

RAILWAY OCCURRENCE REPORT

DERAILMENT

**CANADIAN PACIFIC LIMITED
MILE 111.0, NELSON SUBDIVISION
NEAR PROCTER, BRITISH COLUMBIA
20 JANUARY 1995**

REPORT NUMBER R95V0017

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

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Summary

The lead locomotive of a westward Canadian Pacific Limited (CP) freight train struck fallen rock on the track at Mile 111.0 on the Nelson Subdivision near Procter, British Columbia. Three locomotives and the first two cars behind the locomotives derailed and plunged down a 125 foot rock cliff into Kootenay Lake. The locomotive engineer and a trainman were drowned. The conductor suffered minor injuries.

One car load of lead sulphide and approximately 28,000 litres of diesel fuel from the locomotives were spilled into the lake. Some of the diesel fuel ignited; the remainder was contained with absorbent pads and booms. Work associated with the recovery of the lead sulphide was completed by March 29, 1995.

Other Factual Information

At approximately 0721 Pacific standard time (PST), westward freight train No. 981-20 operating with three locomotives, 27 loaded cars and 22 empty cars approached the ten degree left-hand curve at Mile 111.0. Recovered event recorder data depicted that the train was travelling at approximately 25 mph in the 25 mph zone when an emergency brake application was initiated. The train then travelled approximately 322 feet in about 12 seconds before information recording ceased as the lead locomotive struck the fallen rock.

At the time of the collision the conductor had been positioned in the operating compartment of the third locomotive which was being operated with the long hood leading. This locomotive came to rest with the operating compartment resting on the cliff face with the engine compartment submerged. The lead locomotive was resting on the lake bottom in 20 meters of water with the locomotive engineer and trainman trapped in the operating compartment.

Diesel fuel leaked from the locomotives and ignited as they plunged down to the rock face. The conductor managed to escape from the third locomotive through a side door and climbed onto the rocky shore avoiding the fire which had by then engulfed the protruding locomotive. He scanned the water surface and on seeing no signs of his fellow crew members or the other locomotives climbed the rock face to the tracks. With no means of radio communication, he ran westward on the tracks meeting maintenance-of-way employees at Mile 114.0. The rail traffic controller (RTC) was immediately advised of the accident and emergency response forces were summoned.

The crew members were qualified for their respective positions and met mandatory fitness and rest requirements established to ensure the safe operation of trains. The post mortum examinations did not reveal any pre-existing conditions that would have been a factor in the occurrence.

The fallen rock extended approximately 65 feet along the roadbed sloping across the track from a maximum depth of ten feet at the rock face to the south. The sight-line in the curve was restricted to approximately 350 feet.

The rock that fell was strong, massive, faintly weathered granite containing three sets of natural fractures that divided the rock into blocks. There were also several randomly oriented fractures that had probably been formed by blasting during construction of the railway.

The back and west faces of the rock that fell had been formed by continuous natural fractures, while the base may have been formed by a combination of natural fracture, blast-induced fractures and intact rock.

Soil and vegetation had built-up in the crack network along the back face of the block that fell. Some of this crack network extended into portions of the remaining rock faces and also contained soil.

On 19 January 1995 at approximately 1720 PST, a train had passed Mile 111.0 and the crew had not noticed any irregularities. Also on that date, the track had been inspected by the track foreman by a Hi-rail track vehicle; no unusual conditions were noted.

On 15 January 1995, after the bridge immediate to the rock face at Mile 111.0 had been inspected, a cursory examination had been made of the rock face. Track conditions in the vicinity were also checked. No rock falls or ice build-up were noticed and track conditions were considered good.

CP, with the assistance of a geotechnical consultant, has been carrying out an annual inspection of each rock cut in British Columbia and western Alberta since 1974. Based on the results of the inspections and the priority rating assigned to each cut, stabilization work is conducted at selected sites. Rock cuts on the Nelson Subdivision are inspected annually by track vehicle. However, an aerial inspection for rock slope stability had never been done. Stabilization work was done in the vicinity of Mile 111.0 in 1977 and again in 1987.

The most recent inspection of the subdivision had been in September 1994 at which time the specific block of rock that precipitated the rock fall was not identified, the slope was assessed as having a moderate probability of failure with small volumes of rock reaching the track. It was also noted that it was an area with a high cliff requiring observation. The report from that inspection recommended that stabilization work should be scheduled along Kootenay Lake between Miles 85 and 127 in 1996 or 1997. The report further recommended that more detailed inspections be conducted on the slopes in these sections to establish priorities for future stabilization work.

Rail traffic on the subdivision is controlled by the Occupancy Control System (OCS) and supervised by a RTC located in Revelstoke, British Columbia. There are two trains a day operating on this section of track. There was no slide warning fence at this location.

At the time of the derailment, the temperature was three degrees Celsius, winds were calm, and skies were cloudy with limited visibility in the early morning dawn. From January 6, 1995 to January 10, 1995, temperatures had been below freezing; from January 10, 1995 until the derailment, temperatures had been above freezing. Water was flowing down the fracture face, probably as a result of the most recent freeze-thaw cycle.

Following the derailment, CP conducted a helicopter inspection of the subdivision. Several locations were noted where follow-up inspections should be conducted to monitor potential instabilities.

As a result of the derailment, CP operated a track patrol ahead to every train on the Nelson Subdivision until priority rock stabilization work could be completed.

By 10 October 1995, CP Rail completed stabilization work at five priority locations between Miles 99.5 and 112.5 on the Nelson Subdivision. These slopes had been identified in the September 1994 report as requiring stabilization work within one to two years. Effective 18 October 1995 track patrols ahead of every train were discontinued.

Analysis

As the train approached the accident area, it was operating in accordance with company instructions and government safety standards. Although the crew initiated an emergency brake application, the train could not be stopped before hitting the fallen rock. The crew had been vigilant but unable to see ahead far enough in the curve in an area where the track followed the rock face. A slide warning fence would have provided the crew with advance warning of the obstruction.

The soil in the surface cracks on the rock face indicate that a network of fissures had probably existed for several years behind the rock that fell. Over time, the network would have become more extensive due to forces exerted on it by the roots of trees and bushes, freeze/thaw cycles and surface runoff. The failure occurred once support for the block of rock had been sufficiently weakened by the fissures.

The crack pattern which precipitated the rock slide was not visible from track level and would therefore not have been detected during inspections by Hi-rail track vehicle. An aerial inspection could have provided a better indication of the instability of the rock face.

Findings

1. The train approached the vicinity of Mile 111.0 operating in accordance to company instructions and government safety standards.
2. The train struck rocks at the tracks throwing the locomotives and the first two cars into the lake.
3. Track curvature and a rock face prevented the crew from observing the fallen rock in time to bring their movement to a stop.
4. The network of fissures behind the block of rock that fell had extended over time, probably due to forces exerted on it by the roots of trees and bushes, freeze/thaw cycles and surface runoff, until the rock could no longer be supported.
5. The block of rock that precipitated the rock fall was not identified during the rock slope stability assessment by Hi-rail track vehicle in September 1994.

6. The crack pattern which precipitated this slide could not have been detected by a track level assessment; the instability may have been detected if an aerial assessment had been done.
7. There was no slide warning fence in this area.

Causes and contributing factors

The train derailed after it collided with fallen rock from a rock face weakened by an extensive network of fissures.

The rock fall was triggered by forces due to freeze/thaw cycles, surface runoff and root systems.

Contributing to the collision was the inability of the crew to see the slide because of the curvature of the track as it followed the rock face.

Safety Action

Following this occurrence, an embankment inspection on CP's Nelson, Kootenay Landing and Boundary Subdivisions was completed by helicopter. The inspection revealed approximately twenty additional open rock fractures warranting close inspection. Simultaneously CP initiated the operation of a track patrol ahead of every train on the Nelson Subdivision until October 18, 1995. In December 1995, the TSB forwarded a Rail Safety Advisory to Transport Canada on the circumstances of this occurrence and that TC may wish to advise other federally regulated railways of the follow-up inspections undertaken, specifically those using helicopters, to assist in preventing recurrence.

CP has enhanced its systematic program for the management of rock slope hazards program by: providing maintenance-of-way employees instruction on basic rock slope inspection, principles of rock slope stability, and methods for stabilization and protection; extending the coverage of annual rock slope inspections; using aerial inspections to evaluate rock slope features at higher elevations; and evaluating and cataloguing a broader range of mitigative measures for rock slope instability.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson, John W. Stants, and members Zita Brunet and Maurice Harquail, authorized the release of this report on 04 April 1996.