Federal Railroad Administration
Office of Safety
Headquarters Assigned
Accident Investigation Report
HQ-2005-53

Burlington Northern Santa Fe (BNSF)
Verona, Missouri
July 2, 2005

Note that 49 U.S.C. §20903 provides that no part of an accident or incident report 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.

DEPARTMENT OF TRANSPORTATION
FEDERAL RAILROAD ADMINISTRATION

FRA FACTUAL RAILROAD ACCIDENT REPORT

FRA File # HQ-2005-53

1.Name of Railroad Operating Train #1	1a. Alphabetic Code	1b. Railroad Accident/Incident No.
BNSF Rwy Co. [BNSF]	BNSF	SF0705102
2.Name of Railroad Operating Train #2	2a. Alphabetic Code	2b. Railroad Accident/Incident
N/A	N/A	N/A
3.Name of Railroad Responsible for Track Maintenance:	3a. Alphabetic Code	3b. Railroad Accident/Incident No.
BNSF Rwy Co. [BNSF]	BNSF	SF0705102
4. U.S. DOT_AAR Grade Crossing Identification Number	5. Date of Accident/Incident: Month 07 / Day 02 / Year 2005	6. Time of Accident/Incident: 06:26: ☐ AM ☑ PM

7. Type of Accident/Indicent (single entry in code box): 1. Derailment; 2. Head on collision; 3. Rear end collision; 4. Side collision; 5. Raking collision; 6. Broken Train collision; 7. Hwy-rail crossing; 8. RR grade crossing; 9. Obstruction; 10. Explosion-detonation; 11. Fire/violent rupture; 12. Other impacts; 13. Other (describe in narrative) — Code: 01

8. Cars Carrying HAZMAT	9. HAZMAT Cars Damaged/Derailed	10. Cars Releasing HAZMAT	11. People Evacuated	12. Division
8	0	0	0	Springfield

13. Nearest City/Town	14. Milepost (to nearest tenth)	15. State Abbr	15. State Code	16. County
Verona	274.3	N/A	MO	LAWRENCE

17. Temperature (F) (specify if minus)	18. Visibility (single entry) 1. Dawn 2. Day 3.Dusk 4.Dark	Code	19. Weather (single entry) 1. Clear 2. Cloudy 3. Rain 4. Fog 5.Sleet 6.Snow	Code	20. Type of Track 1. Main 2. Yard 3. Siding 4. Industry	Code
84 F		2		1		1

21. Track Name/Number	22. FRA Track Class (1-9, X)	Code	23. Annual Track Density (gross tons in millions)	24. Time Table Direction 1. North 3. East	Code
Single Main		3	38.58		3

OPERATING TRAIN #1

25. Type of Equipment Consist (single entry): 1. Freight train; 2. Passenger train; 3. Commuter train; 4. Work train; 5. Single car; 6. Cut of cars; 7. Yard/switching; 8. Light loco(s).; 9. Maint./inspect.car; A. Spec. MoW Equip. — Code: 1

26. Was Equipment Attended? 1. Yes 2. No — Code: 1

27. Train Number/Symbol: MTUL GAL10

28. Speed (recorded speed, if available) R - Recorded; E - Estimated: 9 MPH — Code: R

30. Method(s) of Operation (enter code(s) that apply): a. ATCS; b. Auto train control; c. Auto train stop; d. Cab; e. Traffic; f. Interlocking; g. Automatic block; h. Current of traffic; i. Time table/train orders; j.Track warrant control; k. Direct traffic control; l.Yard limits; m.Special instructions; n. Other than main track; o. Positive train control; p. Other (Specify in narrative) — Code(s): e | i | N/A | N/A | N/A

30a. Remotely Controlled Locomotive? 0 = Not a remotely controlled; 1 = Remote control portable; 2 = Remote control tower; 3 = Remote control transmitter - more than one remote control transmitter: 0

29. Trailing Tons (gross tonnage, excluding power units): 7794

31. Principal Car/Unit	a. Initial and Number	b. Position in Train	c. Loaded (yes/no)
(1) First involved (derailed, struck, etc)	N/A	16	no
(2) Causing (if mechanical cause reported)	MRS2524	16	no

32. If railroad employee(s) tested for drug/alcohol use, enter the number that were positive in the appropriate box.

Alcohol	Drugs
N/A	N/A

33. Was this consist transporting passengers? (Y/N): N

34. Locomotive Units	a. Head End	Mid Train b. Manual	Mid Train c. Remote	Rear End d. Manual	Rear End c. Remote
(1) Total in Train	3	0	0	0	0
(2) Total Derailed	0	0	0	0	0

35. Cars	Loade a. Freight	Loade b. Pass.	Empty c. Freight	Empty d. Pass.	e. Caboose
(1) Total in Equipment Consist	43	0	72	0	0
(2) Total Derailed	14	0	10	0	0

36. Equipment Damage This Consist	37. Track, Signal, Way, & Structure Damage	38. Primary Cause Code	39. Contributing Cause Code
178277	195000	E47C	T199

Number of Crew Members

40. Engineer/ Operators	41. Firemen	42. Conductors	43. Brakemen
N/A	0	1	0

Length of Time on Duty

44. Engineer/Operator	45. Conductor
Hrs 8 Mi 16	Hrs 8 Mi 16

Casualties to:	46. Railroad Employees	47. Train Passengers	48. Other
Fatal	0	0	0
Nonfatal	N/A	0	0

49. EOT Device? 1. Yes 2. No — 1

50. Was EOT Device Properly Armed? 1. Yes 2. No — 1

51. Caboose Occupied by Crew? 1. Yes 2. No — 2

OPERATING TRAIN #2

52. Type of Equipment Consist (single entry): 1. Freight train; 2. Passenger train; 3. Commuter train; 4. Work train; 5. Single car; 6. Cut of cars; 7. Yard/switching; 8. Light loco(s).; 9. Maint./inspect.car; A. Spec. MoW Equip. — Code: N/A

53. Was Equipment Attended? 1. Yes 2. No — Code: N/A

54. Train Number/Symbol: N/A

55. Speed (recorded speed, if available) R - Recorded; E - Estimated: 0 MPH — Code: N/A

57. Method(s) of Operation (enter code(s) that apply): a. ATCS; b. Auto train control; g. Automatic block; h. Current of traffic; m.Special instructions; n. Other than main track

57a. Remotely Controlled Locomotive? 0 = Not a remotely controlled; 1 = Remote control portable

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56. Trailing Tons (gross tonnage, excluding power units)	c. Auto train stop d. Cab e. Traffic f. Interlocking	i. Time table/train orders j.Track warrant control k. Direct traffic control l.Yard limits	o. Positive train control p. Other (Specify in narrative) Code(s)	2 = Remote control tower 3 = Remote control transmitter - more than one remote control transmitter
0			N/A N/A N/A N/A N/A	N/A

58. Principal Car/Unit	a. Initial and Number	b. Position in Train	c. Loaded (yes/no)	59. 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)	0	0	N/A		N/A	N/A
(2) Causing (if mechanical cause reported)	0	0	N/A	60. Was this consist transporting passengers? (Y/N)		N/A

61. Locomotive Units	a. Head End	Mid Train b. Manual	Mid Train c. Remote	Rear End d. Manual	Rear End c. Remote	62. Cars	Loade a. Freight	Loade b. Pass.	Empty c. Freight	Empty d. Pass.	e. Caboose
(1) Total in Train	0	0	0	0	0	(1) Total in Equipment Consist	0	0	0	0	0
(2) Total Derailed	0	0	0	0	0	(2) Total Derailed	0	0	0	0	0

63. Equipment Damage This Consist	64. Track, Signal, Way, & Structure Damage	65. Primary Cause Code	66. Contributing Cause Code
0	0	N/A	N/A

Number of Crew Members				Length of Time on Duty	
67. Engineer/ Operators	68. Firemen	69. Conductors	70. Brakemen	71. Engineer/Operator	72. Conductor
0	0	0	0	Hrs 0 Mi 0	Hrs 0 Mi 0

Casualties to:	73. Railroad Employees	74. Train Passengers	75. Other
Fatal	0	0	0
Nonfatal	0	0	0

76. EOT Device?	77. Was EOT Device Properly Armed?	78. Caboose Occupied by Crew?
1. Yes 2. No N/A	1. Yes 2. No N/A	1. Yes 2. No N/A

Highway User Involved

79. Type	Code
A. Auto B. Truck C. Truck-Trailer. D. Pick-Up Truck E. Van F. Bus G. School Bus H. Motorcycle J. Other Motor Vehicle K. Pedestrian M. Other (spec. in narrative)	N/A

80. Vehicle Speed (est. MPH at impact)	81. Direction geographical) 1.North 2.South 3.East 4.West	Code
N/A		N/A

82. Position	Code
1.Stalled on Crossing 2.Stopped on Crossing 3.Moving Over Crossing 4. Trapped	N/A

86a. Was the highway user and/or rail equipment involved in the impact transporting hazardous materials?	Code
1. Highway User 2. Rail Equipment 3. Both 4. Neither	N/A

Rail Equipment Involved

83. Equipment	Code
1.Train(units pulling) 2.Train(units pushing) 3.Train (standing) 4.Car(s) (moving) 5.Car(s) (standing) 6.Light Loco(s) (moving) 7.Light(s) (standing) 8.Other (specify in narrative)	N/A

84. Position of Car Unit in Train
N/A

85. Circumstance	Code
1. Rail Equipment Struck Highway User 2. Rail Equipment Struck by Highway User	N/A

86b. Was there a hazardous materials release by	Code
1. Highway User 2. Rail Equipment 3. Both 4. Neither	N/A

86c. State here the name and quantity of the hazardous materials released, if any.
N/A

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

88. Signaled Crossing Warning (See instructions for codes)	Code
	N/A

89. Whistle Ban	Code
1. Yes 2. No 3. Unknown	N/A

90. Location of Warning	Code
1. Both Sides 2. Side of Vehicle Approach 3. Opposite Side of Vehicle Approach	N/A

91. Crossing Warning Interconnected with Highway Signals	Code
1. Yes 2. No 3. Unknown	N/A

92. Crossing Illuminated by Street Lights or Special Lights	Code
1. Yes 2. No 3. Unknown	N/A

93. Driver's Age	94. Driver's Gender	Code
N/A	1. Male 2. Female	N/A

95. Driver Drove Behind or in Front of Train and Struck or was Struck by Second Train	Code
1. Yes 2. No 3. Unknown	N/A

96. Driver	Code
1. Drove around or thru the Gate 2. Stopped and then Proceeded 3. Did not Stop 4. Stopped on Crossing 5. Other (specify in narrative)	N/A

97. Driver Passed Standing Highway Vehicle	Code
1. Yes 2. No 3. Unknown	N/A

98. View of Track Obscured by (primary obstruction)	Code
1. Permanent Structure 2. Standing Railroad Equipment 3. Passing Train 4. Topography 5. Vegetation 6. Highway Vehicle 7. Other (specify in narrative) 8. Not obstructed	N/A

101. Casulties to Highway-Rail Crossing Users	Killed	Injured
	N/A	N/A

99. Driver Was	Code
1. Killed 2.Injured 3. Uninjured	N/A

100. Was Driver in the Vehicle?	Code
1. Yes 2. No	N/A

102. Highway Vehicle Property Damage (est. dollar damage)
N/A

103. Total Number of Highway-Rail Crossing Users (include driver)
N/A

104. Locomotive Auxiliary Lights?	Code
1. Yes 2. No	N/A

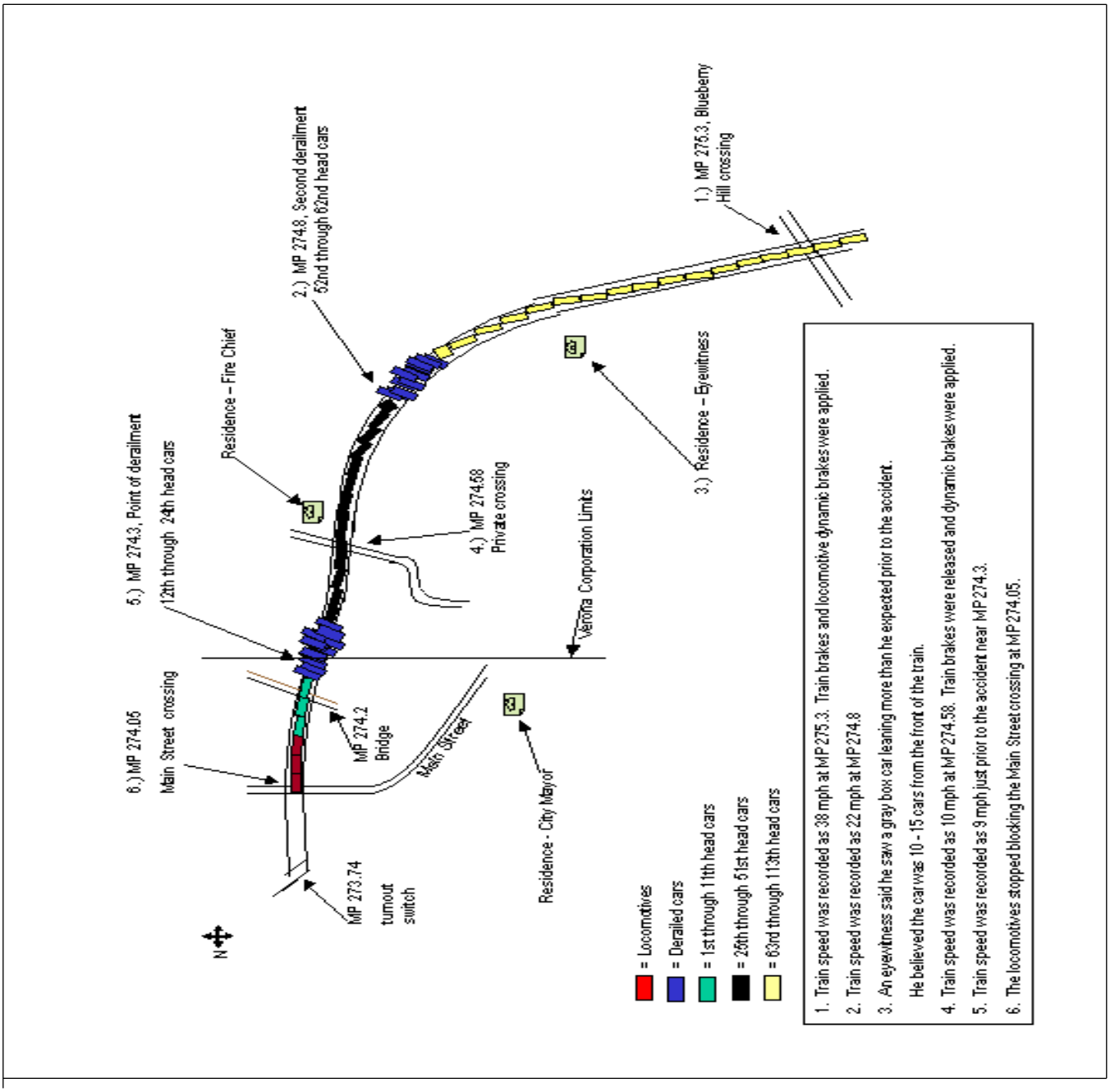
105. Locomotive Auxiliary Lights Operational?	Code
1. Yes 2. No	N/A

106. Locomotive Headlight Illuminated?	Code
1. Yes 2. No	N/A

107. Locomotive Audible Warning Sounded?	Code
1. Yes 2. No	N/A

108. DRAW A SKETCH OF ACCIDENT AREA INCLUDING ALL TRACKS, SIGNALS, SWITCHES, STRUCTURES, OBJECTS, ETC., INVOLVED.

HQ-53-Sketch_JB 2.gif



109. SYNOPSIS OF THE ACCIDENT

On July 2, 2005, at approximately 6:26 p.m. (CDT), timetable eastbound (geographically northbound) BNSF Railway Company (BNSF), Train Symbol M-TULGAL1-02, at a recorded speed of 9 mph, as recorded by the event recorder on the first trailing Locomotive No. BNSF 4525, derailed 24 cars on single main track at Milepost (MP) 274.3. The 12th through the 24th, and the 52nd through the 62nd cars were derailed. There was no hazardous materials (HM) involved, no evacuation, and no injuries. The weather was clear with a temperature of 84 F.

The main track was damaged from MP 274.16 to MP 274.3 and from MP 274.66 to 274.8. Track damages were estimated at $195,000, making the total accident damage $373,277.

The accident was caused by lateral forces pushing against the high rail in a 1-degree curve resulting in high rail rollover. Truck steering performance was investigated on several box cars (beer cars). One car previously exhibited unusual steering characteristics. Track condition was a contributing factor in permitting the rail to roll over.

110. NARRATIVE

The following information was obtained from an investigation that was conducted by the Federal Railroad Administration.

Circumstances Prior to the Accident

A two-man crew operating Train Symbol M-TULGAL1-02 had gone on duty at Tulsa, Oklahoma, at 10:10 a.m., July 2, 2005. The crew consisted of a locomotive engineer and a conductor. They had in excess of the required off-duty time. The engineer was sitting in the seat on the right side of the locomotive operating the train. The conductor was sitting in the front seat on the left side of the locomotive.

Train Symbol M-TULGAL1-02 consisted of 3 diesel electric locomotives (BNSF 4974, lead locomotive, BNSF 4525, trailing locomotive, and BNSF 962, trailing locomotive) and 115 cars (43 loads, 72 empties), consisting of 7,794 trailing tons. The train length was 7,135 feet. Train Symbol M-TULGAL1-02 had departed Tulsa about 10:40 a.m., July 2, 2005. The train had received a Class I, initial terminal freight train air brake test at Tulsa. The train make-up was in compliance with BNSF System Special Instructions No. 10, dated April 3, 2005.

Train Symbol M-TULGAL1-02 had stopped to meet a train at MP 277.61 just east of Globe Hill at MP 277.8 located in Missouri. The train began moving eastward about 6:17 p.m. The train reached a maximum speed of 38 mph. The engineer used a combination of various throttle positions, dynamic brakes, and air brakes to control a down hill descent toward a siding at MP 273.74. About 6:26 p.m., the engineer was operating the train at 9 mph, as recorded by the event recorder on the first trailing Locomotive No. BNSF 4525, with the dynamic brakes and air brakes applied (brake pipe pressure reduction of 12 psi).

The Accident

A brake pipe initiated emergency application of the train air brakes occurred and the train stopped, blocking the Main Street railroad grade crossing near Verona, Missouri. The conductor uncoupled the train to clear the crossing for the responding Verona Fire Department.

Train Symbol M-TULGAL1-02 was derailed in two portions. The 12th through the 24th cars were derailed at MP 274.3, the point of derailment. The 52nd through the 62nd cars were derailed at MP 274.8. Several cars were overturned spilling plastic pellets and lime. Equipment damage was estimated at $178,277.

The main track was damaged from MP 274.16 to MP 274.3 and from MP 274.66 to 274.8. Track damages were estimated at $195,000, making the total accident damage $373,277.

The accident occurred on the single main track of the BNSF's Cherokee Subdivision which extends from MP 239.7 to MP 426.9, a distance of 187.2 miles. The method of operation in this area is by timetable supplemented by a signal system consisting of Centralized Traffic Control (CTC) located in Ft. Worth, Texas. BNSF Timetable No. 5, effective at 8:00 a.m. (CDT), July 7, 2004, authorizes a 50 mph maximum speed for freight trains in the accident area. A 40 mph speed restriction (Form C) was established in May 2004 due to tie condition. There is a 10 mph speed restriction at the siding switch at MP 273.74.

Approaching the accident area from the west, there is a hill crest (Globe Hill) at MP 277.8 where a .99-percent descending grade begins. The grade decreases to .78-percent descending from MP 275.4 to MP 275.01. The grade is practically level from MP 275.01 to MP 274.85. There is a .45-percent descending grade from MP 274.85 to MP 274.75. There is a 1.08-percent descending grade from MP 274.75 to 274.4.

A 3-degree, 3-minute, left hand curve extends from MP 274.9 to 274.6. The track is tangent from MP 274.6 to MP 274.4. A 1-degree, 9-minute, right hand curve extends from MP 274.4 to 274.25. The track is tangent from MP 274.25 to 274.07. There is a 1-degree, 3-minute, left hand curve from MP 274.07 to MP 273.75.

At MP 274.3, the point of derailment, the north rail (high rail) is 136-pound continuous-welded rail (CWR) laid in 2002. The south rail (low rail) is 132-pound CWR laid in 1977. At MP 274.8, the north rail (low rail) is 136-pound CWR laid in 2001. The south rail (high rail) is 136-pound CWR laid in 1998. The rail rests on double shoulder tie plates on timber ties secured by 6-inch rail-holding spikes. The track is ballasted.

In the accident area, the last out-of-face (point-to-point) tie program was in 1998. The ties are old with some end splitting and field-side spikes raised and loose. The last track geometry car inspection was
March 18, 2005. No FRA defects were found. The high rail at the point-of-derailment had a 2-degree inward cant*. The last ultra-sonic rail test was June 22, 2005. No FRA defects were found. The last hi-rail vehicle inspection was July 1, 2005. A loose joint bar was identified and repaired at MP 273.04.

Analysis and Conclusions

There was no FRA mandatory post-accident toxicological testing performed after the accident. None was required.

There were 17 box cars (beer cars) with the initial of MRS in Train Symbol M-TULGAL1-02. The 12th through the 14th cars included Car Nos. MRS 2521, MRS 2524, and MRS 2548. Car No. MRS 2524, the 13th car, was the first car derailed (trailing truck). Post accident investigation revealed a truck performance detector (TPD) identified Car No. MRS 2524, as having unusual steering characteristics when it passed
St. Croix, Wisconsin, on May 10, 2005. The TPD detected the trailing axle of the trailing truck as putting out more lateral force than the leading axle of the leading truck.

The MRS cars are equipped with ASF Ride Control, Designation No. AAR B-2287 truck bolsters (type No. B9A-58HN-FX, cast May 1980). Post accident investigation revealed the bolster friction shoes (hereafter, shoes) on Car Nos. MRS 2521, MRS 2524, and MRS 2548 exceeded the manufacturers maintenance specification for shoe height (shoe rise). That is, the shoes were riding high in the bolster slopes. The ASF Maintenance and Repair Manual for Ride Control Trucks recommends shoe height not exceed 1 13/16 inches. The shoe height on all three cars was 1 7/8 inches, exceeding the recommended maintenance specification height.

BNSF targeted Car No. MRS 2524 for a truck tear-down at Springfield, Missouri, on July 8, 2005. The bolster slopes were worn with some slopes exhibiting metal flow on the trailing truck. The shoe slopes were worn with some shoes on the trailing truck exhibiting asymmetrical wear patterns. Wear on the slopes permitted shoe rise and a consequent relaxation of the shoe springs. This reduces the level of friction damping and the squaring restraint between the bolster and side frames. Additionally, some bolster gibs were worn and there were 2 outer coil truck springs broken on the trailing truck at the A-end, left.

The BNSF forwarded data to Progressive Rail Technologies, Inc. (hereafter Progressive Rail) in Pueblo West, Colorado. Progressive Rail performed detailed computer modeling to assist BNSF in determining the primary contributor (truck or track condition) which caused the high rail to rollover. Progressive Rail concluded the truck condition clearly made a much larger contribution toward reaching a critical lateral and
vertical force ratio (L/V) compared to the track condition. It is as stated in the Results section of their report, “the derailment was likely the result of a locked truck in the trailing position of the MRS 2524 car, and the presence of 2 degrees additional inward cant to the high rail of the 1 degree curve.”

Progressive Rail constructed two models: New and Untried Car Analytical Regime (NUCARS) and Wheel Rail Contact Geometry (WRCON). The models considered four different possibilities of truck and track condition:

- No additional inward rail cant and no locking of the trailing truck (MRS 2524),
- 2-degrees of inward rail cant added to the high rail and no locking of the trailing truck (MRS 2524),
- No additional inward rail cant and locking of the trailing truck (MRS 2524), and
- 2-degrees of inward rail cant added to the high rail and locking of the trailing truck (MRS 2524).

In the 2nd model, the inward rail cant increased the L/V ratio to 25-percent of the critical value necessary to roll over the high rail. In the 3rd model, the locking of the trailing truck increased the L/V ratio to 77-percent of the critical value necessary to rollover the high rail. Progressive Rail determined an L/V ratio of greater than 0.38 in the 1-degree curve would induce a positive rail rollover moment. In the 4th model, the L/V ratio was 0.40. Thus, both a locked truck and the additional high rail cant were required to produce a risk of high rail rollover. Additionally, all trucks in the 3 MRS cars had virtually no warp restraint, significantly increasing lateral forces over a considerable distance.

Post accident investigation revealed an eye witness account prior to the derailment. The witness alleged there was a gray box car about 10 to 15 cars from the front of the train that was leaning more predominantly than he expected. The witness alleged the car appeared to “straighten itself out.” The witness made this observation when the car was near MP 274.8. The witness alleged that about 1 to 1½ minutes passed between seeing the car, hearing an emergency application of the train air brakes, and seeing train cars overturn. The witness was a volunteer fire fighter for the Verona Fire Department and immediately notified the Lawrence County Sheriff concerning the accident.

Probable Cause

The FRA determined that the probable cause of the accident was E47C defective snubbing (including friction and hydraulic)
Contributing Cause - T199 other track geometry defects

*The rail already had a 1:40 cant (1 inch over 40 inches) from the tie plates. The additional cant noted above, is additive to the 1:40 cant.