK-9-06

Sleep setting - Excellent

Overall effectiveness = 56.39%

Lapse Index = 8.8

Reaction Time = 174%

Chronic Sleep Debt = 12.79

Hours of Continuous Wakefulness = 9.27

Time of Day 08:45

BAC Equivalent = >0.08

Finding: Fatigue was probable for this employee.

2. Conductor: BNSF Train H-NTWKCK-9-06

Sleep setting - Excellent

Overall effectiveness = 64.69%

Lapse Index = 6.4

Reaction Time = 153%

Chronic Sleep Debt = 11.54

Hours of Continuous Wakefulness = 9.27

Time of Day 08:45

Time of Day 08:45

BAC Equivalent = >0.08

Finding: Fatigue was probable for this employee

Conclusion - Upon analysis of the fatigue-related information, FRA concluded that fatigue was probable for the two BNSF employees assigned to BNSF Train H-NTWKCK-9-06 and may have been a contributing factor with the cause and severity of this accident due to their impairment due to fatigue.

Probable Cause and Contributing Factors

FRA's investigation determined the probable cause was the too rapid adjustment of the dynamic brakes, with an additional contributing factor identified as buffing action caused by the train makeup.