Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

RAILWAY INVESTIGATION REPORT
R10D0088

MAIN-TRACK DERAILMENT

CANADIAN NATIONAL
FREIGHT TRAIN M36831-18
MILE 58.20, KINGSTON SUBDIVISION
LANCASTER, ONTARIO
18 OCTOBER 2010

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 Investigation Report

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Canadian National
Freight Train M36831-18
Mile 58.20, Kingston Subdivision
Lancaster, Ontario
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Report Number R10D0088

Summary

On 18 October 2010, at about 0945 Eastern Daylight Time, eastward Canadian National freight train M36831-18 derailed 18 cars, including 6 cars containing dangerous goods, at Mile 58.20 on the Kingston Subdivision near Lancaster, Ontario. A small amount of sodium cyanide (solid) was spilled. As a precautionary measure, residents in close vicinity to the accident site left their homes. There were no injuries. About 1000 feet of track were damaged or destroyed.

Ce rapport est également disponible en français.

Factual Information

The Accident

On 18 October 2010, at about 0620, [1] eastward Canadian National (CN) freight train M36831-18 (the train) departed Belleville, Ontario, destined for Montréal, Quebec. The train consisted of 2 head-end locomotives and 122 cars (49 loads, 63 empties and 10 residues). It weighed about 8350 tons and was approximately 7105 feet long. The crew consisted of a locomotive engineer and a conductor. Both crew members were qualified for their respective positions, and met fitness and rest standards.

Shortly after passing through Regis, Ontario (Mile 65.4), and while travelling on the south main track at about 46 mph with the brakes released, the throttle was reduced from position 8 to position 6. At Mile 57.47, near Lancaster, Ontario, while the train was travelling at 48 mph, it experienced an undesired emergency brake application. The locomotive came to rest at Mile 57.18 (see Figure 1).

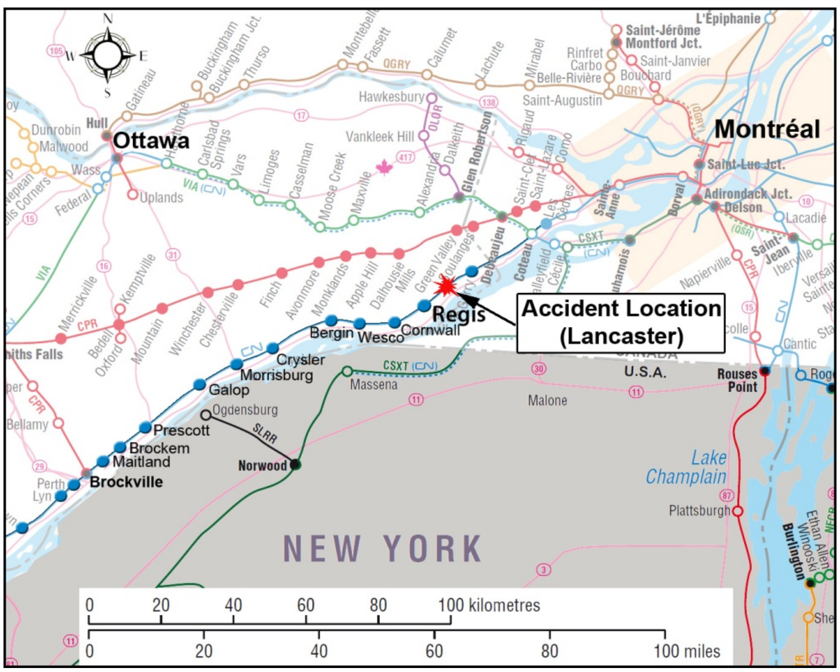

Figure 1. Map of the derailment location

(Source: Railway Association of Canada**, *Canadian Railway Atlas)***

An inspection of the train determined that 18 cars, the 68th to the 85th from the head end, had derailed. The derailed equipment included a covered hopper car containing sodium cyanide (UN 1689), a tank car loaded with sulphuric acid (UN 1830), 3 tank cars loaded with ammonium nitrate (UN 2426), and a tank car loaded with sulphur dioxide (UN 1079). A security perimeter was set up by the local fire department. Residents near the derailment left their homes during

1 All times are Eastern Daylight Time

the site safety assessment as a precautionary measure. A small amount of sodium cyanide (solid) had spilled and was quickly isolated and cleaned up. At the time of the derailment, the weather was 9°C with winds up to 17 km/h from the west.

Site Examination

At Mile 58.33, two ties displayed fresh impact marks between the rails. Wheel marks were observed on the web of the north rail at Mile 58.20, about 700 feet east of the damaged ties. The rail had lifted out of the tie plates and was resting on the spikes. The rail was broken and the track was destroyed for approximately 500 feet. Further east, the north rail was rolled over all the way to the first derailed car, CNIS 623151, the 68th car from the head end. The 69th car, TBOX 665279, and the following 3 cars stayed coupled together and were derailed upright on the track. Sixty feet to the west, cars CNA 404920 and CNA 407068 were overturned off their trucks and were resting on their sides. The remaining derailed cars had piled up and were fouling both the north and south main tracks (see Figure 2).

Car CNIS 623151, an empty centre beam flat car, came to rest at Mile 57.98 with the north wheels of its trailing truck derailed and resting on the gauge side base of the rail. The leading end of the following car, TBOX 665279, an empty box car, was 55 feet to the west of CNIS 623151. The car came to rest with all wheels derailed. The north rail was rolled to the field side and the wheels were resting on the gauge side web. The south side wheels were resting on the gauge side of the rail.

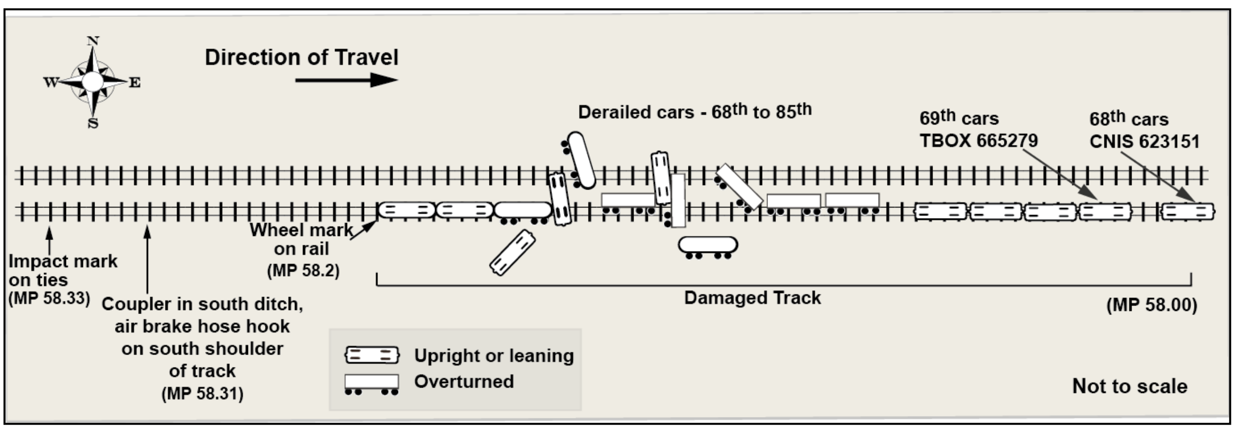

Figure 2. Site Diagram

Track Information

The Kingston Subdivision consists of double main track, extending from Dorval, Quebec (Mile 10.3), to Toronto, Ontario (Mile 333.8). It is a main corridor that handles approximately 42 trains per day (22 passenger trains and 20 freight trains). The track is classified as Class 5 track according to the *Railway Track Safety Rules* with a maximum track speed of 100 mph for passenger trains and 65 mph for freight trains. Train movements are controlled by the Centralized Traffic Control System, authorized by the *Canadian Rail Operating Rules* and supervised by a rail traffic controller. At the time of the accident, the portion of the subdivision from Dorval to Garry (Mile 52.4) was controlled from Montréal while the remaining portion was controlled from Toronto.

The track in the vicinity of the derailment is tangent, oriented in an east-west direction and generally descends with a maximum grade of 0.88% from Mile 58.9 to the derailment location. The rail on the south main track was Sydney 132-pound continuous welded rail manufactured in 1981 and laid on 14-inch double-shouldered tie plates secured to hardwood ties with 3 spikes. The ties were in fair condition. The ballast was crushed rock. The cribs were full and the shoulders were at least 18 inches.

The track had been inspected in accordance with company and regulatory requirements. The last track geometry car inspection took place on 22 September 2010; the last ultrasonic testing on 10 October 2010; and the last visual inspection on 18 October 2010. No defects were noted in the vicinity of the derailment site.

Train Information

Before departing MacMillan Yard in Toronto, the train received a certified car inspection. The train consisted of 6 blocks of loaded and empty cars (see Figure 3). The 1st, 5th and 6th blocks from the head end were to be set out in Taschereau Yard in Montréal while the other blocks were destined for Garneau Yard near Shawinigan, Quebec. The tail-end block was composed of 19 loaded cars. The portion of the train trailing the first derailed car, car CNIS 623151, accounted for 44% of the number of cars and 55% of the train weight. The trailing 25% of the train length (32 cars) accounted for 37% of the train weight.

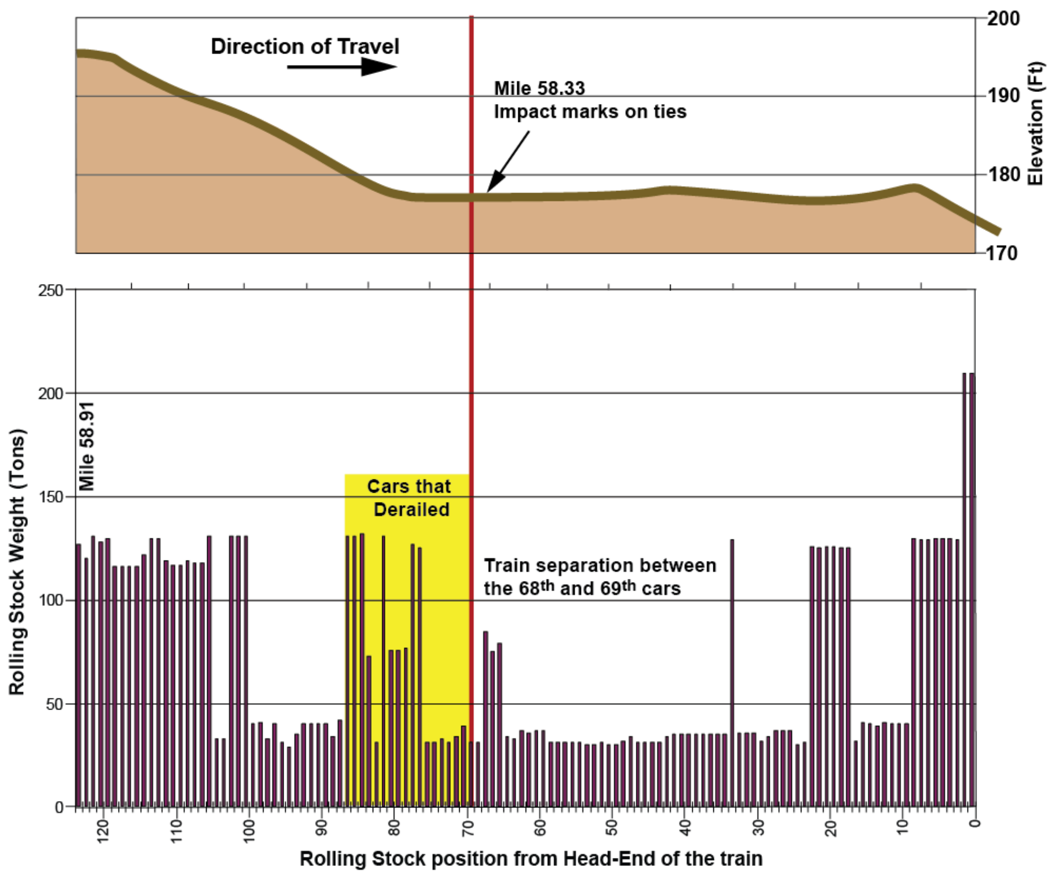

Figure 3. Location of rolling stock at the time of train separation

Cars CNIS 623151 and TBOX 665279

The trailing end of car CNIS 623151 and the leading end of car TBOX 665279 were slightly damaged. On car TBOX 665279, the outside face of the knuckle displayed abrasion marks and there were scrape marks on the car body end and on the brake wheel. The safety appliances on the south side of the car were damaged, the air brake hose hook had broken off and the coupler was skewed to the north. There was damage to the north side of the striker casting and to the north side safety appliances on car CNIS 623151.

The leading end of car CNIS 623151 was equipped with an E type coupler (code SBE68BE), connected to the yoke with an assembly that consisted of a vertical connecting pin, a retaining block, a 7/8″x 9″ retaining bolt and a lock nut (see Figure 4). The trailing end coupler was found laying in the south-side ditch at Mile 58.31, but its connecting assembly was not found. Neither the coupler nor the yoke displayed any fractured surfaces.

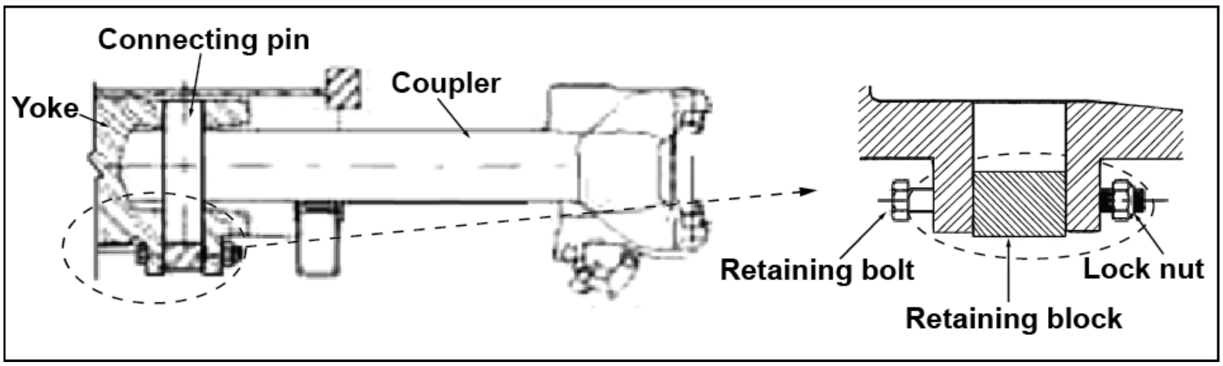

Figure 4. Coupler assembly CNIS 623151

Association of American Railroads – Rule 17

In 2007, the Association of American Railroads (AAR) had noted an increase in the number of pulled-out "E" and "F" type couplers. It was determined that the retaining bolt securing the coupler to the yoke was subject to fatigue failure through the root of the threads, resulting in train separations. Consequently, the AAR issued a circular letter dated November 2007 and modified Rule 17 of the *Field Manual of the A.A.R. Interchange Rules.* Effective 01 January 2008, Rule 17 A.2.a indicates that cars with Type "E" and "F" couplers secured with a retaining bolt are condemnable any time they are on a shop or repair track, for any reason, and are required to have the bolt changed out for a pin assembly. The list of cars subject to modified Rule 17 can be obtained by querying the coupler code in the UMLER Equipment Management System database.

Freight Car Inspection and Repair

Transport Canada–approved *Railway Freight Car Inspection and Safety Rules* (RFCISR) prescribe the minimum safety standards for freight cars. These rules require railway companies to ensure that freight cars placed in service are free from all safety defects described in Part II of these rules. In addition, cars interchanged between railway companies must adhere to the *Field Manual of the A.A.R. Interchange Rules*.

When a car is in need of mechanical attention or repairs and is declared "bad order," an entry stating the status of the car and the nature of the defect is made into the railway's computer tracking system. Car mechanics will receive a work order from the company's tracking system detailing the defects that led to the car being declared "bad order" and will perform the necessary repairs accordingly. Car mechanics are certified and knowledgeable of the RFCISR and the *Field Manual of the A.A.R. Interchange Rules*. Depending upon the nature of the repairs, a car may be taken to a yard track or placed on a repair track where more specialized equipment is available.

However, conditions such as the one stated in AAR Rule 17 A.2.a are not flagged in the tracking system as "bad order" even though they are condemnable because immediate action is not required. Prior to the occurrence, car CNIS 623151 had been repaired 34 times since January 2008. At least 2 of these repairs were performed on a repair track—once in CN's Prince George Yard (Prince George, British Columbia), and once in Burlington Northern Santa Fe Railroad's Newton Yard (Newton, Kansas).

Canadian National Train Marshalling

CN freight trains are normally made up using destination block marshalling where blocks of cars are placed in the train in a manner that facilitates their set-out or pick-up along the train's route. CN uses a computerized system that identifies any train marshalling that does not comply with either the *Transportation of Dangerous Goods Regulations* or CN's General Operating Instructions (GOIs). CN's GOIs have placement restrictions and trailing tonnage restrictions for certain types of cars. However, at the time of the accident, there were few operational restrictions on the marshalling of most types of freight cars, whether empty or loaded.

In March 2010, the Board developed a Watchlist identifying 9 key safety issues that pose the greatest risk to Canadians. Included on this list is the issue of the operation of longer, heavier trains. The Watchlist states that "inappropriate handling and marshalling can compromise the safe operation of longer, heavier trains" and calls on railways to "take further steps to ensure the appropriate handling and marshalling of longer, heavier trains."

In July 2010, CN began developing a series of train marshalling rules to reduce in-train forces and track-train forces by addressing train weight distribution, number and placement of cars with end-of-car-cushioning devices, and various combinations of long and short cars. These rules are based on science, experience, benchmarking with other railways and a review of historical accident root causes. One of the rules which came into effect in December 2010 requires that no more than one third of the train weight be placed on the trailing one quarter of the train length.

The following TSB Laboratory report was completed:

LP154/2010 – Rail Component Analysis

Analysis

Neither the operation of the train nor the condition of the track were considered contributing factors in this accident. The analysis will focus on the coupler connection of car CNIS 623151 and the marshalling of the train.

The Accident

The damage to the ties observed at Mile 58.33 was consistent with impact marks caused by the coupler of car CNIS 623151 (the 68th car) hitting the ground after being pulled away from the yoke and separating the train. The coupler was ejected and fell in the ditch outside of the path of the trailing cars. It did not obstruct their movement as the cars derailed further east where the first wheel marks were visible on the rail.

The moderate damage to the trailing end of the 68th car and the leading end of the 69th car is indicative of a low impact collision between the 2 cars when the trailing portion ran into the head-end portion. The damage to the north side of the 68th car and the resting angle of the coupler of the 69th car, skewed to the north, suggest that the impact force was applied at an angle. As a result, the lateral force generated was sufficient to cause the rail to roll over and the train to derail.

Retaining Bolt Failure

The coupler and the yoke of the trailing end of car CNIS 623151 did not exhibit any fracture surfaces; therefore, the train separation was caused by the failure of the connection joining the two components together. The retaining bolt of the connection has been identified by the AAR as being prone to fatigue failure. In this occurrence, the retaining bolt was not found; however, it is likely that the bolt fractured causing the retaining block to fall to the ground. With no redundancy built into the coupler design, the connecting pin had worked its way out of the assembly, no longer securing the coupler to the yoke. As the coupler was pulled away from the yoke, the train separated between the 68th and 69th cars.

Train Marshalling

Train M36831-18 was marshalled with a block of loaded cars on the tail end trailing mainly empty cars. This marshalling configuration is susceptible to a derailment through the generation of high in-train forces. When the train experienced an emergency application of the brakes after the separation between the 68th and 69th cars, both portions of the train began to slow. Because the trailing portion of the train was composed of mainly loaded cars and was situated on a steeper descending grade, the brakes were not as effective as on the leading portion composed of mainly empty cars. Consequently, the trailing portion of the train decelerated at a slower rate and collided with the leading portion of the train.

Destination block marshalling is a common operating practice used throughout North America. The primary benefits of this marshalling approach are increased operational efficiency and simplified service delivery for the carrier. While this approach is not inherently unsafe, weight distribution within the train may not always be optimal. Consequently, lighter cars can be placed ahead of heavier cars, leading to higher in-train forces during normal train operations and during emergency brake applications, increasing the risk of derailment.

Although CN had started developing marshalling rules aimed at reducing in-train forces, the rules were not fully implemented at the time of the derailment. A rule controlling weight distribution was put in place 2 months after the derailment. Had this rule been in effect at the time of the derailment, the weight of the tail end of the train would have been reduced; thus, decreasing the risk of run-in and the magnitude of the collision impact force.

Amendment to AAR Rule 17

The AAR amended Rule 17, requiring the replacement of the retainer bolt, which secures the coupler to the yoke, with a more robust pin assembly once the car is placed on a repair track. Since the rule came into effect, car CNIS 623151 was repaired on a repair track at least twice by certified car mechanics who were trained and cognisant of the rules. Nevertheless, the car was repaired and returned to service without having the retaining bolt changed.

The AAR amendment to Rule 17 considered couplers secured with retainer bolts as condemnable but did not call for an immediate corrective action. Consequently, cars with this condition were not considered as “bad order” cars and were not flagged in the tracking system. Car mechanics perform repairs according to work orders generated by the tracking system. They will likely focus on the repairs listed on the work orders and would not normally notice other defects unless they are obvious and are located in an area where they are performing the repairs. Consequently, cars with conditions such as the ones identified in AAR Rule 17 A.2.a are not flagged as “bad order” and may not get repaired when placed on a repair track even though they are considered condemnable.

Findings as to Causes and Contributing Factors

1. The train derailed due to a rail roll-over caused by a train separation and a run-in behind the 68th car from the head end.

2. The impact force generated during the run-in was applied at an angle, resulting in a lateral force sufficient to cause the north rail to roll over.

3. The train separated when the coupler pin retaining bolt in the yoke/coupler connection of the trailing end coupler of car CNIS 623151 likely failed and the coupler was pulled away from the yoke.

4. Because the trailing portion of the train was composed of mainly loaded cars and was situated on a steeper descending grade, it decelerated at a slower rate and collided with the leading portion of the train.

5. Since Association of American Railroads (AAR) Rule 17 A.2.a came into effect, car CNIS 623151 was repaired on a repair track at least twice by certified car mechanics who were trained and cognisant of the rules. Nevertheless, the retaining bolt was not changed.

Finding as to Risk

1. Cars with conditions such as the ones identified in AAR Interchange Rule 17 A.2.a are not flagged as "bad order" and may not get repaired when placed on a repair track even though they are considered condemnable, increasing the risk of train separations and derailments.

Other Finding

1. Had CN's marshalling rule controlling weight distribution been in effect at the time of the derailment, the weight of the tail end of the train would have been reduced; thus, decreasing the possibility of a run-in and the magnitude of the collision impact force.

Safety Action Taken

Train Marshalling

Transport Canada (TC) is monitoring the strategies implemented by Canadian National (CN) for the Kingston Subdivision, including the use of distributed power and marshalling rules, which will be implemented system wide.

TC Rail Safety, in conjunction with the industry, has begun a 2-year comprehensive study of long- train operations that they will use to develop policies for train marshalling and train handling in Canada. This study will examine in-train forces, track-train interaction and related train marshalling and handling aspects that have an impact on the safety of long-train operations. It will be conducted in 6 phases with actionable results at the end of each phase.

Coupler Tail Pin

On 21 October 2010, CN issued a letter to all management staff to re-issue the coupler tail pin poster. Effective immediately, all cars equipped with coupler vertical pins that are inspected by certified car inspectors must be inspected closely to verify that the securement is in place. Either the coupler pin or carrier plate under the pin must be chalked to indicate that the inspection has been completed. In addition, management staff was instructed to ensure that the poster is reviewed during job briefings on all shifts during the week and that it is posted on the staff bulletin boards.

On 21 December 2010, TC issued a letter of non-compliance to CN Macmillan Yard for cars found with defective coupler tail pins after a certified car inspection. On 04 January 2011, CN responded to TC indicating that all Macmillan Yard inspectors received further instruction during job briefings with regards to coupler tail pin assembly inspection.

CN implemented a revised repair procedure for coupler tail pin assemblies at all of its repair tracks. TC performed focused inspections on cars equipped with these assemblies. Out shop inspections were performed at maintenance facilities in Windsor, Sarnia, London, Oakville, Macmillan and Belleville to ensure that these pins were applied as required.

Burlington Northern Santa Fe (BNSF) reissued an instruction letter to mechanical car supervisors to standardize the installation of the AAR standard retainer pin at all of its repair shops. The instruction letter explains the requirement for the retainer bolt replacement, and provides step-by-step procedures. In addition, BNSF ensured that its shop in Newton, Kansas is compliant with the AAR Rule. All repair track shifts at Newton Yard were briefed regarding the procedure and supervisors were spot checking for compliance.

The AAR instructed its Mechanical Inspection Department to call attention to Rule 17 requirements as they visit sites on inspection, audit or training efforts.

The AAR indicated that its Comprehensive Equipment Performance Monitoring (CEPM) program is a multi-phase, multi-year initiative to acquire data on specific equipment components. This program will assist railroads, rail equipment owners, repair and wheel shops, and other industry participants with obtaining a complete view of rail equipment health and performance. The first phase (CEPM-Wheel sets) centralizes the registration of wheel set component details and identifies the application of wheel set components for both railroad and non-railroad effected repairs. In January 2012, the component level data created through the CEPM program will be available through Railinc's UMLER system, the Car Repair Billing (CRB) system and the Equipment Health Management System (EHMS). The next phases of the program will include critical casting components. The AAR believes that the CEPM program provides the best approach for identifying and capturing safety-critical components that exhibit condemnable conditions. This approach does not need to balance several databases against each other (i.e., UMLER, CRB and EHMS) in order to compile a list of equipment that may contain a suspect part.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 21 October 2011.

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