RAILWAY OCCURRENCE REPORT
NUMBER R96C0135

DERAILMENT

CANADIAN PACIFIC RAILWAY
TRAIN NO. 823-162
MILE 138.4, WINDERMERE SUBDIVISION
NICHOLSON, BRITISH COLUMBIA
14 JUNE 1996

Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

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.

Railway Occurrence Report

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Synopsis

On 14 June 1996, at approximately 1700 Pacific daylight time (PDT), Canadian Pacific Railway (CPR) freight train No. 823-162 derailed 13 loaded cars of coal near Nicholson, British Columbia, Mile 138.4 of the Windermere Subdivision.

The Board determined that the train derailed as a result of a track buckle in an area where tie renewal work had occurred, but had not been completed. The area was left with a slow order speed in excess of that required for a disturbed ballast track bed.

Ce rapport est également disponible en français.

1.0 Factual Information

1.1 The Accident

Train No. 823-162 (train 823) departed Fort Steel, British Columbia, at approximately 1245 destined for Golden, British Columbia. At approximately 1607, as the train approached Mile 138.40 of the Windermere Subdivision, it experienced a train-initiated emergency brake application. After conducting the necessary emergency procedures, the crew determined that 13 loaded coal cars, the 75th to the 87th car inclusive, had derailed. Seven of the cars came to rest on their side; their contents spilled into the adjacent ditches filled with the backwaters of the Columbia River. No coal was spilled into the main stream of the Columbia River.

1.2 Injuries

There were no injuries.

1.3 Damage to Equipment

Eleven freight coal cars were destroyed.

1.4 Other Damage

Approximately 950 feet of track was destroyed.

1.5 Personnel Information

The train crew consisted of a conductor and a locomotive engineer, positioned in the lead locomotive. Both were qualified for their respective positions and met fitness and rest requirements established to ensure the safe operation of trains.

1.6 Train Information

The train included 3 locomotives and 113 loaded coal cars. It weighed 16,100 tons and was 6,900 feet in length.

[1] All times are PDT (coordinated universal time (UTC) minus seven hours) unless otherwise noted.

1.7 Particulars of the Track

The track structure consisted of 136-pound continuous welded rail (CWR). The rail was laid on 16-inch eccentric tie plates on nine-foot hardwood ties and fastened with five spikes per tie plate. The track was anchored every second tie.

The subgrade was soft with water standing on both sides of the track. Ballast was slag, heavily fouled with fine materials. There was approximately 12 inches of ballast under the ties with shoulders varying between 6 inches and 12 inches. The standard ballast section requires 12 inches of ballast under the ties and 12 inches of ballast on the shoulders. Ballast was disturbed by a tie renewal crew one day before the derailment. Cribs were filled and ballast was loose. An examination of the work area on the final days of work revealed that ties were installed in clusters of three to six ties adjacent to one another; i.e., up to three ties on curves and six ties on tangent track.

The CWR was laid at a rail temperature of 85 degrees Fahrenheit (F). The desired laying temperature for this region is 85°F. The rail temperature at Mile 119.8 shortly after the derailment location was noted to be 105°F.

The last track inspection was carried out by the Assistant Track Supervisor in a Hi-rail vehicle at approximately 1430, 14 June 1996. No defects were noted.

The track was last tested by the track evaluation car on 15 May 1996 and no defects were recorded at Mile 138.4.

The authorized train speed at this location is 35 mph for freight trains. A temporary slow order of 25 mph was in place at the time of the derailment on account of tie renewals.

1.8 Method of Train Control

Train movements on the subdivision are governed by the Occupancy Control System (OCS) authorized by the Canadian Rail Operating Rules (CROR) and supervised by a rail traffic controller (RTC) located in Revelstoke, British Columbia.

1.9 Weather

The temperature at the time of the derailment was 26 degrees Celsius. The sky was clear with good visibility.

1.10 Recorded Information

The event recorder data on the lead locomotive indicated that the train experienced a train-initiated emergency brake application at a recorded time of 1607:32, while it was travelling at a recorded speed of 24.2 mph. All other recorded train information systems were shown to be operating as intended.

1.11 Occurrence Site Information

The Windermere Subdivision extends from Fort Steel, Mile 0.0, to Golden, Mile 143.0.

The track is a single main track located on a level grade and on a four-degree curve. Gross tonnage carried over the track is approximately 30 million gross tons annually.

The derailment occurred on fill near the flood plain of the Columbia River. Backwater from the river saturated the subgrade. Seven coal cars were on their side and approximately 1,100 tons of coal was spilled on the right-of-way and into the ditches along the subgrade. Flotation booms were used to contain floating coal and debris. The coal not collected by the booms and suspected to have become settled at the bottom of the river was later to be salvaged.

1.12 Other Information

1.12.1 Tie Renewal Sequence

The sequence of operation for the tie renewal and follow up surfacing gangs working on the Windermere Subdivision:

	EVENT	EQUIPMENT
Tie Renewal	Distribute ties	Tie cranes (2)
	Remove spikes	Spike pullers (2)
	Spike pick-up	Spike reclaimer
	Remove old ties	Tie extractor
	Spread anchors	Anchor adjuster
	Line ties	Tie crane
	Insert ties	Tie inserter
	Install tie plates	Rail lifter
	Tamp ties	Switch tamper *Note: tamper not included in equipment fleet*
	Spike ties	Spikers (2)
	Adjust anchors	Anchor adjuster
	Clean up	Track motor cars (2)
Surfacing	Fill crib and shoulders	Ballast regulator
	Surface and line	Switch tamper
	Follow up tamper	Switch tamper
	Restore ballast section	Ballast regulator
	Stabilize ballast section	Track stabilizer

1.12.2 Work Gang Schedule

The gang was scheduled to work 10 days on the job with 4 days' leave (8 hours per day). The project was scheduled to install 20,000 ties between Mile 39.0 and Mile 138.5 on the Windermere Subdivision commencing on 23 April 1996 and continuing on the scheduled work cycle until 13 June 1996. The estimated production rate was 625 ties per workday.
Work blocks were arranged on a daily basis with the crew starting work between 0430 and 0500. The start time was scheduled to avoid disturbing the track in the heat of the day. On the final day of the scheduled work cycle, 12 June 1996, the gang started at 2230 and continued through the night, until 0900 on the morning of 13 June 1996. The crew installed 671 ties over that period, and the Track Program Supervisor raised the track speed from 10 mph to 25 mph at 0745 on 13 June 1996.

1.12.3 Standard Practice Circular

Standard Practice Circular (SPC) No. 8, paragraph 27, details certain precautions which must be taken when renewing ties in CWR territory:

- No more ballast than is absolutely necessary to effect renewals may be removed from the cribs and the tie ends.

- Disturbance of surface and alignment of track must be kept to a minimum.

- There must be at least one tie out of the adjacent four ties fully anchored and three ties out of the adjacent four ties fully spiked on each side of every tie from which spikes and anchors have been removed. Not more than two consecutive ties shall have spikes and anchors removed. Where heavier tie renewals are required and the above requirements cannot be met, they must be done in two or more passes. Sufficient time must be allowed between passes to ensure that the ties to remain in track are firmly embedded in the ballast.

- Spikes and anchors must be installed immediately after the new ties have been inserted and tamped, and before the passage of trains . . . .

- Ballast section must be immediately restored to the required standard after completion of tie renewals each day.

- If the rail temperature is, or is expected to be, more than 10 degrees F above the rail laying or adjusted temperature, then the following slow orders must be imposed prior to allowing traffic to

operate:

i) During the course of the work, 10 mph until ballast section is restored to standard.

ii) After ballast section has been restored to standard, 25 mph until the passage of 50,000 gross tons of traffic, ensuring that speed is not raised while rail temperature is above the preferred rail laying temperature.

An interpretation provided by CPR management notes that the SPC No. 8 requirement to "restore the ballast section to standard . . ." also includes ensuring that the track is tamped. That same management interpretation goes on to state that if the track is not tamped and regulated, it is not restored to standard, and that a 10 mph restriction must remain in place until those actions are completed.

1.12.4 Track Buckle Characteristics

A track buckle is a large misalignment of track. Most buckles occur on curves. Track buckles are usually caused by one or more of the following factors:

- weakened track conditions
- high compressive rail forces
- train vehicle forces

A weakened track condition will prevail if ballast is missing from the cribs or ends of ties, if ballast is disturbed, or if ties are installed in clusters and not properly tamped. Track disturbed by heavy tie renewals can lose as much as 80 per cent of its resistance to buckling. The action of the train, particularly the use of dynamic braking on downgrades, can increase the amount of compressive rail forces. Train vehicle forces can contribute to track buckling by exerting lateral wheel forces on a curve.

Other minor track buckles occurred at Mile 136.0 and Mile 114.3 on 12 June 1996. The CWR was distressed by cutting out a section of rail to relieve the compressive forces. The tamper from the tie renewal gang was diverted to correct the alignment. On 14 June 1996, a track misalignment was found at Mile 134.0. Track alignment was corrected by the local track maintenance forces.

1.12.5 Track Program Supervisor

The Track Program Supervisor had eight years' experience as a supervisor on ballast, tie and surfacing gangs. He was appointed to be in charge of the tie installation program which included the installation of 20,000 ties. A fleet of equipment (including a tamper) was assigned to the project to perform the work. Upon starting the program, the tamping equipment was consistently breaking down. Daily production reports showing equipment breakdowns were submitted to project management (Track Programs and Equipment Manager). Eventually, the tamper was transferred to a surfacing crew, which followed behind the tie renewal crew, to improve the efficiency of both units. The tamper required by the tie renewal crew was not replaced; this decision was taken by project management.

The sequencing of installation activities changed with the assignment of the tamper to the follow up surfacing crew. Without the availability of a tamper, the tie renewal crew in this situation would be unable to restore the ballast to standard and would either have to cease the tie installation activity, or impose a 10 mph speed restriction until tamping was complete.

The production expectation on this project was 625 ties per day. Despite ongoing malfunctions of the tamper, and its eventual reassignment to a follow up surfacing crew, the average production schedule was met or exceeded as approximately 10,000 additional ties were installed during the scheduled program.

The Track Program Supervisor was advised by the Track Programs and Equipment Manager to tie up his crew and ship his equipment to another location as of 13 June 1996. This date coincided with the crew's scheduled time-off period. As the end of the work cycle approached, the Track Program Supervisor requested that the surfacing crew be authorized to continue working throughout their time-off period to complete the surfacing behind the tie installation crew to ensure that the ties were properly tamped and restored to standard. This request was denied and he was advised to ship the equipment, including the tamper, to its new destination. He was also advised that another surfacing crew would be brought in to complete the surfacing on the following Tuesday, 20 June 1996.

In the early hours of 13 June 1996, the tie installation equipment was loaded for shipment as directed. The Track Program Supervisor then increased the speed limit from 10 mph to 25 mph in the belief that the ballast section had been restored to standard by filling the cribs and that the requirement of the passage of a minimum of 50,000 gross tons had been met. This procedure had been a practice on this project as well as previous tie programs on which the Track Program Supervisor had worked.

1.12.6 Track Maintenance Supervisor

The role of the Track Maintenance Supervisor and his assistants is to ensure that the track is maintained and is safe for operating trains at the authorized speed designated in the timetable. The supervisor's function is entirely separate from the tie renewal program and the supervisor's involvement with the tie renewal program consists of a cursory inspection and acceptance of the completed work.

The quality control for the tie installation work was the responsibility of the Track Program Supervisor. Acceptance of the finished work by the Track Maintenance Supervisor was based on a "blind trust" that the work was completed in accordance with the SPCs by a competent and qualified supervisor. Only extenuating circumstances or unexpected conditions which would render the track unsafe would overrule a Track Program Supervisor's decisions. However, the Track Maintenance Supervisor was aware that there was no tamper in the tie installation consist.

1.12.7 Work Program Training

Work program training is comprised of on-the-job work experience and in-house training covering SPC requirements for specific job applications, job planning, health and safety issues, budgetary control, CROR rules and administration. A Track Program Supervisors Seminar had been held in January 1996; however, the substance of this training session was not documented and any interpretations given to the requirements of SPC No. 8 are not known.

1.12.8 Management of Work Program

CPR reorganized its Engineering management structure, resulting in the Track Program Supervisor reporting to the Track Programs and Equipment Manager, reporting in turn to the Engineering Manager at the district level.

At the outset of the project, an eight-hour work block was planned; however, this plan incurred considerable overtime and production was above schedule. The Track Programs and Equipment Manager reduced the work block time to seven hours to curtail unnecessary overtime. Scheduled production was still met.

The Track Programs and Equipment Manager or his assistant visited the job site three times between start up on 23 April 1996 and the tie-up of the gang on 13 June 1996. The management team was informed through daily production reports and telephone conversations that the tamping machine was breaking down and that its availability was not keeping up with tie installation.

The scope of the work changed when a surfacing crew was added to the complement. It became apparent shortly thereafter that the surfacing was falling behind the installation, creating lengthy 25 mph slow orders. Throughout this work cycle, the mandatory 10 mph slow order while undertaking work was consistently increased to 25 mph after a ballast section had been restored without tamping and 50,000 tons of traffic had passed over the track. This practice was condoned by the Track Programs and Equipment Manager. At the time of shutdown of the installation gang, the surfacing was approximately eight miles behind.

2.0 Analysis

2.1 Introduction

The train was operated in accordance with company procedures and government safety standards. Although the crew was in compliance with the slow order, the speed at which the slow order was set was far in excess of the requisite speed restriction for areas where tie renewal was incomplete, rendering the disturbed track in the area susceptible to buckle. The analysis will therefore focus on the actions taken by the Track Program Supervisor to increase the slow order speed from the required speed and also explore the reasons why such a condition was allowed to continue.

2.2 Track Buckle

A 10 mph maximum speed requirement over untamped track had been lifted and replaced by a 25 mph slow order. The untamped track, over which train 823 proceeded, was weakened to a condition where the integrity of the track structure was unable to withstand the compressive forces brought on by the rail expansion and the passing of the train. It is likely that, as the train passed over the rail at a speed of approximately 24 mph, the rail began to shift until it completely misaligned and caused the train to derail. The following track conditions contributed to the overall weakness of the track structure:

- the ballast section was less than standard for CWR,
- ballast was in poor condition and fouled with fine materials,
- ballast was loose and newly installed ties were not tamped,
- ties were installed in clusters, and
- the subgrade was soft.

2.3 Weakened Track Structure

Existing fouled ballast was used to restore the ballast section. No additional ballast was added and the existing quantity was insufficient to provide the required 12-inch shoulder. The new ties were installed in clusters and not immediately tamped, as required by SPC No. 8, because of malfunctioning equipment and because of an eventual reassignment of the required tamper out of the tie renewal gang's equipment

consist.

2.4 Improper Speed Restriction

The Track Program Supervisor removed a 10 mph slow order before the track had been tamped and restored to standard. This decision was based on an improper belief that the requirements of SPC No. 8 would be met once the ballast had been returned to the cribs, and 50,000 tons had passed over the track section.

The Track Program Supervisor was experienced and trained to do the work he was undertaking. He adopted work practices that were acceptable to the program management and achieved the anticipated production and budget targets. The interpretation that he had applied to SPC No. 8 had been used throughout this project's work cycle, and this practice had been condoned by the Track Programs and Equipment Manager.

The Track Program Supervisor was under pressure to complete the track renewal by the end of this particular work cycle and to ship the equipment consist to a new work location on 13 June 1996. He "did what he had to do" to achieve the main objective, i.e., to install the ties. The availability and performance of the tamping equipment were beyond his control. Furthermore, his attempt to obtain authorization for the surfacing crew to complete the work at overtime rates was unsuccessful. Leaving a 10 mph speed restriction on the track until the next work cycle would have greatly impaired CP's ability to effectively utilize that section of track.

2.5 Communication Between the Track Maintenance Supervisor and the Track Program Supervisor

There is limited communication between the Track Maintenance Supervisor and the Track Program Supervisor as the quality control, daily work activities and placement of slow orders are under the control and supervision of the Track Program Supervisor. The judgement that the condition of the track was satisfactory for 25 mph was solely the decision of the Track Program Supervisor who knew that the job was not complete. A subsequent track patrol by the Track Maintenance Supervisor was ineffective in identifying the track hazard even though the Track Maintenance Supervisor was aware that the tie renewal crew did not have a tamper in their consist. Track Maintenance Supervisors rely heavily on the judgement of Track Program Supervisors and that judgement would be overruled only under extenuating circumstances.

3.0 Conclusions

3.1 Findings

1. The train was operated in compliance with company procedures and government safety standards.

2. It was a practice for the Track Program Supervisor to increase the slow order speed from 10 mph o 25 mph for an area where it was known that newly installed ties were not tamped. Program management ondoned this practice during the subject project work cycle and at no time advised the supervisor that track peed should not be increased until tamping was completed.

3. The Track Program Supervisor's interpretation of a restored ballast section was not in line with he requirements of SPC No. 8.

4. The restored ballast section approaching the point of derailment did not meet CWR standards. No dditional ballast was added to restore cribs and shoulders, the existing ballast was heavily contaminated with ine materials, the subgrade was saturated by flood waters, and the grade was soft.

5. The tamping machine supplied with the original fleet of tie renewal equipment was transferred to he surfacing crew at the early stages of the program and was not replaced for the duration of the work at this ocation.

6. The surfacing crew was approximately eight miles behind tie installation when the tie installation rew was instructed by the Track Programs and Equipment Manager to tie up and move to another location on 3 June 1996. The replacement surfacing crew was scheduled to take over the completion work on 20 June.

7. Clusters of three ties in a row on curves and up to six ties in a row on tangent track were nstalled, contrary to SPC No. 8.

3.2 Cause

The train derailed as a result of a track buckle in an area where tie renewal work had occurred, but had not been completed. The area was left with a slow order speed in excess of that required for a disturbed ballast track bed.

4.0 Safety Action

4.1 Action Taken

A TSB Rail Safety Advisory relating the circumstances of this occurrence was forwarded to Canadian Pacific Railway. It stated that a misinterpretation of standing instructions, Standard Practice Circular No. 8, may have occurred and had not been detected by program management. It further suggested that the railway bring the circumstances to the attention of those involved in tie renewal programs to reduce the likelihood of recurrence.

In response, CPR has initiated the following safety action:

1) The annual review/training period for track program supervisors was extended from the 9 days held in 1996 to 15 days in 1997. The 1997 program included a review of Standard Practice Circulars and a thorough review and discussion of occurrences. All track program supervisors were given instructions on the Track Safety Rules, and were retested and qualified as licensed track supervisors.

2) Training and certification as track supervisors was given to all extra gang foremen who were assigned to District gangs.

Furthermore, CPR is considering rewriting Standard Practice Circular No. 8, to clarify the terms “ballast section restored to standard ”.

Transport Canada railway safety officers have initiated spot checks in the course of their annual track monitoring program to ensure that all current railway policies and instructions with respect to track buckling are adhered to by track maintenance personnel.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson Benoît Bouchard, and members Maurice Harquail, Charles Simpson and W.A. Tadros, authorized the release of this report on 25 February 1998.