



***Federal Railroad Administration  
Office of Railroad Safety***

***Accident Investigation Report  
HQ-BNSF-2021-0303-1417***

***BNSF Railway (BNSF)  
Ludlow, California  
March 03, 2021***

***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 March 3, 2021, at 12:20 pm PST, BNSF Railway Company (BNSF) freight train H-KCKBAR1-28A (Train 1) was operating westbound on BNSF's Needles Subdivision when it derailed 45 cars approximately one mile east of Ludlow, California. As a result, one tank car containing Ethyl Alcohol sustained significant damage rupturing the tank and releasing its contents to the ground.

This accident was not Positive Train Control (PTC) preventable.

There were no injuries.

At the time of the accident, it was sunny, 78° F, clear skies, with 18 mph intermittent winds gusts.

Total estimated damages were \$4,077,569 (Track / Signal and Structure: \$502,871 and Equipment: \$3,574,766).

The Federal Railroad Administration (FRA) has determined that train make-up was the probable cause of the incident, cause code H504 - buffing or slack action excessive, train makeup. There were no other contributing factors.

**TRAIN SUMMARY**

1. Name of Railroad Operating Train #1 BNSF Railway Company	1a. Alphabetic Code BNSF	1b. Railroad Accident/Incident No. CA 0321-102
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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. CA 0321-102
2. U.S. DOT Grade Crossing Identification Number	3. Date of Accident/Incident 3/3/2021	4. Time of Accident/Incident 12:20 PM
5. Type of Accident/Incident Derailment		
6. Cars Carrying HAZMAT 14	7. HAZMAT Cars Damaged/Derailed 1	8. Cars Releasing HAZMAT 1
9. People Evacuated 0		
10. Subdivision BNSF RAILWAY COMPANY - NEEDLES		
11. Nearest City/Town LUDLOW	12. Milepost (to nearest tenth) 692	13. State Abbr. CA
14. County SAN BERNARDINO		
15. Temperature (F) 78 °F	16. Visibility Day	17. Weather Clear
18. Type of Track Main		
19. Track Name/Number 1	20. FRA Track Class Freight Trains-80, Passenger Trains-90	21. Annual Track Density (gross tons in millions) 98
22. Time Table Direction West		
23. PTC Preventable No	24. Primary Cause Code [H504] Buffing or slack action excessi	25. Contributing Cause Code(s)

**OPERATING TRAIN #1**

1. Type of Equipment Consist: Freight Train					2. Was Equipment Attended? Yes		3. Train Number/Symbol H-KCKBAR1-28A				
4. Speed (recorded speed, if available) R - Recorded 52.0 MPH E - Estimated		Code R	5. Trailing Tons (gross excluding power units) 10528		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: _____											
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 <i>(derailed, struck, etc.)</i>		CRYX 8332	36	no				0	0		
(2) Causing <i>(if mechanical, cause reported)</i>		0	0	no	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		e. Caboose
		b. Manual	c. Remote	d. Manual	e. Remote		a. Freight	b. Pass.	c. Freight	d. Pass.	
(1) Total in Train	3	0	0	0	2	(1) Total in Equipment Consist	72	0	28	0	0
(2) Total Derailed	0	0	0	0	0	(2) Total Derailed	20	0	25	0	0
12. Equipment Damage This Consist 3574766			13. Track, Signal, Way & Structure Damage 502871								
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: 5 Mins: 20		19. Conductor Hrs: 5 Mins: 20	
Casualties to:		20. Railroad Employees		21. Train Passengers		22. Others		23. EOT Device? No		24. Was EOT Device Properly Armed? N/A	
Fatal		0		0		0		25. Caboose Occupied by Crew?		N/A	
Nonfatal		0		0		0					
26. Latitude 34.723950000				27. Longitude -116.139053000							

# DERAILMENT SKETCH

HQ-2021-1417

Ludlow, California

Railroad – BNSF

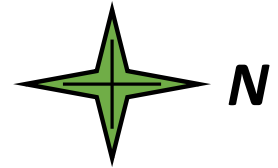
Division – California, Needles Subdivision

Milepost – 692.0, Main Track One

Date – March 3, 2021 @ 12:20 PM (PST)

Train – H-KCKBAR1-28A

HQ-2021-1417



### Derailed Cars List

(E) Empty (L) Loaded

Line #	Car Type	(L) Loaded (E) Empty	Car ID #
26 -	box car	(L)	BN 459622
27 -	box car	(E)	BNSF 782091
28 -	box car	(E)	BNSF 782046
29 -	box car	(E)	BNSF 782217

These cars were still coupled to head end portion of the train at MP 692.40.

30 -	gondola	(E)	AIMX 15003
31 -	hopper	(E)	SHPX 43068
32 -	hopper	(E)	ACFX 42719
33 -	box car	(E)	CRYX 8323
34 -	box car	(E)	CRYX 8025
35 -	box car	(E)	CRYX 8143
36 -	box car	(E)	CRYX 8332 (POD)
37 -	box car	(E)	CRYX 8132
38 -	box car	(E)	CRYX 8290
39 -	box car	(E)	CRYX 8346
40 -	box car	(E)	CRYX 8251
41 -	box car	(E)	CRYX 8238
42 -	box car	(E)	CRYX 8016
43 -	box car	(E)	CRYX 8150
44 -	box car	(E)	CRYX 8115
45 -	box car	(E)	CRYX 8366
46 -	box car	(E)	BNSF 781168
47 -	box car	(E)	CRYX 8284
48 -	box car	(E)	BNSF 782036
49 -	tank car	(L)	ADMX 28823
50 -	hopper	(L)	NOKL 823344
51 -	hopper	(L)	NOKL 830581
52 -	hopper	(L)	SMW 823307
53 -	hopper	(L)	NDYX 830903
54 -	hopper	(L)	FURX 822178
55 -	hopper	(L)	NOKL 825408
56 -	hopper	(L)	NOKL 822871
57 -	tank car	(L)	TILX 190777
58 -	hopper	(L)	CGEX 1880
59 -	hopper	(L)	CGOX 1056
60 -	tank car	(L)	DMIX 190601
61 -	hopper	(L)	NCUX 50256
62 -	hopper	(L)	ITFX 91016
63 -	hopper	(E)	CBFX 306116
64 -	box car	(E)	MWCX 461919
65 -	box car	(L)	KCS 112464
66 -	box car	(E)	BNSF 782402
67 -	box car	(L)	NS 473189
68 -	box car	(L)	FBOX 504226
69 -	tank car	(L)	TILX 265549
70 -	tank car	(E)	CRGX 290085

Cars 71 through 100 were still coupled to the rear portion of the train.

**NARRATIVE****Location of Incident Description**

This segment of BNSF's Needles Subdivision is an east and west route, consisting of multiple main tracks. The method of operation for the subdivision is Traffic Control System (TCS) with PTC overlay. The maximum authorized timetable speed on this segment of the Needles Subdivision is 79 mph for passenger trains and 55 mph for freight per the BNSF's California Division Timetable No.4, effective February 27, 2019 (updated: November 10, 2020).

The site of the derailment was at milepost (MP) 692.0 between Ash Hill and Ludlow stations. This segment of the Needles Subdivision is in a remote desert area, located approximately one (1) mile east of Ludlow, California.

**Note:** Timetable directions will be used throughout this report.

**Circumstances Prior to the Accident**

Train 1 was a mixed freight train consisting of three head end locomotives and two rear end distributed power units (DPU) with 72 loads and 28 empties for a total train length of 6,621 feet and 10,528 trailing tons. Train 1 departed from Kansas City, Missouri, on February 28, 2021. Prior to departure, the train received a Class 1 extended haul brake test inspection by mechanical personnel with no exceptions noted. Train 1 was PTC-enabled and equipped with Trip Optimizer.

The two-person crew consisted of a locomotive engineer and conductor, who both went on duty Wednesday, March 03, 2021, at 7:00 am PST, at Needles, California. This was the crew's home terminal. Both crew members had received their statutory required off-duty time.

Upon arrival at the Needles Terminal, the inbound crew job briefed the outbound crew. No unusual issues were noted during this job briefing. Train 1 then departed the Needles, California Terminal at 8:31 a.m., PST.

**The Accident**

On March 03, 2021, at approximately 12:20 pm, Train 1 was traveling westbound near MP 693.4 at a recorded speed of 52 mph when it experienced an undesired emergency brake application (UDE). After entering the first of two curves before control point Ludlow, on a .12 percent ascending grade, the crew stated, "they felt the run-in due to slack action, prior to the train going into emergency." The Engineer made several attempts to recover the train's air while simultaneously attempting to contact the BNSF Train Dispatcher via radio, while the conductor exited the locomotive and began walking east to inspect the train.

A BNSF track maintainer was at the National Trails Highway grade crossing at MP 691.0 when he observed a large cloud of dust rising into the air. He drove to the location, observed that Train 1 had derailed, and contacted the BNSF dispatcher via emergency radio to inform them that Train 1 was on the ground and to stop all train movements within the area. The dispatcher then advised he would get emergency response personnel headed that way. After briefing with the train crew, the maintainer and conductor drove back to the pileup to assess the damage and determine what cars had derailed. During

their assessment, it was determined that Train 1 derailed cars line numbers 26 through 70 from the head end. After evaluating several of the tank cars involved in the derailment it was discovered that tank car TILX190777 (Line No. 47), containing Ethyl Alcohol had ruptured due to damage sustained in the derailment. An evacuation was ordered for 1,000 feet downwind per the USDOT Emergency Response Guidebook instructions. The evacuation was lifted when San Bernardino County Fire HAZMAT personnel deemed it safe.

### **Post - Accident Investigation**

On March 3, 2021, both the FRA and BNSF began an investigation of this accident. After the on-site inspection and investigation, FRA investigators requested all necessary event recorder downloads, dispatcher audio files, records, forms, and other documentation necessary to conduct the final analysis and conclusion concerning the facts of the accident.

### **Analysis and Conclusions**

*Analysis — Toxicological:* This accident met the requirements of Title 49 Code of Federal Regulations (CFR) Section 219, subpart C, Post-Accident Testing. FRA Post-Accident Forensic Toxicology Result Reports indicate that each of the two employees tested had negative test results.

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

*Analysis — Train Make-up:* Train 1 consisted of three head end locomotives, 100 cars of mixed freight, and two rear distributive power (DP) locomotives. The train's configuration met BNSF's train make-up standards. Per policy Train 1 was allowed 3,471 tons in the rear 25 percent of the train. At the time of the incident, Train 1 was at 3,335 tons, 136 tons less than allowed or the average weight of one loaded tank car. The weight distribution of the 100 cars represents the trailing tonnage that is described as distinct blocks (sections) in the following breakouts by weight distribution. Block 1 is the first 26 cars that were all loads with a total combined weight of 3,198 tons (average car weight of 123 tons). Block 2 is the following 22 empty cars with a total combined weight of 970 tons (average car weight of 44 tons). Block 3 contains the remaining 52 cars with a total combined weight of 6,292 tons (average car weight of 121 tons). The empty cars of Block 2 depict a scenario illustrating that the lightest part of Train 1 is the middle block weighing 970 tons that was compressed between the forward Block 1 which weighed 3,216 tons and the rear Block 3 that weighed 6,340 tons. This is in line with event recorder analysis that reveals as the cars began bunching on the descending grade, the rear end of the train gained 3.3 mph relative to the speed of the head end of the train. This resulted in Block 3 tonnage of the train pushing Block 2 of the lighter weighing cars into a slower heavier mass of tonnage on the head end of the train that generated enough lift forces to cause the wheels of an empty car CRYX 8332 (Line No. 36) to jump the rail causing the derailment.

*Conclusion:* FRA determined that excessive buffing due to train make-up was the probable cause of this derailment.

*Analysis — Operating Practices/Train Handling:* A review of crew member records revealed no exceptions with their training, testing, certification, or hours of service records. A conversation with the crew confirmed that Train 1 was equipped with PTC and Trip Optimizer (TO). In anticipation of a possible stop signal at Ludlow at (MP 693.4), the engineer disabled the TO, taking manual control of Train 1 at West Ash Hill due to a signal indication of flashing yellow (advanced approach) at the intermediate signal located at MP 688.3. A review of the event recorder data clearly shows the rear end of the train running in as the train was negotiating the grade on the west side of the summit at Ash Hill, MP 687.5. This is 5.6 miles of descending grade averaging between .90 and 1.03 and is characterized by a 0.5-mile-long, level plateau between MP 689.9 and MP 690.4. The event recorder revealed that the engineer was in dynamic brake throttle position three as the head end of the train was traversing the plateau. The lead unit speed was 47.6 mph and the rear end of the train was 47 mph. As the head end of the train descended from the plateau, the speed of the head end of the train increased to 49.8 mph and held steady. At the same time, the rear end of the train increased speed from 47 mph to 50.8 mph. Over the next 15 seconds, as the head end of the train was holding steady at 49.8 mph the rear of the train continued to increase in speed to 53.1 mph.

Seven seconds prior to the UDE, the head end of the train increased its speed from 49.8 mph to 51.6 mph causing slack in the train that bunched up allowing the rear tonnage to gain momentum. As a result, excessive forces were generated by the rear tonnage running into the slower head end tonnage when the head end dynamic brake was applied.

*Conclusion:* FRA determined that car CRYX 8332 (Line No. 36) was the first empty car to derail, resulting in the UDE and general pile-up due to in-train forces generated by the tonnage at the rear end of the train. The exact point of the derailment was never determined due to the extensive debris pile and the carriers' clearing of the wreckage to return the tracks to service. Evidence gathered at the derailment site supports the derailment originating in the block of empty cars; with 13 of the derailed cars being identified as empty boxcars equipped with end-of-cushion drawbars. The end-of-cushion drawbar design allows for additional free travel (additional 26-inch per car) which can substantially amplify train induced forces. Excessive in-train forces were then generated as the rear end of Train 1 identified as Block 3, had accelerating tonnage running in on the slowing head end tonnage of Block 1, compressing Block 2, characterized by an accordion-style pile-up in the mid-section of the train.

*Analysis - Track:* The track through the accident area consisted of Continuous Welded Rail (CWR) on wood crossties with standard 6-1/2-inch, double shoulder plates and six-inch long cut track spikes as fasteners. Every other tie was box anchored in compliance with BNSF's CWR policies. The rail's information on tangent track was 136 lbs. controlled cooled (CC), CF&I rail; both rails were manufactured in February 1992. There was no evidence of missing or defective fasteners. Average tie spacing was 19-1/2-inches between tie centers. The track ballast is crushed granite. The tie cribs appeared to be full, with an average of 12 to 18-inches of shoulder ballast. A post-accident track inspection was conducted with no defects being noted. Post derailment track measurements were not taken due to extensive damage caused by the accident. This segment of track is required to be inspected twice weekly by



BNSF track inspectors. After a review of the railroad's track inspection records, ultrasonic rail flaw test records, and the most recent BNSF and FRA geometry car surveys, no defective track conditions were identified in the derailment area.

*Conclusion —Track:* FRA determined track conditions did not contribute to the cause or severity of the incident.

*Analysis – Signal and Train Control:* FRA reviewed logs and records of the Hot Box detectors (MP 691.8, MP 683.6, MP 680.0, MP 674.5, MP 670.0, and MP 665.2) traversed by the BNSF H-KCKBAR-1-28A prior to this accident. No exceptions were noted. BNSF signal trouble logs and signal test records between the West Ash Hill and East Ludlow control points were reviewed with no problems reported.

*Conclusion:* FRA concluded signal and train control did not contribute to the cause or severity of the derailment.

*Analysis – Mechanical (Locomotives):* FRA reviewed BNSF's mechanical records for the locomotives, no mechanical or maintenance defective conditions were noted.

*Conclusion:* FRA determined that the locomotives' condition did not contribute to the severity of the derailment.

*Analysis – Mechanical (Cars):* FRA's records review indicates the train received a Class I Brake Test and mechanical inspection by qualified mechanical personnel at Kansas City, Missouri, on February 28, 2021, at 10:45 a.m. CST with no defective conditions noted.

*Conclusion:* A comprehensive review of the available documentation found no indications of defective equipment within the consist. FRA determined that the cars' condition did not cause or contribute to the severity of the derailment.

## **Overall Conclusions**

The mid-train placement of empty boxcars equipped with end-of-cushion drawbars, along with significant trailing tonnage, created the opportunity for a run-in derailment. As a result, when the head end of Train 1 slowed on the approach to CP Ludlow, the rear end power continued to push causing the lighter empty cars to lose wheel-to-rail contact. Even though Train 1 complied with BNSF's train make-up policies and procedures, the derailment was the result of in-train buff forces compounded by the placement of empty boxcars.

## **Probable Cause and Contributing Factors**

FRA has concluded the probable cause of the accident was in-train forces generated by the rear DPUs running in on the middle section of Train 1, which was compounded by train make-up, placing more tonnage behind empty cars. The probable cause code H504 - buffing or slack action excessive, train makeup.