Transportation Safety Board of Canada | Bureau de la sécurité des transports du Canada

Rail Transportation Safety Investigation Report R20V0005

MAIN-TRACK TRAIN DERAILMENT

Canadian National Railway Company
Freight train U79351-06
Mile 69.97, Bulkley Subdivision
near Kitwanga, British Columbia
07 January 2020

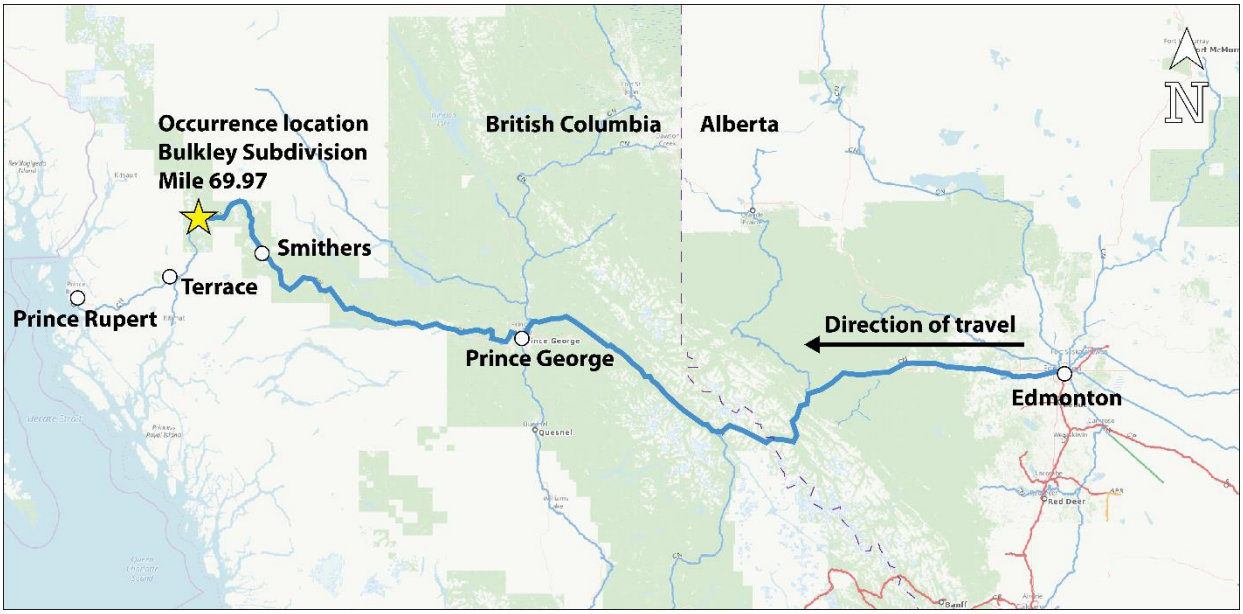
The occurrence

On 07 January 2020, at 0600 Pacific Standard Time, Canadian National Railway Company (CN) westward train U79351-06 experienced a train-initiated emergency brake application while proceeding at about 35 mph at Mile 70.14 of the Bulkley Subdivision (Figure 1).

Inspection by the train crew revealed that 34 cars loaded with wood pellets had derailed. There were no injuries, and there was no environmental impact.

Canada

Figure 1. Map of derailment location (Source: Railway Association of Canada, *Canadian Rail Atlas*, with TSB annotations)



Weather

Weather at the time of the occurrence was cloudy and −8° C.

Crew information

The crew consisted of a locomotive engineer and a conductor. Both crew members were qualified for their respective positions, met established fitness and rest requirements, and were familiar with the territory.

Train information

The conventional[1] train comprised 2 locomotives and 90 loaded cars. It was 6160 feet long and weighed 11 915 tons. It had departed Smithers, British Columbia (BC), at 0235 destined for Prince Rupert, BC. This train operates daily, originating in Smithers and terminating in Prince Rupert.

Wayside inspections

Before the derailment, the train had passed hot box and dragging equipment detectors at Mile 34.0 and Mile 49.61 of the Bulkley Subdivision with no alarms noted. In addition, there were no anomalous readings from the last wheel impact load detector (WILD) passed before the derailment.[2]

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[1] Conventional trains have all locomotives positioned at the head end.

[2] Mile 98.6 of the Telkwa Subdivision on 06 January 2020.

Recorded information

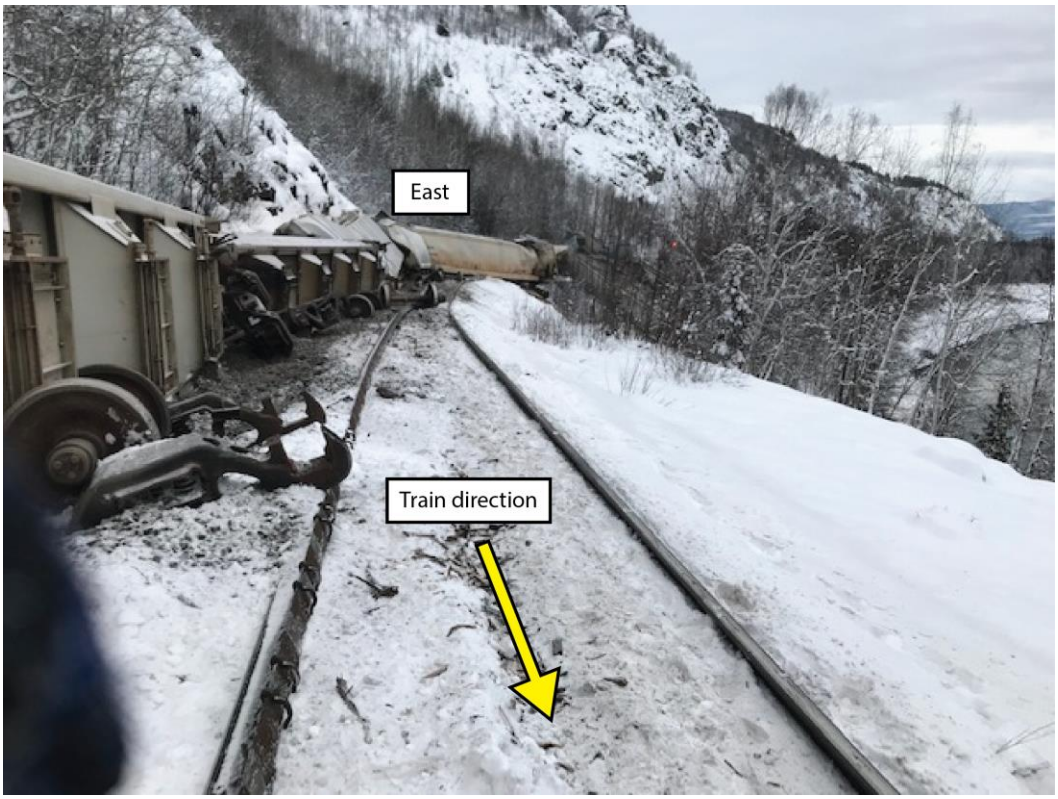
The locomotive event recorder (LER) was reviewed and no train handling anomalies were noted. LER data indicate that the lead locomotive was at Mile 70.14, exiting a left-hand (LH) curve when the emergency brake application occurred.

The forward-facing video and audio from the lead locomotive were reviewed. A sound was heard and a noticeable side-sway motion (to the north side) was observed as the train travelled through the LH curve immediately before the train-initiated emergency brake application occurred.

Site examination

Post-derailment inspection revealed that the point of derailment was in the eastern spiral[3] of a 6° LH compound curve at Mile 69.97. The 3rd through 36th cars behind the locomotives derailed. The 3rd car to the 8th car remained upright along the track. The 9th car struck a rock face and rotated laterally. The 10th through 36th cars piled up in jackknife pattern perpendicular to both sides of the track (Figure 2).

Figure 2. Derailed cars to the high (north) side of the eastern spiral of the 6-degree left-hand compound curve, looking east (Source: Canadian National Railway Company, with TSB annotations)



The south wheel outer rims on the first 3 derailed rail cars were scored, indicating that they fell into gauge and were rubbing up against the gauge side of the south rail. In contrast, no scoring was noted

[3] A spiral is a portion of the curve where the track transitions from tangent to curved track. Each curve has an entry and exit spiral, depending upon the direction of travel.

on the north wheel inner rims, suggesting that the backside of the wheels was not pressed up against the field side of the north rail. The first 6 cars derailed to the high side of the LH curve and the high (north) rail rolled over.

Subdivision and track information

The Bulkley Subdivision is part of CN's northern route to Prince Rupert. Train traffic on the Bulkley Subdivision consists of 14 to 18 trains per day; much of the train traffic consists of loaded westbound bulk unit trains of coal, grain and wood pellets and loaded eastbound intermodal trains. Tonnage has grown over 10% per year since 2017 with 51.0 gross ton-miles (millions)[4] recorded for 2019.

In the vicinity of the derailment, the track is Class 3 track according to the Transport Canada–approved *Rules Respecting Track Safety*, also known as the Track Safety Rules (TSR). The maximum authorized speed for freight trains was 35 mph. The derailment occurred in a 6° LH curve that consisted of 136-pound continuous welded rail set on 16-inch tie plates secured to hardwood ties with 5 spikes per plate anchored every other tie. Tie condition was good. The high rail was 2016 Nippon rail manufactured by Nippon Steel Corporation and laid in September 2016. The low rail was 2017 EVRAZ rail manufactured by EVRAZ North America and laid in July 2018. The ballast was in good condition with 2 ½-inch crushed rock, 12-inch shoulders and full cribs. There are multiple reversing curves in the area of the derailment. The track is on a 0.2% to 0.4% westward descending grade.

Track inspection

An inspection conducted on 09 July 2019 with a heavy track geometry test vehicle recorded 11 priority wide-gauge[5] deviations in several curves between Mile 69.83 and Mile 71.21, including 8 feet of wide gauge of 57.31 inches at Mile 69.98 in the 6° LH curve.

On 29 September 2019, the track was again inspected with a heavy track geometry test vehicle. During this inspection, 19 priority wide-gauge deviations were identified in curves in the same section of track, including 19 feet of wide gauge of 57.56 inches at Mile 69.97, in the beginning of the eastern spiral of the 6° LH curve.

Comparison of the 09 July 2019 and 29 September 2019 heavy geometry test vehicle results indicates that the number and extent of priority wide-gauge deviations had increased (Table 1).

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[4] Gross ton-miles for a subdivision are calculated by multiplying the weight of locomotives, loaded or empty freight cars by the number of miles travelled over a given period.

[5] Standard gauge is 4 feet 8½ inches (56.5 inches). CN's *Engineering Track Standards* define a priority wide gauge for Class 3 track as ¾ inch wide and urgent wide gauge as 1¼ inches wide. The *Rules Respecting Track Safety* (TSR) define a wide gauge defect on Class 3 track as more than 1¼ inches greater than the standard gauge. Priority deviations are to be monitored and corrected before they worsen.

Table 1. Location of priority wide-gauge deviations identified by track geometry inspections between Mile 69.82 and Mile 71.21 of the Bulkley Subdivision in July and September 2019 (Data source: Canadian National Railway Company)

Location description	09 July 2019 inspection			29 September 2019 inspection		
	Mile	Gauge (inches)	Length (feet)	Mile	Gauge (inches)	Length (feet)
Beginning of 0.75° right-hand (RH) curve west spiral	-	-	-	69.82	57.41	14
0.75° RH curve	69.83	57.30	8	69.82	57.40	6
Beginning of 6° LH east spiral	69.98	57.31	8	69.97	57.56	19
End of 6° RH east spiral	-	-	-	70.37	57.26	2
End of 6° RH east spiral	-	-	-	70.37	57.26	2
End of 6° RH east spiral	-	-	-	70.37	57.28	2
End of 6° RH east spiral	-	-	-	70.38	57.28	10
1.45° RH curve	70.86	57.32	25	70.85	57.34	36
1.45° RH curve	70.86	57.28	5	70.86	57.26	5
1.45° RH curve	70.87	57.29	10	70.86	57.33	26
Beginning of 2.95° RH spiral	71.10	57.44	15	71.10	57.44	17
Beginning of 2.95° RH spiral	71.10	57.28	5	71.11	57.25	3
Beginning of 2.95° RH spiral	-	-	-	71.11	57.27	3
2.95° RH curve	71.14	57.33	7	71.13	57.28	7
2.95° RH curve	-	-	-	71.13	57.25	3
2.95° RH curve	71.15	57.26	3	71.15	57.31	15
2.95° RH curve	71.18	57.28	5	71.18	57.31	7
2.95° RH curve	-	-	-	71.18	57.25	2
2.95° RH curve	71.21	57.39	14	71.21	57.32	11

The September 2019 inspection recorded 249 feet of rail with wide gauge over ½ inch, 19 feet of rail with wide gauge over ¾ inch and 11 feet of rail with wide gauge over 1 inch in the 6° LH curve where the derailment occurred.

Seven rail flaw detection (RFD) tests were conducted using an RFD test vehicle over the derailment area in 2019. The test conducted on 20 November 2019 was the last test before the derailment. There were 4 rail flaw defects noted in the vicinity of the derailment, all of which had been removed prior to the derailment.

Visual inspections (by maintenance personnel) and RFD joint bar inspections (by rail flaw detection inspection vehicle) were also conducted with no defects noted. There were no in-service rail failures in the derailment area. In addition, there were no high or critical vehicle-track interaction)[6] anomalies noted between Mile 60 and Mile 80.

[6] Vehicle track interaction units are accelerometers mounted on locomotives that identify unusual movements or accelerations resulting from track geometry or rail joint issues. The track location of potential exceptions are

Track maintenance

The high rail and the low rail in the derailment curve were re-laid in 2016 and 2018 respectively. There is no record of any other gauging work done between the installation of the high rail in 2016 and the derailment on 07 January 2020.

CN has installed over 115 000 concrete ties in various curves between miles 16 and 131 of the Bulkley Subdivision. Concrete ties require elastic fastening systems. These systems are much more resistant to gauge widening than conventional fastening systems (i.e., tie plates fastened to the ties with spikes). In addition, nearly 8000 feet of curves between miles 16 and 116 have been strengthened with rolled steel plates, screw fasteners, and clips.

Effects of bulk unit train traffic

Loaded high-capacity rail cars in unit trains pose special problems to the rails and wood track structure.[7] A loaded unit train consist is usually uniform, with all cars of the same design and loading. Therefore, each rail car on the train responds to track irregularities in the same manner as the previous car. This will typically concentrate the impacts in the irregularities in the track structure. Trains with numerous rail cars of the same design and with high load capacity provide the track little or no opportunity for elastic recovery during their passage. As a result, permanent, and usually non-uniform, track deformation is hastened by the accumulation of repeated stresses.

Recent derailments on the Bulkley Subdivision

On 08 December 2017, 52 empty coal cars derailed at Mile 35.10 of the Bulkley Subdivision, near Bulkley Canyon, BC (TSB Rail Transportation Occurrence R17V0249). This occurrence was not the subject of a TSB investigation. The railway determined that the derailment was the result of defective or missing rail fasteners.

On 19 January 2018, 27 loaded coal cars of a westbound unit coal train derailed at Mile 48.6 of the Bulkley Subdivision while travelling through New Hazelton, BC. A TSB investigation determined that the derailment resulted from a broken axle on the 52nd car and was not related to any track deficiencies (TSB Rail Transportation Safety Investigation Report R18V0016).

Safety message

The video and audio recordings from the lead locomotive strongly suggest that a sudden track failure occurred. Given the annual tonnage on the Bulkley Subdivision and the frequency of loaded unit train operations, it is likely that bulk unit train traffic accelerated the development and deterioration of priority wide-gauge conditions in the 6° LH curve where the derailment occurred.

Emerging wide-gauge conditions can progress quickly, particularly on track where bulk unit trains operate, making increased inspection and timely repairs a necessity for safe railway operations.

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identified by GPS (global positioning system) coordinates and automatically sent out from a modem on the locomotive. Potential exceptions are inspected to assess the condition and to determine the required action. (Source: Canadian National Railway Company, Safety Technology Overview: May 2018)

[7] TSB Railway Safety Issues Investigation Report SII R05-01: Analysis of Secondary Main-Line Derailments and the Relationship to Bulk Tonnage Traffic, section 1.5: The effects of bulk unit train traffic on secondary main lines.

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 21 October 2020. It was officially released on 4 November 2020.

Visit the Transportation Safety Board of Canada's website (www.tsb.gc.ca) for information about the TSB and its products and services. You will also find the Watchlist, which identifies the key safety issues that need to be addressed to make Canada's transportation system even safer. In each case, the TSB has found that actions taken to date are inadequate, and that industry and regulators need to take additional concrete measures to eliminate the risks.

ABOUT THIS INVESTIGATION REPORT

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