Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

RAILWAY INVESTIGATION REPORT
R02E0114

MAIN-TRACK DERAILMENT

CANADIAN PACIFIC RAILWAY
TRAIN 614-046
MILE 11.8, TABER SUBDIVISION
BULLSHEAD, ALBERTA
04 DECEMBER 2002

Canada

Railway Investigation Report

Main-Track Derailment

Canadian Pacific Railway
Train 614-046
Mile 11.8, Taber Subdivision
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Summary

At 0055 mountain standard time on 04 December 2002, eastward Canadian Pacific Railway freight train 614-046, proceeding toward Dunmore, Alberta, from Lethbridge, Alberta, derailed 42 loaded non-pressure tank cars of molten sulphur at Mile 11.8 of the Taber Subdivision, near Bullshead, Alberta. Ten tank cars were breached, spilling molten sulphur, which caught fire. Approximately 20 people were evacuated from farms near the accident site as a precaution due to the toxic nature of the smoke. There were no injuries.

Ce rapport est également disponible en français.

Other Factual Information

At 0055 mountain standard time[1] on 04 December 2002, Canadian Pacific Railway (CPR) freight train 614-046, proceeding eastward on the CPR Taber Subdivision at approximately 38 mph, derailed at Mile 11.8 after a train-initiated emergency brake application. The crew immediately contacted the rail traffic controller (RTC), who advised the Medicine Hat Fire Department, Seven Persons Fire Department, Ambulance, and the Royal Canadian Mounted Police (RCMP). Inspection of the train revealed that 42 tank cars loaded with liquid sulphur, commencing behind the seventh car, had derailed, 10 of which were on fire. The rear wheels on the eighth car in the consist had derailed. The locomotives and the first eight cars continued approximately 1/4 mile east of the main pile-up. The following 40 cars were jackknifed perpendicular to the track, one beside the other, within 400 feet of the last derailed car, which had derailed leading wheels. About 440 feet of track was

destroyed.

As a precaution, the RCMP ordered seven farm families within one mile of the accident site (about 20 people) to be evacuated. There were no reported injuries or adverse effects to the train crew, first responders, or the public resulting from this occurrence. The Seven Persons Fire Department remained on the scene, extinguishing flare-ups during the clean-up operation.

Forty tank cars were severely damaged and ultimately scrapped. Nine SHLX tank cars and one PROX tank car were breached by dents and punctures to the tank shell heads and sides. Six cars, including the PROX car, were breached with four SHLX cars badly damaged with safety vents sheared off and torn side jackets. None of the tank cars was equipped with head shields; however, a nine per cent increase in puncture resistance was incorporated into the SHLX cars design, as required by Transport Canada's (TC) Equivalent Level of Safety Permit SR 5206. The bottom fitting protection and skid plates on these cars did not prevent the loss of product from some of the cars involved in the derailment. Four cars had the bottom outlet valves sheared off but did not open. All tank cars involved in the derailment were general purpose, insulated, non-pressurized tank cars built without head shields to specification DOT 111A100W2 or 211A100W1 design.

The train was powered by two General Electric AC4400 horsepower (HP) locomotives and was hauling 80

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[1] All times are mountain standard time (Coordinated Universal Time minus seven hours).

loads. It weighed approximately 10 948 tons and was 3748 feet long. The train was inspected by hot box detectors (HBDs) at Mile 52.0, Mile 34.6 and Mile 12.6. No alarms were recorded. These detectors were inspected and were reported to be in proper working order. In addition, previous trains (864-046, 573-12, 387-05 and 463-02) were inspected by the HBD at Mile 12.6 on December 3, and no alarms were recorded.

An impact reading of 126.3 kips was registered at Mortlach, Saskatchewan, on the Swift Current Subdivision, from a carload of potash that was on the last train over the point of derailment (POD) prior to the derailment. The impact was below the threshold value of 170 kips, which is required to activate an alarm. This car travelled from the detector to Lethbridge, before it was removed from service due to flat spots on all of the car's wheels. CPR attributed impact forces generated by this car to a number of broken rails on other subdivisions in the general area and a broken rail that led to this derailment.

The operating crew comprised a locomotive engineer and a conductor. They were qualified for their respective positions and met the required fitness and rest standards.

The Taber Subdivision is controlled by the RTC located in Calgary, Alberta. The method of train control is the Occupancy Control System authorized by the *Canadian Rail Operating Rules*. The Taber Subdivision is part of a CPR east-west rail transportation corridor that extends from North Portal, Saskatchewan, to Kingsgate, British Columbia. The subdivision is located in Alberta and is 116.4 miles long, extending from Dunmore to Lethbridge. The maximum authorized timetable speed is 40 mph, the track is classified as Class 3 under TC's *Railway Track Safety Rules* (TSR).

Traffic on the line in 2002 was 12.2 million gross tons, with 72 per cent of the traffic consisting of unit coal, grain, sulphur, and potash trains. Typically, these types of trains are handled by 3000 to 4400 HP locomotives. The railway is encouraging the use of dynamic braking as the preferred method for controlling train speed. This method of controlling train speed puts additional dynamic forces into the track structure.

At the time of the derailment, the sky was clear, visibility was good, the wind was calm, and the temperature was -15°C.

Particulars of the Track

The area of the derailment was tangent track on a 0.61 per cent descending grade into a sag vertical curve at the POD. The railway subgrade in the vicinity of the derailment was constructed of local materials consisting of silty, sandy clays, and sand on a six- to eight-foot fill. The terrain in the area of the derailment is flat and generally well drained.

The rail in the area of the derailment consists of jointed 100-pound head free (HF) rail manufactured by Lackawanna, Dominion, and Algoma between 1943 and 1960. The rail was cropped, welded into 72-foot lengths, and joined together with six-hole joint bars and laid in 1979. The rail had approximately 1/8-inch to 3/16-inch head wear and little or no flange wear. The majority of the rail on the Taber Subdivision is this type. However, recycled 115-pound continuous welded rail (CWR) was laid between Mile 104 and Mile 114.8, and on several higher degree curves.

The ties are softwood (7 inches by 9 inches by 8 feet) with approximately 3000 laid per mile. Current tie conditions on the Taber Subdivision in the area of the derailment indicated an average of 600 defective ties per mile. Random samples of defective tie counts across the subdivision were in the order of 300 to 400 per mile, concentrated mainly in the joint areas. Track ties in joint areas were skewed and damaged by broken plates, with only a marginal ability to hold spikes. Random samples indicated that clusters of five to eight ties were affected at each joint where the plates were broken and that three to five ties were defective. The joint bar assemblies at these locations were twisted inward to the gauge side, resulting in 3/8-inch to 1/2-inch tight gauge. Several joints showed evidence of wheel flanges having been in contact with the joint bars. There were 61 broken joint bars on the Taber Subdivision in 2000, 211 in 2001, and 284 in 2002.

The tie plates throughout the 100-pound rail consisted of the standard 100-pound variety, with a few combination 85-pound/115-pound plates and some double-shouldered plates. The plates were spiked with two spikes on the gauge side and one spike on the field side of the rail. Random samples indicated that an average of 5 to 10 plates per 72 feet of rail were broken, which represents approximately 20 per cent of the plates. Broken plates were more prevalent at the rail joint area. Railway personnel estimated that there was a marked increase in tie plate breakage over the previous year. This condition causes the rail joint to tilt inward, contributing to tight gauge. A temporary slow order (TSO) of 25 mph due to the condition of the tie plates was in effect between Mile 15 and Mile 23.8, commencing approximately 3.2 miles from the derailment site. A tie plate replacement program, to replace all broken tie plates between miles 0.4 and 20.0, was scheduled to commence in 2003. The TSR require that there must be non-defective tie plates under the running rails on at least 8 of any 10 consecutive ties.

The rail is box-anchored every second tie. At the time of the occurrence, rail anchors were in fair condition, but many were two to three inches away from the ties, indicating rail movement. In some areas of the subdivision, where there is soft track, additional anchors were installed every tie (beyond Standard Practice Circular (SPC) standards) to prevent rail creep.

The ballast consisted of crushed gravel that met CPR's G-3[2] specification, with 6 to 7 inches under the ties and 20-inch shoulders. Spot maintenance surfacing to correct major problem areas is done on an annual basis with a tamper and a regulator machine. The equivalent of 21.6 miles of track was surfaced on the Taber Subdivision in 2002. This degree of surfacing has been the norm for the past four years and is expected to continue. Those parts of the Taber Subdivision with ballast sections meeting G-3 or G-4.5 specifications were generally considered adequate. However, pit run ballast sections were in poor condition with mud pumping between the ties, particularly at the joints. The track surface and rail is generally good for Class 3 track through these areas; however, there are low joints throughout. Pit-run and fouled ballast, poor alignment of welds, and surface bent rail all contribute to poor track and surface across much of the Taber Subdivision.

The following is a list of the locations and types of ballast on the subdivision:

- Mile 0.4 to Mile 20.0: G-3 specification, in fair condition, exhibiting a high proportion of fines
- Mile 20.0 to Mile 35.0: G-4.5 specification in good condition
- Mile 35.0 to Mile 75.0: pit-run ballast was placed in 1959; the ballast is in very poor condition with mud pumping throughout the limits
- Mile 75.0 to Mile 78.0: G-4.5 specification in good condition
- Mile 78.0 to Mile 105.0: G-3 specification ballasted in 1984-1985; ballast is in fair condition with considerable fines and blown dirt in some areas

G-4.5 ballast is a coarser material with a higher percentage of fractured particles than G-3 ballast, making it more suitable to higher traffic lines with CWR. Other TSOs on the Taber Subdivision in effect at the time of the occurrence were attributed to the surface condition of the track: 25 mph at Mile 98.54, between Mile 28.0 and Mile 29.0, and between Mile 91.5 and Mile 96.0.

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[2] Indicator of track movement

The precise POD was not verified conclusively and not all rail pieces were recovered; however, a number of rail pieces and seven joints (four from the north rail and three from the south rail) with bars remaining on them were recovered from the derailment area and sent to CPR's lab in Winnipeg, Manitoba, for analysis. All joint bars observed were a six-hole, 100-pound RE HF type, manufactured in 1978. All joints leading up to the suspected POD were recovered intact, indicating that if the rail broke, it broke between the joints. Seven of the 14 joint bars inspected displayed minor vertically oriented cracks along the top easement area in the middle of the bar, but none was considered significant.

Track Safety

Federally regulated railways in Canada are governed by the TSR that were approved by the Minister of Transport in March 1992, and became effective 03 September 1992. The purpose of these rules is to ensure the safe operation of trains on standard gauge track owned by, operated on, or used by a railway company. They are not intended to replace or circumvent good track maintenance practices, as specified in CPR's SPC – Track.

Tracks are classified according to maximum allowable train operating speeds, not tonnage or type of traffic, and are based on track geometry conditions. This practice reflects a maintenance standard based on train speed rather than track strength. Railways set train speeds according to their operational needs and must maintain the track according to the TSR for that class of track, which corresponds to the train speed regardless of train axle loading or tonnage being moved over that portion of track.

CPR's SPC 08 covers lining, maintaining, and renewing ties. Section 4.0, Inspecting Ties and Tie Defects, requires ties in the joint area, where support is most needed, to be sound and able to maintain surface and gauge. At each rail joint location, each rail joint must be supported by one non-defective tie with a tie plate no farther than 12 inches from the rail end. The number of defective ties within a joint area on a secondary or feeder line is limited to no more than two and no more than three outside the joint area. While defective tie conditions across the subdivision are not excessive and may not warrant a renewal program across the entire subdivision, overall joint tie conditions in the area of the derailment generally did not meet CPR's SPC 08 standard.

As axle loadings, speeds, and traffic volumes increase, there is a greater need for increased stiffness in rail sections. Increasing the rail weight increases rail stiffness, which reduces rail deflection. The heavier weight contributes to stability and to limiting bridging action[3] between the ties, especially if poor ballast and surface conditions exist.

Track Inspection

Under TC's TSR, Class 3 track is required to be inspected twice per week. The track in the vicinity of the derailment was last inspected on December 3, the day prior to the derailment. At that time, loose and missing track bolts were observed and these were tightened and replaced as necessary. The track was also inspected on December 2 and, in addition to the loose and missing

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3 Bridging action is the deflection of rail between two ties as load is applied.

track bolts, two broken joint bars were replaced. The inspection reports in the vicinity of this occurrence for the month previous to the derailment consistently noted loose and missing track bolts.

TC performed a track inspection from Mile 23 to Mile 80.94 on 28 June 2001. The inspection noted an improperly installed derail, and poor crossing surfaces and sight-lines. There were no anomalies noted on the ties, running rail, or joint conditions. The inspection in the vicinity of the derailment site previous to this was in April 1995, and the inspection report noted improperly installed derails and road crossing irregularities.

On 17 July 2002, TC inspected the track between Mile 55.69 and Mile 114.64. This inspection recorded fouled ballast conditions, defective tie clusters, tie and tie plate deterioration, ineffective anchoring, and general poor track conditions. TC wrote to CPR on 18 July 2002, requesting information on CPR's rail/tie/ballast program, both for work completed in 2001 and work planned for 2002. CPR was given 14 days to provide details of the corrective action they planned to take to address the track deficiencies identified during the July 17 inspection. CPR responded on 08 August 2002, outlining the immediate corrective action taken. However, there was no supplementary information regarding the long-term maintenance plans necessary to address the inspector's observations.

On 08 January 2003, another inspection was completed between miles 32.5 and 62.0. On 10 January 2003, TC identified concerns regarding the ongoing maintenance and accelerated track degradation due to the overall subdivision tonnage increases and increased car loading over the previous four years. TC requested that CPR provide it with details by 30 April 2003 of its plans to maintain the infrastructure of the Taber Subdivision to safely handle anticipated rail traffic. CPR responded on 28 April 2003, indicating that, for 2003, the maintenance plans on the Taber Subdivision would include relay rail installation, turnout upgrades, and broken tie plate replacement. In addition, CPR provided TC with its 2004 to 2008 multi-year maintenance plan. TC reviewed this information and expressed concerns regarding the tie program and the plan to address the sub-standard ballast conditions. CPR was requested to review TC's concerns and provide a follow-up.

On 22 September 2003, CPR advised TC that it was limiting train speed on the subdivision until it had the infrastructure upgraded with better rail, fastenings, ballast and, where necessary, ties. CPR also indicated that TC's other concerns expressed earlier could be addressed through appropriate revisions to the capital plan. There was no further information on what revisions were being contemplated for the capital plan.

The rail service failures[4] identified on the Taber Subdivision since 2000 are as follows: three in 2000, seven in 2001, and eight in 2002.

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[4] "Rail service failure" notes that the rail failed while in active service and was not necessarily detected by the rail flaw detector car.

Track Evaluation and Testing

CPR's track evaluation car (TEC) tested the Taber Subdivision on 02 May 2002 and 04 September 2002. Both tests indicated a north rail alignment deviation of 3/4 inch near the point of derailment. The September 4 test also indicated a 3/4-inch alignment deviation on the south rail. Minor surface deviations of +/- 1/2 inch were noted throughout the derailment area on both tests. As these were not considered an urgent priority, they were not addressed.

The TEC noted that the urgent and priority defects over the Taber Subdivision between Mile 0 and Mile 106.7 (Stirling Subdivision Junction) are as follows:

- 28 March 2001, Mile 0.2 to Mile 106.7: 263 priority defects[5] and 8 urgent defects,[6] total of 271
- 13 September 2001, Mile 0.5 to Mile 106.7: 171 priority defects and 19 urgent defects, total of 190
- 02 May 2002, Mile 0.3 to Mile 106.7: 313 priority defects and 72 urgent defects, total of 385
- 04 September 2002, Mile 0.3 to Mile 106.7: 358 priority defects and 25 urgent defects, total of 383

The rail flaw detector car detects flaws in the rail. The last rail flaw test over the Taber Subdivision was conducted on 23 July 2002, between miles 37 and 0.4. The detector noted at that time a total of nine defects: two transverse defects, three vertical split heads, and four broken joints. None of the defects was in the vicinity of the derailment site. On the day of the derailment, the rail flaw detector car was awaiting repairs at Taber. CPR's plan was to test east on the Taber Subdivision through the derailment area once repairs were completed.

At the time of the derailment, the regular inspection and maintenance of the Taber Subdivision, including the Lethbridge Yard and the 27-mile-long Turin Spur, was performed by 13 employees. Four employees are headquartered in Taber (Mile 76.3), six in Montana (Mile 106.7), and three in the Lethbridge Yard (Mile 116.4). The group of six employees in Montana includes a four-person mobile gang, which can be called upon to assist the regular section crews maintaining the Stirling, Coutts, and Cardston subdivisions, as well as assist as required on the Taber Subdivision. In February 2003, CPR created two additional positions headquartered in Taber. CPR planned to relocate three persons from Taber to Bow Island (Mile 41.4) during 2003.

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5 Priority defects are those that must be inspected and corrected as soon as possible. If necessary, they must be protected by a slow order until remedied.

6 Urgent defects are those that require a mandatory slow order (unless corrected before the passage of a train). They include all CPR and government (Transport Canada and Federal Railroad Administration) safety violations.

In the three years prior to this occurrence (2000, 2001, and 2002), CPR replaced 23 393 ties over various locations on the Taber Subdivision and 42 960 feet of rail, none of which was in the vicinity of the derailment. A total of 4000 broken tie plates were replaced in 2001, between miles 15 and 22. At the time of the derailment, a TSO of 25 mph was in effect due to tie plate conditions between miles 15 and 23.8.

CPR maintenance planning is based on multi-year plans built on a four-year cycle. These programs vary from year to year. For the four years subsequent to this occurrence, CPR's maintenance plan for the Taber Subdivision consists of the following:

- 2003: 6.0 miles of relay rail at various locations; 30 000 tie plates at various locations; nil ties for the main track;[7]
- 2004: 17.01 miles of relay rail at various main-track locations; 852 cars of ballast for various locations; replacement of 3000 ties on the main track; and miscellaneous plant maintenance;
- 2005: 31.4 miles of relay rail at various main-track locations; 824 cars of ballast for various locations; replacement of 12 000 tie plates; and other work at turnouts and bridge at Mile 109.7; and
- 2006: 50.0 miles of relay rail at various main-track locations; 971 cars of ballast for various locations; and 18 000 ties.

Heavy Axle Loading

In recent years, railways in North America have increased axle loading on their networks from 33 tons (263 000 pounds) to 36 tons (286 000 pounds). Cars of 263 000 pounds that have been upgraded to 286 000 pounds must meet the requirements of Rule 88 of the Association of American Railroads' office manual and must, as a minimum, meet the requirements of S-259 for controlled/restricted interchange service. Apart from specific car-strength requirements, specification S-259 requires upgraded spring capacity to account for the 8.75 per cent increase in static weight. Effective July 2004, new 286 000-pound cars are required to meet the more stringent requirements of S-286 and associated S-976 truck requirements. Heavier loading results in increased plant capacity and lower train operating costs, because fewer locomotives, cars, and trains can handle more volume of commodities.

[7] This planned work for 2003 was completed.

Equivalent Level of Safety Permit SR 5206 was issued on 22 April 2002 by TC's Transport of Dangerous Goods Directorate. This permit allows tank cars with reporting numbers SHLX 100-395 and PROX 61000-61049 to be loaded with molten sulphur, class 4.1, UN 2448, to a maximum gross weight on rails of 286 000 pounds. This is in excess of the 263 000 pounds authorized in CAN/CGSB 43.147-97.[8] The permit has an explanatory note that states, "In view of the economic and environmental benefits that larger shipments may bring to the rail industry, Transport Canada and the Federal Railroad Administration of the U.S.A. have published a joint White Paper outlining the conditions under which a Permit of Equivalent Level of Safety and/or an exemption may be granted with regard to an increase to the maximum gross weight on rail while maintaining or increasing the current level of safety. The Permit application has been evaluated against the 7 requirements for additional safety features as set out in the White Paper 'Maximizing Safety and Weight,' revision 'A' dated September 1999."

The white paper requirements referred to are limited to the car design itself and are essentially applicable to the car designer, builder, and to a lesser extent to the lessee or owner. Any infrastructure requirements or restrictions resulting from this increased loading were left to the railways and TC's Rail Safety Directorate to determine. Permit SR 5206 contained no infrastructure requirements or restrictions.

High-capacity rail cars in unit trains pose special problems to the track structure. A heavy axle unit train consist is usually uniform, that is all cars are of the same design and loading with the car trucks and car bodies responding more or less as one unit. Therefore, each rail car on the train responds to track irregularities in the same manner as the previous car, with the result that cumulative impacts are concentrated at whatever irregularities are encountered 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[9] during their passage. As a result, permanent, and usually non-uniform, track deformation is hastened.

Right-of-Way Remediation

Prior to repairing the right-of-way, the sulphur-contaminated soil was excavated and replaced with clean fill material. The contaminated soil was disposed of at the Medicine Hat municipal landfill site.

Analysis

The operation of the train met all company and regulatory requirements. The manner of train operation did not play a role in the accident. In addition, no defective equipment was identified on the occurrence train.

The role played by a loaded potash car with flattened wheels, which was handled on the last train over the derailment site prior to the accident, remains uncertain. While the wheel impact values, as measured on an adjoining subdivision, were significantly below the railway's safety threshold, they have been attributed to broken rails on other subdivisions and the cold ambient temperature when the car passed over the derailment

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8 Canadian General Standards Board, article 43.147-97

9 "Elastic recovery" refers to the track's ability to return to its original size and shape after being loaded and unloaded.

location (-15°C), which would have made the rail less ductile and prone to failure. Therefore, the operation of this car over the Taber Subdivision must be considered as one possible contributing factor of this accident. The analysis also considered the general track conditions, inspection, and maintenance, and the influence of the type and volume of traffic on the Taber Subdivision infrastructure.

A joint analysis of the rail pieces and joints by the TSB and CPR indicated visible fractures on a number of rail pieces, with typical, brittle failure consistent with post-derailment damage sustained by the rail. Although a visual inspection of the recovered rail pieces and joint bars failed to reveal any defects that may have contributed to the occurrence, one 24-inch piece of the north rail located between two joints close to the suspected point of derailment had noticeable batter on the west end. Considering the battered rail end, the high number of cars involved, and the concentrated derailment damage, the derailment was likely caused by a sudden rail break on the north rail under the train.

The Taber Subdivision is a secondary or feeder track system, defined as Class 3 track under TC's TSR. Track and substructure conditions on these types of lines are generally adequate for traditional railway cars that weigh up to 263 000 pounds (33-ton axle loads), but they have the potential to be inadequate and potentially unsafe for 286 000-pound cars (36-ton axle loads). On track where ideal geometry does not prevail and poorly supported joints exist, such as on the Taber Subdivision, this nine per cent increase in load can translate into an exponential increase in dynamic loading and can accelerate the deterioration of a track structure that was not designed to carry such loads.

As 100-pound rail can safely support 30 000 pounds of concentrated single wheel load, an additional 5750 pounds of concentrated wheel load places the rail beyond the safety margin. It would seem prudent that, because of the limited long-term load-bearing capacity that the lighter rail sections have in carrying such traffic, such as was the case at the derailment site on the Taber Subdivision, rail in the 100-pound or less category should be used only in those locations where rail cars exerting wheel loads in excess of 30 000 pounds are not likely to be operated frequently.

Impact forces imposed by the heavy axle loads and poor ballast and surface conditions led to an increased number of broken joint bars, tie plates, and damaged track ties in joint areas. Skewed ties and rail anchors away from the ties were an indicator of track structure movement instability and rail creep. In addition, the increased use of dynamic braking of heavy unit trains for controlling train speed added additional stress to the track structure. These combined factors reduced the overall track integrity.

Secondary or feeder lines with 100-pound rail or less can carry a limited volume of heavy axle traffic in the short term, provided the rail is continuous welded rail with good ballast, surface, and tie conditions. If the rail is jointed and proper ballast, surface, and tie support are not prevalent, such as existed on much of the Taber Subdivision including the derailment area, a marked increase in defective rails can be expected. The data for the Taber Subdivision indicate a steady increase in rail service failures between 2000 and 2002. The Taber Subdivision crushed gravel ballast is soft and fine, and is prone to fouling and degradation under heavy traffic. The high number of urgent and priority defects identified by track evaluation cars since March 2001 are indicative of the accelerated deterioration of ballast and surface conditions on the Taber Subdivision. The condition of the track, the current level of defects, and the number of component failures on the Taber Subdivision indicate an accelerated rate of track deterioration due to the high volume of heavy axle traffic.

Even though track degradation and maintenance requirements increase with heavier axle loadings, industry testing and experience have shown that heavier axle loads can be operated safely over conventional track systems with improved or upgraded rail, ties, track fastenings, ballast and subgrade conditions. In the absence of major infrastructure component upgrade programs (e.g. rail, high-strength splice bars, ties, tie plates, increased spiking, ballast, and drainage), increased maintenance, inspection, and rail and track strengthening are considered to be the minimum requirements to ensure the same level of safety that was experienced prior to the introduction of increased axle loading on a subdivision.

Industry experience suggests that increased tonnage can be safely handled by conventional track with the appropriate upgrades. However, the present levels of maintenance and plant renewal programs on the Taber Subdivision may not be timely or sufficient to keep pace with the accelerated rate of track deterioration and are inadequate to safely support heavy axle load traffic in the long term, even at reduced speed. Therefore, the risk of derailment due to similar circumstances still exists.

Railways have some flexibility to choose their traffic, operating and maintenance practices, and routes over which the traffic is moved. When track conditions deteriorate, railways may choose to upgrade the infrastructure or reduce train speed, and, if necessary, lower the track classification. Lowering train speed reduces impact loading and the rate of track degradation, allowing infrastructure upgrades to be temporarily deferred. However, the continued operation of this traffic without infrastructure upgrades presents potential long-term safety risks.

Although TSR Part II (c) specifies increased geometry car inspections for Class 1, 2 and 3 tracks that have carried more that 25 million gross tons (MGT) during the preceding 12 months, there is no provision for the type of traffic being carried. The Taber Subdivision carried 12.2 MGT in 2002, with 72 per cent of the traffic consisting of unit coal, grain, sulphur, and potash trains. Under the TSR, increased geometry car and visual inspections of the Taber Subdivision would not be required. While railways are able to comply with the TSR by reducing speed, the current TSR do not adequately consider heavy axle loading, tonnage, and frequency of train traffic in determining track classification.

TC's inspection activities on the Taber Subdivision and reporting of track deficiencies to the railway indicated a general awareness of the deteriorating track conditions. However, waiting for appropriate revisions to the railway's capital plan to rectify some of the noted safety deficiencies may mean that the deficiencies are left unaddressed for a considerable length of time, thereby increasing the risk of future derailments.

In issuing the Equivalent Level of Safety Permit to allow for the increased loading of the molten sulphur cars, TC considered criteria limited to the car design itself and essentially applicable to the car designer, builder, and, to a lesser extent, to the lessee or owner. The permit contained no infrastructure conditions, requirements or restrictions for the movement of heavier loaded molten sulphur cars over the Taber Subdivision. Any infrastructure requirements or restrictions resulting from this increased loading were left to the railways and TC's Rail Safety Directorate to determine. Although CPR and the rail industry are aware of the adverse effect of increased equipment gross weights on infrastructure through extensive study and analysis, CPR's deferred response to the accelerated track deterioration on the Taber Subdivision is considered inadequate. Increasing the maximum gross weight on rails without a corresponding requirement for timely and adequate infrastructure improvements increases the risk of track-related derailments, especially when this type of traffic is carried over the long term.

Findings as to Causes and Contributing Factors

1. The derailment of the sulphur train was likely caused by a sudden break on the north rail under the train. The cold ambient temperature would have made the rail less ductile and prone to failure.

2. The operation of a loaded potash car with flat wheels on the last train to operate over the point of derailment prior to the occurrence train may have generated sufficient impact to have caused a broken rail, particularly given the ambient temperature and the weak track structure.

3. The condition of the track, the level of defects, and the component failures on the Taber Subdivision indicate an accelerated rate of track deterioration due in part to the high volume of heavy axle traffic and the increased tonnage being handled over the subdivision.

4. Current *Railway Track Safety Rules* (TSR) are insufficient because track classification is determined by speed without consideration of heavy axle loading, tonnage, and frequency of train traffic.

Findings as to Risk

1. Although railways are able to meet the minimum safety standards of the TSR by reducing speed, current TSR may be insufficient to ensure the long-term safety of increased train traffic and heavy axle loads over secondary or feeder track systems.

2. While regulatory activities on the Taber Subdivision indicated growing concern with the deteriorating track condition, the absence of prompt action by the railway to address these concerns allowed the associated risk of derailment to remain unmitigated.

3. Increasing the maximum gross weight on rails without corresponding infrastructure improvements increases the risk of track-related derailments, especially when heavier traffic is carried over the long term.

Safety Action

Transport Canada is presently reviewing the *Railway Track Safety Rules* (TSR). As part of this review, it will be considering the factors of heavy axle loads, tonnage, and frequency of train traffic when making changes to the TSR.

The primary activity of the track inspections on the Taber Subdivision involves tightening or replacing track joint bolts or bars. In February 2003, Canadian Pacific Railway (CPR) created two additional positions headquartered in Taber. With all maintenance-of-way employees located west of Mile 76.3, CPR planned to relocate three persons from Taber to Bow Island (Mile 41.4) during 2003, to better balance the workforce and workload.
Although the track is only required to be inspected twice per week, inspection frequency has been increased, reflecting concern for the deteriorating track conditions. CPR is planning major improvements to the Taber Subdivision, including upgrading 115-pound rail, the replacement of crossties, and a shoulder-ballast program in rail renewal locations.

The frequency of rail flaw testing has been increased from three tests per year to four tests.

CPR has equipped four Sperry cars with B-scan technology, which will provide a greater number of ultrasonic sensors to cover a greater volume of rail. These cars will provide real-time data transmission capabilities, and they have been scheduled over all main track prior to the winter and at intervals not greater than 45 days.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 22 September 2004.

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