Track Factual Report

Nodaway, Iowa

DCA01MR003

NATIONAL TRANSPORTATION SAFETY BOARD

OFFICE OF RAILROAD, PIPELINE & HAZARDOUS MATERIAL INVESTIGATIONS

WASHINGTON, D.C.

TRACK & ENGINEERING FACTUAL REPORT
May 1, 2001

Location:	Nodaway, Iowa
Date of Accident:	March 17, 2001
Time of Accident:	11:40 p.m. Central Standard Time
Railroads Involved:	National Railroad Passenger Corporation Operating Over Burlington Northern Santa Fe Railway
NTSB Investigation No.:	DCA 01 MR 003

Factual Report Prepared by:

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Accident Summary

On March 17, 2001, approximately 11:40 p.m. central standard time, westbound National Railroad Passenger Corporation (Amtrak) train No. 5, the California Zephyr, en route from Chicago, Illinois to Oakland, California, derailed near Nodaway, Iowa. At the time of the derailment, the train was being operated at a recorded speed of 52 miles per hour (mph). A broken rail was discovered at the point of derailment.

Amtrak train No. 5 was operating over the Burlington Northern Santa Fe Railway (BNSF) Creston Sub-Division at the time of the derailment. The engineer indicated that he was operating his train under the authority of a clear signal indication when he felt the train "tug" in resistance. He subsequently initiated an emergency brake application, and shortly thereafter realized that his train had derailed.

Amtrak train No. 5 consisted of two locomotive units, one Caltrans cab-car coach (in tow), one material handling car, one baggage car, one transition sleeper car, two coach cars, one lounge car, one dining car, two sleeping cars, four express cars and one Roadrailer car. The lead two locomotive units and all but the four express cars and one Roadrailer car derailed. There was no fire, nor hazardous materials involved in the accident.

The Amtrak operating train crew consisted of an engineer and two conductors with 12 "on-board" service personnel. In addition, there were 241 passengers on board the train. As a result of the derailment, there were 97 passenger injuries, which included one fatality and nine serious injuries.

The weather conditions were clear and about 21° Fahrenheit. The wind was calm.

Location of the Accident and Description of Track

The derailment occurred on the BNSF Creston Subdivision of the Nebraska Division (Line Segment #1) on single main track at milepost (MP) 419.92. This location was near the town of Nodaway, Iowa. The legal property description is Sections 11 and 14, Township 71, Range 35 West, and within the limits Adams County.

The main track was owned, inspected, maintained, and operated by the BNSF. The single main track was designated as Federal Railroad Administration (FRA) Class 4 track. Class 4 track had a maximum allowable operating speed of 60 mph for freight trains and 80 mph[1] for passenger trains. The main track was bi-directional, with the predominance of loaded train traffic being eastbound in direction. A typical daily train count in the eastbound direction included one Amtrak train, 2 intermodal trains, 2 general freight trains, 11 loaded unit coal trains, and 1 local freight

[1] The maximum authorized timetable speed was 79 mph for passenger trains. Signal regulation Part 236.0, states passenger trains cannot exceed 79 mph without having either a functioning Automatic Cab Signals, Automatic Train Stop, or Automatic Train Control System.

train. A typical train count in the westbound direction included one Amtrak train, 2 intermodal trains, 2 general freight trains, 11 empty unit coal trains, and 1 local freight train. This train density accounted for an annual gross tonnage in 1999 of 103.52 million gross tons (mgt).

The track was oriented both geographically and by timetable in a westward to eastward direction. The milepost numbering increased in the westward timetable direction.

In the immediate area of the derailment, the track grade gradually descended on average 0.34 percent between MP 419.0 and MP 419.9. At MP 419.9 the grade ascended 0.17 percent to MP 420.2, and then nearly became level (0.08) descending to MP 420.8. The track was tangent between MP 419.55 and MP 419.99. A 1° 0 minute 1,600 foot long left hand curve (spirals included) was located between MP 419.25 and MP 419.55. A 1° 0 minute 1,613 foot long left hand curve (spirals included) was located between MP 419.99 and MP 420.3.

The track structure in the area of the point of derailment (POD) was built on about 15 feet of fill[2]. The track segment was supported with granite ballast with an approximate depth of 24 inches under the crossties and about 12 inches of ballast at each tie shoulder. The tie cribs[3] were completely full of ballast in the area adjacent to and under the rail. The double shoulder tie plates were 7 3/4 inches wide by 14 inches long. The spiking pattern was four, six inch cut track spikes per tie plate (two rail-holding and two plate-holding spikes). The continuous welded rail (CWR) was placed on 8 foot 6 inch wooden cross ties with an average centerline spacing of 19.5 inches or 23 cross ties per 39-feet of rail length. The rail was box anchored[4] at every other cross tie location, averaging about 24 rail anchors[5] per 39-feet of rail length. The rail anchors were a mixture typified by Channel Loc and Unit Rail Anchors with sporadic Fair type rail anchors installed.

The rail through the accident site was 132-pound section CWR, except for a jointed section at the POD. At the POD, MP 419.92, a 14 feet 11½ inch piece of "plug rail"[6] with the Milling information (132# RE CC Beth Steelton, February 1988) was installed on the South rail. This rail had been previously installed to repair a rail defect that was detected by ultrasonic inspection on February 13, 2001. The CWR section West of the POD on the South side was 132.25# RE CC USS Illinois, October 1974. The CWR section East of the POD on the South side was 132.25# RE CC Tennessee USA, March 1975. There were numerous field-welded rails to the East and in the immediate vicinity of the POD, but the Tennessee manufactured rail appeared to be the parent rail that was originally installed through the area in 1975. The BNSF track chart indicated the CWR was installed in 1979, which was reported by the BNSF as being an error.

[2] The fill was measured from the ditch line to the top of the subgrade.
[3] A crib is the space between the cross ties.
[4] Box anchoring places rail anchors on both rails across from each other on each side and against the side of a tie.
[5] Rail anchors are designed to transfer the longitudinal forces developed in the rail to the ties and ballast.
[6] The term "plug rail" is used to describe a replacement rail segment that had been installed to repair a rail defect in CWR.

Damages

As a result of the derailment 1,677 feet of the main track was destroyed requiring the installation of 43 track panels. This accounted for about $250,000.00 in track damage.

Postaccident Investigation

The track committee members studied the footprint of the derailment,[7] and from that information determined the POD. In the area of the POD, MP 419.92, a 14 feet 11 ½ inch piece of 132# RE CC Beth Steelton (February 1988) "plug rail" was installed on the South rail, and was found to be broken at two locations. The first rail break, and the determined POD, measured between 25 ½ inches at its the base to 26 inches at its running surface from the East end bolted joint, and the second rail break measured 74 inches from the first brake. Visual examination of the fracture faces revealed two large Transverse Defects (engulfing approximately 60% of the railhead).

The "plug rail" from the POD was recovered, identified, photo-documented and tagged with NTSB Part Tags. Also, the fracture surfaces were treated with WD-40 to prevent oxidation. In addition to the milling information, the heat number[8] (MH 08220 S-12) was recorded from the rail for identification purposes. The rail and accompanying two pairs of splice bars were sent to the BNSF Materials Laboratory in Topeka, Kansas for forwarding to the NTSB Laboratory in Washington, D.C. See Chain of Custody.

Investigative staff noted the track conditions, and measured/recorded the track geometry for 25 stations[9] east of the POD and 4 stations west of the POD. The track geometry measurements were not measured under a loaded [10]condition, however the measurements were adjusted for evident track structure movement. The stations west of the POD could not be measured because the track was destroyed. In addition, between the POD and station 11 east of the POD there were varying degrees of track damage that also prohibited track geometry measurements. Between stations 12 and 25, gage[11] measurements ranged between 56 ½ inches and 56-15/16 inches. Cross-level[12] measurements revealed the North rail was consistently lower than the South rail, ranging from ½ inches to 7/8 inches. Mid-ordinate alignment[13] readings ranged between –3/8

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[7] The footprint included any and all visible evidence such as: marks on the ties, rail, and other track material; marks on equipment components; car and truck component positions; and broken track components.

[8] The heat number is composed of a series of digits and letters which designate the type of furnace which produced the rail steel, the sequential number of the "heat" produced from the furnace, the type of steel used in the rail, and the number or strand within the "heat".

[9] Each station measured 15 feet 6 inches apart.

[10] Loaded measurements required placing a loaded freight car or locomotive unit at each station and measuring the track geometry.

[11] Gage refers to the distance between each parallel rail of the track measured between the inside heads of the rails at 5/8 inch below the top of the rail head. Standard gage of track as used in the United States, Canada, Mexico, most of Europe and parts of Asia and Africa is 4.708 feet (56 ½ inches).

[12] Cross-level is the distance one rail is above or below the opposite parallel rail.

[13] Alignment refers to the horizontal location of the rails as described by curves, tangents, and spirals.

inches and +1/4 inches. All the track geometry measurements were compliant with the Track Safety Standards for Class 4 track as required in 49 Code of Federal Regulations (CFR) 213 Parts 213.53 Gage; 213.55 Alignment; and 213.63 Track Surface.

An engineering survey was conducted for additional information purposes. The survey tied the POD as station 0+00 to the postaccident train position, the track geometry measurements, the milepost location, the intermediate signal location, and the culvert locations. See the engineering drawing for additional details.

On March 19th, investigative staff conducted a walking inspection approximately one mile in each direction from POD (MP 418.8 to MP 421.2). The Iowa Department of Transportation Track Inspectors noted ten locations of "non-compliant for class of track operated". Nine exceptions were noted for defective ties (defect code 213.109.04) and one exception was noted for ties not effectively distributed (defect code 213.109.03). The accompanying BNSF Roadmaster initiated remedial action[14]; the Class of track was reduced to Class 3 track for the defective area.

During the walking inspection, investigative staff measured the super-elevation[15] of the two curves located between MP 419.25 and MP 419.55, and between MP 419.99 and MP 420.3. Both curves had designated super-elevations of 1.5 inches. Measurements indicated the curve at MP 419.25 varied between 1 ¾ and 2 ¾ inches of super-elevation. The measurements were within the requirements specified in 49 CFR 213.57, Curves, Elevation and Speed Limitations. Elevation measurements could not be taken on the curve at MP 419.99 due to damage from the derailed equipment.

In addition, an FRA Track Safety Inspector reviewed BNSF track inspection records from January 1, 2001 through March 17, 2001. He reported the track safety standards, 49 CFR Part 213.233 which require twice weekly inspections for Class 4 track standards, were met and exceeded by BNSF. He did not note any exceptions with the records inspection. Although BNSF policy recommended daily track inspection, the records indicated the track inspection was not conducted on January 1st and 23rd, on February 9th, and 19th, and on March 4th, 5th, 11th, and 12th. During the records inspection, the FRA Inspector noted that the BNSF track inspector also performed a head-end train ride inspection[16] on Amtrak trains No. 5 and No. 6 on consecutive days. The track inspector noted a track irregularity that resulted in a 40 mph speed restriction being placed at (MP 425.5).

It was noted that the daily track inspections were conducted by individuals, designated by the BNSF, as qualified under 49 CFR Part 213.7 regulations. Also, there was no evidence of any pre-

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[14] Remedial action allows the inspector to reduce the Class of track and associated authorized operating speeds to where the defect is within the allowable Track Safety Standard parameters, or repair the defect. Class 3 track allows a maximum operating speed of 40 mph for freight trains and 60 mph for passenger trains.
[15] Curved track can be banked so, the outside rail of the curve is higher then the inside rail.
[16] During a head-end inspection, the inspector rides the lead locomotive unit and observes the track from a different perspective for unusual track condition. He also feels for train ride quality/smoothness, and on the lookout for bouncing, excessive lateral movement, and rocking.

existing track geometry, cross tie, fastener, or rail defects on the inspections records within the area of the derailment.

Tests and Research

The BNSF Roadmaster stated that the track was inspected daily, seven days per week on the Creston Subdivision. The practice of daily track inspections was instituted by the BNSF and is based on high tonnage lines with passenger service. This practice exceeded 49 CFR Part 213.233, which required twice-weekly inspections with no less than one-day interval between inspections. According to the Roadmaster, daily track inspections have been a practice on the Creston Subdivision for at least the past 14 years.

In addition, the Amtrak Senior Director Track Maintenance stated that an Amtrak Route Engineer performed a head-end train ride inspection on March 12, 2001, when he rode on the lead locomotive unit of an Amtrak train. He took no exception to the track ride quality between MP 408.0 and MP 470.0.

The BNSF Roadmaster stated that other then reported track defect maintenance, the only program maintenance conducted on the Creston Subdivision; involved "out-of-face" surfacing[17]. The surfacing was conducted about three years prior to the derailment.

The BNSF record of rail and weld defects, including service failures[18], was reviewed for the tangent track between MP 419.55 and MP 419.99. In 2001 (on February 13th), there was one detected defect located at MP 419.92. In 2000, there were two detected defects and one service failure. In 1999, there were two detected rail defects and three crushed head defects. In 1998, there were two detected rail defects and two crushed railhead defects.

The BNSF track geometry car #80 performed the last track geometry test on the Creston Subdivision on August 10th and 28th, 2000. The data from the exception report was reviewed. It was noted that the main track was tested for Class 4 track standards. Between MP 415 and MP 425, there were no recorded defects noted for Class 4 track. However, there was one track-warp, two track-dips, and three crosslevel conditions that were given a "yellow tag"[19] priority.

In conjunction with the track geometry test, the BNSF track geometry car #80 was equipped with a laser railhead wear measuring device. The report indicated that the average vertical railhead wear was 3/16 inch, and there was no gage face loss. The BNSF's condemning limits for vertical railhead wear in 132-pound rail section in track that carries 50 mgt or more per year is 7/16 inch.

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[17] Out-of-face surfacing is a mechanized maintenance operation where alignment, crosslevel, and super-elevation irregularities are repaired.

[18] A service failure is when a rail breaks under normal operating conditions.

[19] Yellow tag indicates a track condition that is within FRA Track Safety Standards, but warrants a field check for actual condition.

A search for internal rail defects (ultrasonic rail testing) was conducted every 30 days on the Creston Subdivision. The BNSF instituted a system wide method of establishing rail test frequencies utilizing a model from Zeta-Tech[20]. The formula includes a base line number of 0.09 service failures per mile, per year, minus 0.02 for lines with passenger trains and minus 0.01 for single main tracks. The formula also took into consideration the previous year's rail defects. Between September 1, 1999 and March 31, 2000 there were 65 internal defects (10 service failures included) on 46.1 track miles of rail on single main line track on the Creston Subdivision. With that historical data included, the formula also included a Weibull statistical analysis rail failure prediction model. The risk factor of 0.06 service failures per mile, per year equated to a 32-day rail defect inspection frequency. Therefore, the BNSF set the target test frequency of 30-days for the single-track segments of the Creston Subdivision. The 49 CFR Part 213.237[21] required an inspection frequency for this segment of track on the Creston Subdivision of once every 40 mgt.

Herzog Services, Inc. conducted the most recent test for internal rail defects over the Creston Subdivision on February 13, 2001. Additionally, a search for internal rail defects was conducted January 8, 2001, and on December 19, November 20, October 20, and September 26, 2000. During the February 13th test, a detail fracture was detected in the area of the POD. Track maintenance personnel installed a replacement "rail plug" to remove the detected defect. This rail segment was identified during the postaccident field inspection to contain two transverse fissures.

The Creston section foreman was convinced that the suspect "rail plug", identified at the POD, came off his section's rail pile. The Creston section gang was one of three section gangs and one-maintenance gang that followed the rail defect test car on February 13, 2001. As the rail defect test car would find rails with internal defects, the gangs would take the appropriate remedial action. The foreman stated that he got the rail off the rail pile that he maintained at his section headquarters in Creston. The rail pile included rail that the welders had removed from other track locations for reuse. He thought the suspect rail had been in the rail pile since at least March 2000, the day he started working on that section. He remembered that the rail needed to have the bolts and splice bars removed. In addition, the rail ends had to be cropped because of rail-end-batter. He stated that the rail had two boltholes in each end, and he cropped enough rail so the second bolthole was now the first bolthole. This equated to about six inches of rail being cropped off of each rail end. The foreman stated that he did not know if or when the rails in the rail pile were ever tested for internal defects before reuse.

The foreman stated that he had cut out a segment of rail with the identified defect at the POD, then he installed an equal length segment of rail that he prepared from the rail pile. Once placed in the track, the foreman remembered drilling the third bolthole on one end of the rail. However, he could not remember how the other end of the rail was drilled.

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[20] Zeta-Tech is a railroad-consulting firm, which collects and analyzes broken rail data and recommends inspection frequencies based on a mathematical formula.

[21] A continuous search for internal defects shall be made of all rail in Classes 4 through 5 track, and Class 3 track which passenger trains operate, at least once every 40 mgt or once a year, whichever interval is shorter. On Class 3 track over which passenger trains do not operate such a search shall be made at least once every 30 mgt or once a year, whichever interval is longer.

The foreman stated that there was a shortage of rails to use behind the rail test car. The Springfield, Missouri Rail Complex had sent some additional replacement rails. He stated that the Rail Complex sent primarily rail with head loss of 9/32, 10/32, 11/32, and 12/32 inches. He believed that the rail he used had only 6/32 inch of railhead loss.

On the other hand, the BNSF Roadmaster (the foreman's superior) stated that he believed the broken rail at the POD came from the Springfield Rail Complex shipment. He stated that he was in dire need of replacement rails during the November 2000 and February 2001 time period. He requested that replacement rail be shipped by railroad freight car from the Springfield, Missouri Rail Complex. Additionally, as time passed and the need for rail became a concern, he had some replacement rail transported by truck. On January 12, 2001, twenty-six 39-foot long rail sections were received at Red Oak in freight car BN 565829. The rail ends were either torch cut or saw cut, and with no boltholes. On January 16th, a truck delivered thirty 39-foot long rail sections to Red Oak. On January 17th, a truck delivered thirty 39-foot long rail sections to Creston.

The BNSF Roadmaster stated that local track forces saw cut a 14 ft. 11 ½ inch piece from the 39-foot length and drilled three boltholes at each end for 132# rail section drillings. BNSF personnel checked locations where rail defects had been changed since January 2001 for the remainder of the defective rail section. The remainder of the 39-foot replacement plug rail was not found installed at those track locations, nor in the Creston, Glenwood, and Red Oak, Iowa rail stock piles.

Similar repair rail stockpiles were located in Glenwood and Red Oak. The rails were ultrasonically hand tested March 19, 2001. Information from the BNSF Roadmaster indicated that one rail had an internal defect identified. The internal defect was identified as a detail fracture, and it was found in the stockpile of repair rail located at Red Oak. There were no exceptions taken from the stockpile at Glenwood.

Members of the track committee visually inspected the repair "plug rails" that were stock piled at Creston Yard. There were 25 rails measuring approximately 39-feet long. The rails were all torch cut on both ends with no drilled boltholes. The rail was manufactured by CF&I and rolled between 1980 and 1988. This rail was also ultrasonically hand tested by March 26, 2001, and no rail defects were identified.

The BNSF General Director Rail stated that it was not unusual for replacement rail to come from a welder changing out a jointed plug rail. In addition, before rail is picked-up and sent to a Rail Complex for rehabilitation, area Roadmasters sometimes retain some of the rail sections for future use.

The Springfield Rail Complex is one of three BNSF owned Rail Complexes. The other two are located in Laurel, Montana and in Pueblo, Colorado. The supervisor at the Springfield Rail Complex stated that all three Rail Complexes operate similarly. The primary operations at the Rail Complex involve taking both new and second hand (sh) rail and weld them into CWR strands. The CWR strand lengths very from 1,200 feet to 1,400 feet for sh rail, and 800 feet to

1,440 feet for new rail.

The supervisor stated that when sh rail arrives in CWR form, it is visually inspected for obvious surface damage and defects. In addition, the CWR is visually inspected for excessive wear and "outlawed" rails, such as; "A" rails, "CR" rails, and open-hearth manufactured rails. As the inbound CWR progresses along the rehabilitation line conveyor, the rejected rail sections are cut out of the continuous lengths. Then the rail is welded back together into the desired lengths, and loaded onto an outbound CWR train. The rejected rails are loaded into a gondola as they are cut out of the inbound CWR. He stated that if a gondola is not available, the scrap rail is piled for later handling. Additionally, any odd lengths of visually acceptable rail that cannot be used in the welding process are kept for defect replacement rails. These rails are stockpiled by rail section size for distribution as requested.

The supervisor stated that when sh rail arrives in jointed sections, it is visually inspected for the same obvious damage, defects, excessive wear, and outlawed rails, as for the CWR. The next step is to crop about 18-inches off each end of the rail, so now the rail segment is about 36-feet long. The rail is loaded onto a roller table, and then onto a conveyor system and welded into required CWR lengths. Basically, rails that are less then 30-feet long are not welded, and are scrapped. If replacement rails were requested, they would most likely come from the cropped jointed rail segments prior to welding.

The supervisor stated that laborers conduct the visual rail inspections. If they have any questions about a particular rail, they ask the foreman. If the foreman has a question, he asks a supervisor. If the supervisor has a question, the rail is scrapped. He stated that the inspectors are not given any specific training on rail inspection. Their training is primarily "on-the-job."

The supervisor stated that after the rails are welded into CWR, all "flash butt" welds are magnetic particle inspected[22] for defective welds. However, no other search for internal defects is conducted prior to shipping out the CWR or segmented rail sections. He stated that he does not know if the inbound rail was inspected for internal defects prior to being received at the Rail Complex. He knows what territory the inbound rail came off of, so he could check when the rail was last inspected. But that is not the normal procedure. However, the BNSF General Director Rail stated that it was normal procedure to have the rail tested for internal defects prior to the rail being picked up and sent to a Rail Complex. This test for internal defects was not in addition to the regular test schedule, but occurred during the normal testing schedule.

The supervisor stated that if the rail was originally laid as new segments in a territory, the BNSF knows the accumulated tonnage and defect rate for that rail. But if the rail has moved as sh rail, the BNSF does not maintain the rail's accumulated tonnage history and defect rate history.

After this investigator learned of the BNSF procedures for addressing the need for sh replacement rail, a survey was conducted with the Union Pacific Railroad (UP), CSX Transportation (CSXT), Canadian National Illinois Central Railroad (CNIC), and the Norfolk

[22] Magnetic particle inspection is the scientific term given to an trade inspection term more commonly called MagnaFlux.

Southern Railroad (NS). The survey was conducted to get a better understanding of the systemic railroad procedures for addressing the need of sh replacement rail.

The UP had three Rail Complexes that were operated by contractors who's primary job was to generate CWR, but also generated replacement rail. They were located in Laramie, Wyoming; Denison, Texas; and Pueblo, Colorado. The Senior Director of Derailment Prevention stated that the rail was visually inspected for obvious surface damage and defects, and all "flash butt" welds were magnetic particle inspected for defective welds. There was no other search for internal defects conducted prior to shipping out the CWR or segmented rail sections. It was normal procedure to have the rail tested for internal defects prior to the rail being picked up and sent to their Rail Complexes. This test for internal defects was not in addition to the regular test schedule, but occurred during the normal testing schedule. Replacement rail may be gathered by the area Managers for reuse prior to shipping the rail to the Rail Complex. Also, it was not unusual for welders to add changed rail to a section stockpile as long as it was not previously identified as defective rail or for rail to be added to a stockpile prior to it being sent to a Rail Complex.

CSXT had two Rail Complexes whose primary job was to generate CWR, but also generated replacement rail. They were located in Nashville, Tennessee and Russell, Kentucky. The Staff Engineer stated that the rail was visually inspected for obvious surface damage and all "flash butt" welds were magnetic particle inspected for defective welds. There was no other search for internal defects conducted prior to shipping out the CWR or segmented rail sections. It was normal procedure to have the rail tested for internal defects prior to the rail being picked up and sent to their Rail Complexes. This test for internal defects was not in addition to the regular test schedule, but occurred during the normal testing schedule. Replacement rail may be gathered by the area Roadmaster for reuse prior to shipping the rail to the Rail Complex. Also, it was not unusual for welders to add changed rail to a section stockpile as long as it was not previously identified as defective rail or for rail to be added to a stockpile prior to it being sent to a Rail Complex.

The CNIC had two Rail Complexes whose primary job was to generate CWR, but also generates replacement rail. They were located in Markham, Illinois and Transcona, Winnipeg Canada. The CNIC Division Engineer stated that the Markham facility was operated by a contractor, and supplied the CNIC and the other Canadian owned United States located railroads with much of the CWR and segmented rail. The rail was visually inspected for obvious surface damage, and all "flash butt" welds were magnetic particle inspected for defective welds. There was no other search for internal defects conducted prior to shipping out the CWR or segmented rail sections. It was normal procedure to have the rail tested for internal defects prior to the rail being picked up and sent to their Rail Complexes. This test for internal defects was not in addition to the regular test schedule, but occurred during the normal testing schedule. Replacement rail may be gathered by the area Roadmaster for reuse prior to shipping the rail to the Rail Complex. Also, it was not unusual for welders to add changed rail to a section stockpile as long as it was not previously identified as defective rail or for rail to be added to a stockpile prior to it being sent to a Rail Complex.

However, at the Transcona Rail Complex the rail would enter a classification shed where in addition to the usual visual inspection for excessive wear and damage, the Canadians ultrasonically inspected the railhead and web for internal defects, and induction inspected the rail-base for internal defects. These additional internal inspections were conducted prior to the rail being welded. After welding the CWR, the welds were magnetic particle inspected for defects.

The NS owns and manages one Rail Complex whose primary job was to generate CWR, but also generates replacement rail. Contractors, under the supervision of NS managers perform the work. The Rail Complex is located in Atlanta, Georgia. The NS Manager Innovative Research stated the inbound sh rail is inspected for excessive wear and surface damage. The undesirable areas are cropped out, and the railhead wear is matched up for best fit, then the rail is welded together in desired CWR lengths. Prior to picking up the rail and sending it to their Rail Complex, the NS schedules testing for internal defects. If prior testing is not accomplished, the NS will schedule the rail testing for internal defects shortly after the CWR is re-laid. The rail is not tested for internal defects at the NS Rail Complex, nor are the flash butt welds magnetic particle inspected for defects. Replacement rail may be gathered by the area Roadmaster for reuse prior to shipping the rail to the Rail Complex. Also, it was not unusual for welders to add changed rail to a section stockpile as long as it was not previously identified as defective rail or for rail to be added to a stockpile prior to it being sent to a Rail Complex.

The BNSF has drafted revisions to their Engineering Instructions which require that, for all main tracks with passenger trains and/or 20 mgt per year, secondhand rail installed for maintenance activity such as detected defect removal, service failure repair, joint elimination, and derailment repair must be certified that it has been ultrasonically tested for internal defects. If certified rail is not available and non-certified rail is used, it must be protected with a 40 mph temporary speed restriction until it is ultrasonically tested in track. These requirements take effect May 15, 2001.

Additional Data/Information

The FRA database for was searched for all derailments that were reportedly caused by track related defects on all Classes of track. Included in the database were derailments caused by broken rails. The database was also searched to focus on all reportedly track caused derailments that occurred on main line track. The time frame of the both searches was from January 1995, thru December 2000.

The following table reflects data from train accidents by cause from form FRA F 6180.54, on all types of track. See Table 1.

Table 1, Derailments that occurred on all types of track.

Specific Causes of the Derailment	Total Number of Derailments	Percentage of All Track Derailments	Amount of Reported Dollar Damage
T201-Bolt hole crack or break	38	2.3	10,138,712.00
T202-Broken base of rail	291	17.6	36,994,933.00
T203-Broken weld (plant)	6	0.4	1,955,684.00
T204-Broken weld (field)	35	2.1	16,700,909.00
T207-Detail fracture-shelling/head check	161	9.7	44,991,529.00
T208-Engine burn fracture	3	0.2	184,084.00
T210-Head & web separation outside of joint bars limits	172	10.4	17,605,482.00
T211-Head & web separation inside joint bar limits	34	2.1	7,755,237.00
T212-Horizontal split head	34	2.1	2,225,589.00
T218-Piped rail	5	0.3	236,107.00
T220-Transverse/compound fissure	306	18.5	52,334,776.00
T221-Vertical split head	184	11.1	26,305,380.00

The following table reflects data from train accidents by cause from form FRA F 6180.54, on main line tracks. See Table 2.

Table 2, Derailments that occurred on main line tracks.

Specific Causes of the Derailment	Total Number of Derailments	Percentage of All Track Derailments	Amount of Reported Dollar Damage
T201-Bolt hole crack or break	19	2.5	9,010,478.00
T202-Broken base of rail	98	12.8	28,071,702.00
T203-Broken weld (plant)	5	0.7	1,932,268.00
T204-Broken weld (field)	26	3.4	16,371,956.00
T207-Detail fracture-shelling/head check	109	14.3	41,832,732.00
T208-Engine burn fracture	2	0.3	157,084.00
T210-Head & web separation outside of joint bars limits	63	8.2	13,079,380.00
T211-Head & web separation inside joint bar limits	15	2.0	7,091,254.00
T212-Horizontal split head	12	1.6	1,443,088.00
T218-Piped rail	3	0.4	172,896.00
T220-Transverse/compound fissure	157	20.5	44,288,680.00
T221-Vertical split head	89	11.6	22,550,046.00

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