Federal Railroad Administration
Office of Safety
Headquarters Assigned
Accident Investigation Report
HQ-2010-10

Burlington Northern Santa Fe (BNSF)
Keene, CA
February 20, 2010

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-2010-10

1.Name of Railroad Operating Train #1	1a. Alphabetic Code	1b. Railroad Accident/Incident No.
BNSF Rwy Co. [BNSF]	BNSF	CA-2010106
2.Name of Railroad Operating Train #2	2a. Alphabetic Code	2b. Railroad Accident/Incident No.
N/A	N/A	N/A
3.Name of Railroad Operating Train #3	3a. Alphabetic Code	3b. Railroad Accident/Incident No.
N/A	N/A	N/A
4.Name of Railroad Responsible for Track Maintenance:	4a. Alphabetic Code	4b. Railroad Accident/Incident No.
Union Pacific RR Co. [UP]	UP	0210LA016
5. U.S. DOT_AAR Grade Crossing Identification Number	6. Date of Accident/Incident: Month 02 Day 20 Year 2010	7. Time of Accident/Incident: 09:02: ☐ AM ☑ PM

8. 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

9. Cars Carrying HAZMAT	10. HAZMAT Cars Damaged/Derailed	11. Cars Releasing HAZMAT	12. People Evacuated	13. Division
28	3	1	35	Los Angeles

14. Nearest City/Town	15. Milepost *(to nearest tenth)*	16. State Abbr	16. State Code	17. County
Keene	351.1	N/A	CA	KERN

18. Temperature (F) *(specify if minus)*	19. Visibility *(single entry)* 1. Dawn 2. Day 3.Dusk 4.Dark — Code	20. Weather (single entry) 1. Clear 2. Cloudy 3. Rain 4. Fog 5.Sleet 6.Snow — Code	21. Type of Track 1. Main 2. Yard 3. Siding 4. Industry — Code
40 F	4	2	1

22. Track Name/Number	23. FRA Track Class (1-9, X) — Code	24. Annual Track Density *(gross tons in millions)*	25. Time Table Direction 1. North 2. South 3. East 4. West — Code
Single Main	2	21.7	1

OPERATING TRAIN #1

26. 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	27. Was Equipment Attended? 1. Yes 2. No — Code	28. Train Number/Symbol
	1	1	MBARST0120

29. Speed *(recorded speed, if available)* R - Recorded E - Estimated	Code	31. Method(s) of Operation *(enter code(s) that apply)*	31a. Remotely Controlled Locomotive?
20 MPH	R	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)*	0 = Not a remotely controlled; 1 = Remote control portable; 2 = Remote control tower; 3 = Remote control transmitter - more than one remote control transmitter

30. Trailing Tons *(gross tonnage, excluding power units)*: 5869

Code(s): e | N/A | N/A | N/A | N/A

32. Principal Car/Unit	a. Initial and Number	b. Position in Train	c. Loaded *(yes/no)*
(1) First involved *(derailed, struck, etc)*	GATX206118	60	yes
(2) Causing *(if mechanical cause reported)*	0	0	N/A

33. 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

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

35. 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	4	0	0	0	1
(2) Total Derailed	0	0	0	0	0

36. Cars	Loaded a. Freight	Loaded b. Pass.	Empty c. Freight	Empty d. Pass.	e. Caboose
(1) Total in Equipment Consist	38	0	26	0	0
(2) Total Derailed	5	0	1	0	0

37. Equipment Damage This Consist	38. Track, Signal, Way, & Structure Damage	39. Primary Cause Code	40. Contributing Cause Code
$321,143.00	$1,929,657.00	M405	T102

Number of Crew Members

41. Engineer/ Operators	42. Firemen	43. Conductors	44. Brakemen
1	0	1	0

Length of Time on Duty

45. Engineer/Operator	46. Conductor
Hrs 5 Mi 1	Hrs 5 Mi 1

Casualties to:	47. Railroad Employees	48. Train Passengers	49. Other
Fatal	0	0	0
Nonfatal	0	0	0

50. EOT Device? 1. Yes 2. No — 2

51. Was EOT Device Properly Armed? 1. Yes 2. No — N/A

52. Caboose Occupied by Crew? 1. Yes 2. No — N/A

OPERATING TRAIN #2

53. 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	54. Was Equipment Attended? 1. Yes 2. No — Code	55. Train Number/Symbol
	N/A	N/A	N/A

56. Speed *(recorded speed, if available)* R - Recorded E - Estimated	Code	58. Method(s) of Operation *(enter code(s) that apply)*	58a. Remotely Controlled Locomotive?
N/A MPH	N/A	a. ATCS; b. Auto train control; g. Automatic block; h. Current of traffic; m.Special instructions; n. Other than main track	0 = Not a remotely controlled; 1 = Remote control portable

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57. Trailing Tons *(gross tonnage, excluding power units)* N/A

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) N/A N/A N/A N/A N/A

2 = Remote control tower
3 = Remote control transmitter - more than one remote control transmitter N/A

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

60. 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

61. Was this consist transporting passengers? (Y/N) N/A

62. 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	N/A	N/A	N/A	N/A	N/A
(2) Total Derailed	N/A	N/A	N/A	N/A	N/A

63. Cars	Loaded a. Freight	Loaded b. Pass.	Empty c. Freight	Empty d. Pass.	e. Caboose
(1) Total in Equipment Consist	N/A	N/A	N/A	N/A	N/A
(2) Total Derailed	N/A	N/A	N/A	N/A	N/A

64. Equipment Damage This Consist N/A

65. Track, Signal, Way, & Structure Damage N/A

66. Primary Cause Code N/A

67. Contributing Cause Code N/A

Number of Crew Members

68. Engineer/ Operators	69. Firemen	70. Conductors	71. Brakemen
N/A	N/A	N/A	N/A

Length of Time on Duty

72. Engineer/Operator Hrs N/A Mi N/A

73. Conductor Hrs N/A Mi N/A

Casualties to:	74. Railroad Employees	75. Train Passengers	76. Other
Fatal	N/A	N/A	N/A
Nonfatal	N/A	N/A	N/A

77. EOT Device? 1. Yes 2. No N/A

78. Was EOT Device Properly Armed? 1. Yes 2. No N/A

79. Caboose Occupied by Crew? 1. Yes 2. No N/A

OPERATING TRAIN #3

80. 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

81. Was Equipment Attended? 1. Yes 2. No Code N/A

82. Train Number/Symbol N/A

83. Speed *(recorded speed, if available)* Code
R - Recorded
E - Estimated N/A MPH N/A

84. Trailing Tons *(gross tonnage, excluding power units)* N/A

85. 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) N/A N/A N/A N/A N/A

85a. 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 N/A

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

87. 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

88. Was this consist transporting passengers? (Y/N) N/A

89. 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	N/A	N/A	N/A	N/A	N/A
(2) Total Derailed	N/A	N/A	N/A	N/A	N/A

90. Cars	Loaded a. Freight	Loaded b. Pass.	Empty c. Freight	Empty d. Pass.	e. Caboose
(1) Total in Equipment Consist	N/A	N/A	N/A	N/A	N/A
(2) Total Derailed	N/A	N/A	N/A	N/A	N/A

91. Equipment Damage This Consist N/A

92. Track, Signal, Way, & Structure Damage N/A

93. Primary Cause Code N/A

94. Contributing Cause Code N/A

Number of Crew Members

95. Engineer/ Operators	96. Firemen	97. Conductors	98. Brakemen
N/A	N/A	N/A	N/A

Length of Time on Duty

99. Engineer/Operator Hrs N/A Mi N/A

100. Conductor Hrs N/A Mi N/A

Casualties to:	101. Railroad Employees	102. Train	103. Other
Fatal	N/A	N/A	N/A
Nonfatal	N/A	N/A	N/A

104. EOT 1. Yes 2. No N/A

105. Was EOT Device Properly 1. Yes 2. No N/A

106. Caboose Occupied by Crew? 1. Yes 2. No N/A

Highway User Involved

107. 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)* Code N/A

108. Vehicle Speed *(est. MPH at impact)* N/A

109. *geographical)* 1.North 2.South 3.East 4.West Code N/A

Rail Equipment Involved

111. Equipment
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)* Code N/A

112. Position of Car Unit in N/A

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110. Position	Code	113. Circumstance	Code
1.Stalled on Crossing 2.Stopped on Crossing 3.Moving Over Crossing 4. Trapped	N/A	1. Rail Equipment Struck Highway User 2. Rail Equipment Struck by Highway User	N/A
114a. Was the highway user and/or rail equipment involved in the impact transporting hazardous materials? 1. Highway User 2. Rail Equipment 3. Both 4. Neither	N/A	114b. Was there a hazardous materials release 1. Highway User 2. Rail Equipment 3. Both 4. Neither	N/A

114c. State here the name and quantity of the hazardous materials released, if any.
N/A

115. Type 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	116. Signaled Crossing *(See instructions for codes)* Code	117. Whistle Ban Code 1. Yes 2. No 3. Unknown
Code(s)	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A	N/A

118. Location of Warning Code 1. Both Sides 2. Side of Vehicle Approach 3. Opposite Side of Vehicle Approach	119. Crossing Warning with Highway Signals Code 1. Yes 2. No 3. Unknown	120. Crossing Illuminated by Street Lights or Special Lights Code 1. Yes 2. No 3. Unknown
N/A	N/A	N/A

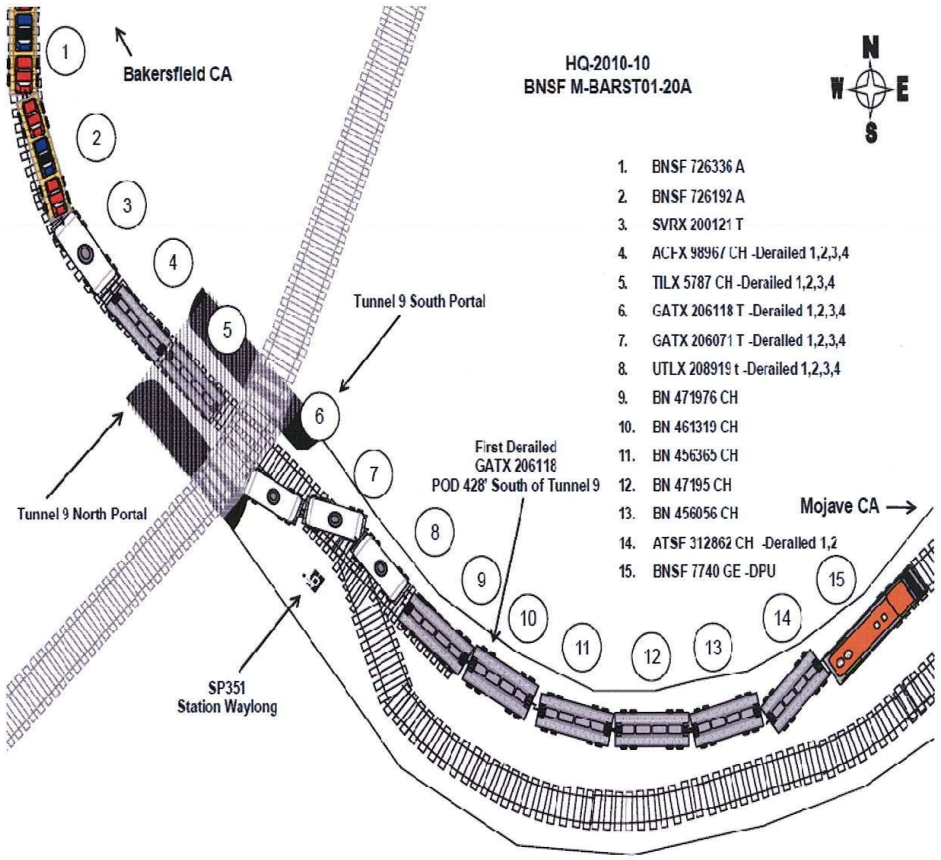
121. Age	122. Driver's Gender Code 1. Male 2. Female	123. Driver Drove Behind or in Front of and Struck or was Struck by Second Train Code 1. Yes 2. No 3. Unknown	124. Driver Code 1. Drove around or thru the Gate 2. Stopped and then Proceeded 3. Did not Stop 4. Stopped on Crossing 5. Other *(specify in narrative)*
N/A	N/A	N/A	N/A

125. Driver Passed Highway Vehicle Code 1. Yes 2. No 3. Unknown	126. 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	N/A

Casualties to:	Killed	Injured	127. Driver Code 1. Killed 2.Injured 3. Uninjured	128. Was Driver in the Vehicle? Code 1. Yes 2. No
			N/A	N/A
129. Highway-Rail Crossing Users	N/A	N/A	130. Highway Vehicle Property Damage *(est. dollar damage)* N/A	131. Total Number of Highway-Rail Crossing Users *(include driver)* N/A

132. Locomotive Auxiliary Lights? Code 1. Yes 2. No	133. Locomotive Auxiliary Lights Operational? Code 1. Yes 2. No
N/A	N/A
134. Locomotive Headlight Illuminated? Code 1. Yes 2. No	135. Locomotive Audible Warning Sounded? Code 1. Yes 2. No
N/A	N/A

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



137. SYNOPSIS OF THE ACCIDENT

On February 20, 2010 at approximately 9:02 p.m. PST a northbound BNSF Railway train M-BARSTO1-20A operating on Union Pacific (UP) Mojave Subdivision derailed six cars at milepost (MP) 351.17 south of Tunnel 9 near Station Walong on the Tehachapi Loop. The derailment occurred in the vicinity of Keene, California, an unincorporated community of Kern County, CA, approximately 10 miles north of Tehachapi and 40 miles southeast of Bakersfield, CA. Movements on this part of the railroad are under Centralized Traffic Control (CTC) by a UP Dispatcher located in Omaha, NE.

A tank car containing Alcohol N.O.S., a flammable liquid, ruptured and burned when it struck the south portal of Tunnel 9. The fire also set ablaze a covered hopper car containing grain and a second covered hopper car containing plastic pellets. Two other cars containing Alcohol, N.O.S. derailed but did not leak or catch fire. Approximately 1,100 feet of track was damaged. As a safety precaution, emergency responders evacuated seven homes affecting 35 residents within a two-mile radius of the derailment site for approximately 21 hours. There were no injuries to the BNSF train crew or to the civilian populace.

Weather at the time of the accident was dark and overcast with a temperature of 40° Fahrenheit.

UP track and signal damages were reported at $1,929,657 and BNSF's equipment damage was $321,143.

Post-accident drug testing was conducted on the engineer and conductor. The results of the test were negative.

The probable cause of the derailment was interaction of lateral/vertical forces (includes harmonic rock off) with a contributing cause of cross level of track irregular (not at joints).

138. NARRATIVE

CIRCUMSTANCES PRIOR TO THE ACCIDENT

The crew of northbound BNSF freight train MBARSTO1-20A consisting of a locomotive engineer and a conductor reported for duty at 4:00 p.m. PST on February 20, 2010 at their away from home terminal in Barstow, CA. Prior to reporting for duty, the crew had 13 hours and 45 minutes of off-duty time. Their assigned train was made up of five locomotives, four in the lead and one trailing Distributive Power Locomotive Unit (DPU), 38 loads, 26 empties, with 5,869 tons and 3,782 feet in length, and was scheduled to travel between Barstow and Stockton, CA.

A class 1 air brake test was performed by the Barstow Car Department. The crew departed Barstow yard at approximately 5:00 p.m. heading west on the BNSF Mojave Subdivision. The train was routed through Hinkley and Jim Grey sidings where they met two trains without stopping, then proceeded to Edwards where they held the Main Track while an opposing train took the siding. At Mojave, the train entered the UP's Mojave Subdivision heading geographically and timetable north. Timetable directions will be used throughout this report.

Approaching the derailment site, trains traverse an area of the railroad known as the Tehachapi Loop. The Loop is an approximate three-quarter of a mile long 'spiral', or helix, on the main line through the Tehachapi Pass with multiple back-to-back 8- to 10-degree curves at a maximum descending grade of 2.20 %. The track runs between the towns of Tehachapi and Keene. The Loop derives its name from the circuitous route it takes in which the track passes over itself, a design which lessens the angle of the grade.

The engineer was seated at the controls on the east side of the leading locomotive and the conductor was seated on the west side of the leading locomotive.

The engineer stated that he set 8-9 pounds of air with his DPU in synchronous mode at the crest of the Tehachapi grade. Both crew members said the train was handling normally with no exceptions and continued on with a clear signal indication. As the train passed the south switch at Walong, it continued sweeping in the

right hand curve where the conductor had a view of the total consist and stated everything appeared normal. When the head-end of the train passed Tunnel 9, the crew observed an approach diverging (yellow over yellow) signal aspect for Wolford.

THE ACCIDENT

At 9:02 p.m. the lead locomotive, BNSF 7720, went into undesired emergency (UDE) north of Intermediate Signal 3507 at MP 350.2. Train crew statements described the UDE as smooth with no slack action or run out. The engineer attempted to recover the air and was unsuccessful. At this point the crew thought that an air hose might have uncoupled due to a "lack of in-train forces".

At 9:04 p.m. the conductor notified the dispatcher that their train had gone into emergency. The dispatcher immediately notified a BNSF Rapid Responder; a car department person assigned to the area to help crews with mechanical issues, and provided him with the lead locomotive number and location of the train.

The conductor started walking towards the rear of the train and tied down hand brakes on approximately 20 cars as he performed an inspection of the cars. He continued walking towards the rear of the train when he noticed a fire ahead.

The conductor continued to walk and inspect the train when he came around a curve with a straight view to Tunnel 9. He could see a glow within the tunnel indicating a fire. At 9:27 p.m. the Mojave dispatcher recordings reflect the BNSF trainmaster's conversation with the conductor. The conductor told the trainmaster that the train was tied down and his concern regarding the tunnel fire. The trainmaster directed the conductor to move to a safe place away from the fire. He then headed away from the fire, which he could see was flaring rapidly. At this time, he observed the Kern County Fire Department was already on the scene. He radioed the locomotive engineer to meet him halfway with the train list so he could expedite getting the consist information to the firemen.

Once he had given the information to the fire department he returned to the locomotive where he and the locomotive engineer awaited the arrival of the trainmaster. Upon arrival, the trainmaster took the crew to the Incident Command Center where the crew was job briefed about separating the head-end portion of the train from the rear portion of the train that was on fire to prevent damage to other rail cars. They then returned to the train and remained on the head-end until relieved by another BNSF crew.

EMERGENCY RESPONSE

The Kern County 911 operator received a call from a local resident approximately 9:15 p.m. who reported the incident. The fire department immediately responded with the first units arriving at the scene at 9:39 p.m. The BNSF and UP hazardous materials response teams arrived at the scene. Additional agencies at the scene were Kern County Sheriff's Department, California Highway Patrol, and the Kern County Environmental Health Division. Paramedic and ambulance service provided by Halls Ambulance Company were also called to the scene.

A burning hopper car containing plastic pellets prompted the Kern County Fire Department to evacuate seven homes within a two-mile radius. The evacuation order was carried out by the Kern County Sheriff's Department and the California Highway Patrol.

The decision was made to use foam to extinguish the burning hopper cars. Dirt embankments to contain the foam were constructed across the right of way and two foam nozzles were placed on each side of the burning cars. Chemguard 3% / 6% AR-AFFF C-363 fire fighting foam concentrate was used. The fire was finally extinguished at about 2:00 p.m. the following day.

The Kern County Fire Department maintained a watch to put out any flare-ups from hot spots until 6:45 p.m. At this time, the Fire Department cancelled the evacuation order. There were no reported injuries as a result of the hazardous material spill and resulting fire. There were no events reported as a result of the evacuation. One local rancher who lives near the derailment scene was examined by the paramedics for smoke inhalation and released without treatment. Neither crew members was injured and no one in the area of evacuation or at the derailment site sought medical treatment.

The ambient temperature at the scene of the derailment was about 40° Fahrenheit. The sky was completely obscured by a low cloud cover and it rained intermittently. The cloud cover and rain deflected the toxic smoke cloud from the fire down toward the ground preventing it from drifting to more populous areas. The area surrounding the derailment site is a sparsely populated rural area. No air sampling was done pursuant to this incident.

POST-ACCIDENT INVESTIGATION

FRA and California Public Utilities Commission (CPUC) inspectors were called to the scene to commence an investigation and to secure documents, event recorder downloads, records, and photographs. FRA and CPUC interviewed the engineer and conductor on February 22, 2010 at 9:00 a.m. at the BNSF Bakersfield yard office. Both crew members stated that this was a routine trip and that they did not feel anything abnormal while traversing over the point of derailment (POD) on the previous trip the day before between Bakersfield to Barstow. A review of the event recorder downloads excluded train handling as contributing to the accident.

The derailment occurred at MP 351.17 in the body of a 10-degree right hand curve where the 56th car from the front of the train derailed; the car, identified as GATX 206118, was transporting Alcohol, N.O.S. The car traveled on the field side of the rail 495 feet while still coupled into the train before impacting the southwest portal of Tunnel 9. The impact caused the train to separate between cars listed as lines 55 and 56 on the train consist. Upon impacting the south portal, the alcohol tank was breached, caught fire, and released approximately 28,500 gallons of product. The fire spread through the tunnel and ignited two hopper cars containing dry corn kernels and plastics. An additional three cars derailed. The derailed cars were listed on the consist as lines 54 through 58 and line 64. The 64th car derailed the rear set of trucks and sustained no damage. After it was re-railed the BNSF removed it along with the unaffected portion of the train back to Bakersfield. This was completed prior to FRA's arrival at the scene.

Tank car GATX 206118 was determined to be the first car to derail based on two observations. First, this car had moved the furthest over to the south and was the first car to impact the tunnel, and second, the leading #4 axle had incurred the most damage out of all 20 axles that derailed. The tank car struck the tunnel on the left side of the "A" end (AL) of the tank car. The tank head compressed into the first tub of the tank car tearing an approximate 8–12 inch gap in the tank car near the heat affected zone of the weld near the top of the AL tank car body bolster.

The first sign of a derailment was recorded on the rear DPU locomotive BNSF 7740. It recorded 8 cfm of air flow at 21:01:55 followed by 30 cfm of air flow, PCS open, increased brake cylinder pressure, loss of speed and tractive effort. The train had 64 cars and separation occurred between cars 55 and 56 or 3252 feet back. Considering that a train line emergency travels through a train at approximately 1,000 feet per second, it was first recorded on the rear DPU locomotive two seconds prior to the leader at 21:01:57.

Evidence of impact on the tank car hitting the sidewall of the tunnel was recorded on the rearward facing DPU locomotive. The impact was strong enough that at 21:01:56 the automatic brake handle moved from the continuous service position to suppression.

The rear locomotive went 64 feet after the first sign of air loss and went from 21 mph to zero in 4 seconds. The lead locomotive went 328 feet after the first sign of air loss and went from 19 mph to zero in 21 seconds. The front half of the train went 264 feet further than the rear, which would indicate that the rear of the remaining portion of the train would still be in the tunnel. Tunnel 9 is 428 feet long.

HAZARDOUS MATERIALS INVESTIGATION AND ANALYSIS

The alcohol in the tank from GATX 206118 poured out onto the right of way and into the tunnel. The two percent descending grade carried the flow toward the north end of the tunnel. There is no drainage in the tunnel and the alcohol began to pool as it neared the north portal and collected under the two covered hopper cars that were ahead of the tank car. A spark or hot steel from the track and hopper cars dragging through the tunnel provided an ignition source for the alcohol. The resulting fire traveled back through the tunnel to the leaking tank car while setting the two covered hopper cars ablaze. Tank car GATX 206118 was scorched along three-quarters of its length from the A end. The paint was burned off this portion of the car leaving white ash.

The two covered hopper cars which preceded the tank car in the train were on fire near the north end of the tunnel. The first hopper next to the tank car was loaded with dry corn kernels while the second hopper was loaded with plastic pellets. Heat from the fire ignited the corn and the plastic inside the hopper cars. Both hopper cars were completely destroyed.

Tank car GATX 206118 was loaded and shipped by Siouxland Ethanol, LLC, from station Tom Lynch, NE on BNSF waybill number 660268 dated February 5, 2010. It was consigned to Kinergy Marketing Company in Stockton, CA. It was loaded with 28,477 U.S. gallons of 96.9% ethanol by volume and weighed 188,233 pounds. The gross weight at shipping was 254,233 pounds. The outage was 1,803 U.S. gallons. Packaging, loading and documentation at the time of shipment were consistent with 49 CFR requirements.

The DOT specification for this tank car is DOT 111A100W1. It was built in August, 2007 by Union Tank Car Company. It is not equipped with insulation or thermal protection. It is equipped with a self-reclosing pressure relief valve with a set-to-release pressure of 75 psi. The valve was tested in 2007 and is due for retest in 2017. The tank was tested in 2007 and was due for retest in 2022.

There were 28 hazardous material shipments in the train, of which 26 were loads and 2 contained residues. They were all tank cars and began at the sixth car from the locomotives at the head end. The hazardous material shipments lined in the train as follows:

- 6 through 15
- 24 and 25
- Line 31
- 34 through 41
- 44 through 45
- 47 through 48
- 56 through 58

CONCLUSION – HAZARDOUS MATERIALS

All loading, packaging requirements, and shipping documents in possession of the shipper and the railroad were found to be in compliance with Federal regulations. The train list, position in the train of all hazardous materials, emergency phone number and emergency response information were immediately made available to emergency responders at the scene in compliance with 49 CFR requirements. The train crew had the hazardous material information in their possession in compliance with 49 CFR requirements.

TRACK INVESTIGATION AND ANALYSIS

At the POD the track structure consisted of 141-pound continuous welded rail (CWR) laid on concrete ties predominantly spaced at 24 inches apart with 16 by 7¾ inch double shoulders secured with two elastic fasteners.

The timetable speed at the POD is 23 mph designated as FRA Class 2 track. FRA Class 2 track allows for a maximum speed of 25 mph for freight trains. UP maintenance of way personnel recorded track notes developed from measurements taken at 15.5-feet incremental stations using a 62-foot chord, 31-ft. mid-ordinate measurements. A total of 21 stations, 15 stations or 232.5 feet ahead of the POD and 5 stations or 77.5 feet behind the POD. Station Zero was identified as the POD. Investigators observed fouled ballast and saturated roadbed extending from station 4 to the POD.

The maximum gage measurement allowed in the FRA Track Safety Standards Class 2 track is 57.75 inches. Track notes determined that the widest gage was 57.25 inches at stations 2 and 5 past the POD.

The maximum allowed deviation of alignment using a 62-feet chord in curved track for FRA Class 2 track may not be more than 3 inches. Track notes record that the greatest alignment deviation measurement of 1.75 inches at station 7 ahead of the POD.

The maximum allowable difference in cross level between any two points less than 62-feet apart for FRA Class 2 track may not be more than 2.25 inches. Track notes recorded the greatest cross level measurement

deviation of 0.5 inch at the POD.

FRA reviewed UP's inspection track reports for the period January 17 through February 20, 2010, for the area of the POD. No defects were noted by the UP inspector and FRA took no exceptions to the reports.

The UP Rail Flaw Detector surveyed the area of the POD on February 1, 2010. The survey discovered a 30% engine burn fracture at MP 350.24. This defect did not contribute to the derailment. UP's EC4 Geometry Car surveyed the area on December 21, 2009. No defects were noted at the POD.

A California Public Utilities Commission (CPUC) and a FRA track inspector had completed a high-rail track inspection of the area on January 12, 2010. The inspector's report reflects no track defects in the vicinity of MP 351.17

CONCLUSION - TRACK

Investigators observed foul ballast and saturated roadbed in the area of the POD during their post-accident investigation. Although no geometry defects exceeded the minimum standards, these conditions contributed to the post-geometry measurements and were likely contributors to excessive lateral over vertical (L/V) forces.

SIGNAL INVESTIGATION AND ANALYSIS

The signal system in this area is Traffic Control System operated by the Dispatching Control Center in Omaha, Nebraska. Radio communications are on channel 1414, dispatcher 54.

Signal wayside locations near the POD are CP SP 353 Marcel, Intermediate Signal 3525 and 3526, CP SP 352 South Walong, and CP SP 351 North Walong derailment site. All control points are field controlled by the Dispatch Center in Omaha, NE, by use of coded line from the wayside carrier in Tehachapi to a non-vital logic controller, controlling KP relays for switch operation and signal routes. Field indications are by use of shelf relays controlling track and switch field conditions to allow proper power switch alignment and signal routes for safe train movements through the Mojave subdivision. There is no data recording equipment at the control points.

Signals in operation are US&S H-2 style searchlight signal. The H-2 searchlight signal houses the H-2 signal mechanism relay that can display a yellow and green aspect upon the activation of the polarized internal relay coils. With no energy applied and the counter balance, weights return to a centered position with the display of the red aspect (normal).

Signal circuits between locations are conveyed by line wire that carry vital information to wayside locations that operate relays for proper signal aspects displayed by signals at the control point and intermediate signals.

Control points at North Marcel, South and North Walong sidings utilize a M23 dual control power switch machine. This allows trains to enter an adjacent track (siding track) in order for trains to meet and pass.

There is one dragging equipment detector located at North Marcel, MP 353.0 prior to the POD. The dragging equipment detector is radio activated if defective dragging equipment is detected. Dispatcher tapes did not disclose any defects identified by the dragging equipment detector.

FRA tested signal locations beginning at adjoining control points, North Marcel to North Walong. Tests included a train ride for visual inspection of the signals and a review of test records and documents in the area of the POD.

CONCLUSION - SIGNAL

FRA testing and review indicated that the signal system was in compliance with Federal Regulations and working as intended at the time of the derailment.

OPERATIONS INVESTIGATION AND ANALYSIS

FRA OP Inspector reviewed the list of events from the lead locomotive event recorder, BNSF 7720:

- 20:57:17 Horn Sequence (last Crossing before derailment)
  Dynamic Brake N5
  8 psi brake pipe reduction
  20 mph
- 20:58:56 21 mph
- 20:59:25 22 mph
- 20:59:46 23 mph (max. allowable speed)
- 20:59:44 Dynamic Brake N6
- 20:59:55 One horn blast
- 20:59:59 Dynamic Brake N7
- 21:00:17 22 mph
- 21:00:32 21 mph
- 21:00:39 Dynamic Brake N6
- 21:00:44 20 mph
- 21:01:04 19 mph
- 21:01:49 Dynamic Brake N5
- 21:01:57 49 cfm of air flow
- 21:01:58 PCS open

CONCLUSION - OPERATIONS

An FRA review of the event recorder data indicated that the locomotive engineer was in compliance with applicable Federal Regulations and all railroad operating and train handling rules.

MECHANICAL INVESTIGATION AND ANALYSIS

The five cars that derailed near the tunnel were fully inspected for mechanical defects and are listed below along with their train consist number:

ACFX 98967	Covered Hopper Plastic Pellets	Line 54
TILX 5787	Covered Hopper Cornmeal	Line 55
GATX 206118	Tank Car Hazmat	Line 56
GATX 206071	Tank Car Hazmat	Line 57
UTLX 208419	Tank Car Hazmat	Line 58

The freight car side bearings were inspected on line items 57 and 58. The side bearings on line items 54-56 were mostly destroyed or melted during the accident. Portions of the side bearing cages and car body wear plates that remained were inspected for abnormal wear. No defect or abnormalities were noted.

Also inspected on the five cars were the wheels and axles, side frames and bolsters center plate to bowl condition and clearance, snubbing, wear plates, and draft assemblies. There were no defects noted. A review of the mechanical repair history and detector reports revealed no trends or defects that would have contributed to the derailment and were in full compliance with Federal regulations. The subject train was inspected at Barstow by BNSF qualified mechanical inspectors with no defects noted on their inspection report.

CONCLUSION - MECHANICAL

Post accident investigation revealed that the rolling stock was in full compliance with Federal requirements and AAR standards.

DETERMINING PROBABLE CAUSE AND CONTRIBUTING FACTORS

FRA has concluded that the derailment was a result of interaction of vehicle and track conditions. No non-complying defects were found in the equipment, track, signal or train handling. However, BNSF simulations of the derailment revealed that the ratio of lateral to vertical (L/V) rail forces at the point of derailment

exceeded 1.2. Research has shown that an L/V ratio of more than .8 or 1.0, depending upon friction and other factors, can result in wheel climb. BNSF concluded from its simulations that equipment factors such as worn wheels and side bearing clearances may have increased the curving forces. BNSF's simulations indicated that repeated cross level perturbations of less than 3/8" at spacing of 60 ft., which approximately corresponds to the truck center spacing on cornmeal covered hopper car TILX 5787 (line 55) was the largest factor contributing to the derailment. BNSF cited the cause of the derailment as cross level of track irregular (not at joints), T102. UP concluded that the derailment resulted from interaction of lateral/vertical forces (includes harmonic rock off), M405. FRA's evaluation of the track, which occurred after the track repair was initiated, showed fouled ballast and drainage conditions in the area approaching the POD. The pumping track condition was a contributing factor to vertical track movement, which affected the cross level and track profile. FRA's inspection team concurs with the UP's probable cause code and accepts BNSF's cause as a contributing factor. No equipment or track defects exceeding the Federal regulations were identified.

PROBABLE CAUSE AND CONTRIBUTING FACTORS

FRA has concluded that the derailment resulted from interaction of lateral/vertical forces (includes harmonic rock off), M405, with a contributing cause of irregularity of cross level of track (not at joints), T102.