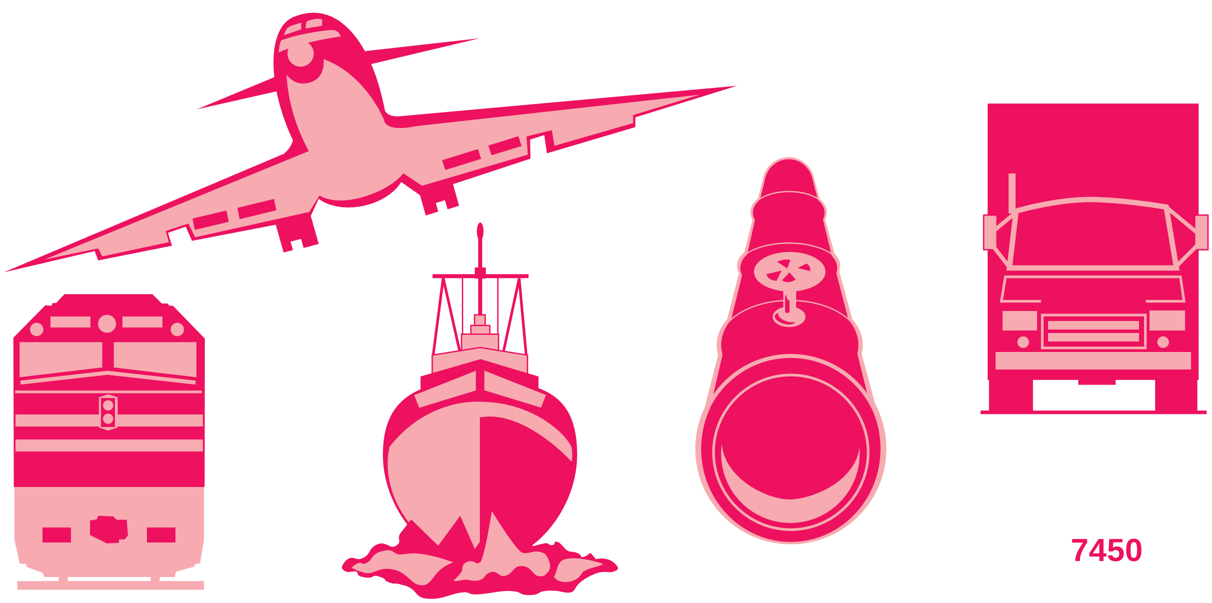
PB2002-916303
NTSB/RAR-02/03

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

DERAILMENT OF UNION PACIFIC RAILROAD TRAIN QFPLI-26 AT EUNICE, LOUISIANA, MAY 27, 2000



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Railroad Accident Report

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NTSB/RAR-02/03
PB2002-916303
Notation 7450
Adopted April 2, 2002

National Transportation Safety Board
490 L'Enfant Plaza, S.W.
Washington, D.C. 20594

National Transportation Safety Board. 2002. ***Derailment of Union Pacific Railroad Train QFPLI-26 at Eunice, Louisiana, May 27, 2000*** **. Railroad Accident Report NTSB/RAR-02/03. Washington, DC.**

Abstract: On Saturday, May 27, 2000, about 11:48 a.m., central daylight time, 33 of the 113 cars making up eastbound Union Pacific Railroad train QFPLI-26 derailed near Eunice, Louisiana. Of the derailed cars, 15 contained hazardous materials and 2 contained hazardous materials residue. The derailment resulted in a release of hazardous materials with explosions and fire. About 3,500 people were evacuated from the surrounding area, which included some of the business area of Eunice. No one was injured during the derailment of the train or the subsequent release of hazardous materials. Total damages exceeded $35 million.

The major safety issues identified in this investigation are track conditions on the Union Pacific's Beaumont Subdivision and the effectiveness of the Union Pacific's track inspection activities, including management oversight.

As a result of the investigation, the National Transportation Safety Board makes safety recommendations to the Federal Railroad Administration, the Union Pacific Railroad, and the Association of American Railroads.

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Executive Summary

On Saturday, May 27, 2000, about 11:48 a.m., central daylight time, 33 of the 113 cars making up eastbound Union Pacific Railroad train QFPLI-26 derailed near Eunice, Louisiana. Of the derailed cars, 15 contained hazardous materials and 2 contained hazardous materials residue. The derailment resulted in a release of hazardous materials with explosions and fire. About 3,500 people were evacuated from the surrounding area, which included some of the business area of Eunice. No one was injured during the derailment of the train or the subsequent release of hazardous materials. Total damages exceeded $35 million.

The National Transportation Safety Board determines that the probable cause of the May 27, 2000, derailment of Union Pacific train QFPLI-26 was the failure of a set of joint bars that had remained in service with undetected and uncorrected defects because of the Union Pacific Railroad's ineffective track inspection procedures and inadequate management oversight.

The major safety issues identified in this investigation are track conditions on the Union Pacific's Beaumont Subdivision and the effectiveness of the Union Pacific's track inspection activities, including management oversight.

As a result of the investigation, the National Transportation Safety Board makes safety recommendations to the Federal Railroad Administration, the Union Pacific Railroad, and the Association of American Railroads.

Factual Information

Accident Synopsis

On Saturday, May 27, 2000, about 11:48 a.m.,[1] 33 of the 113 cars making up eastbound Union Pacific Railroad (UP) train QFPLI-26 derailed near Eunice, Louisiana. Of the derailed cars, 15 contained hazardous materials and 2 contained hazardous materials residue. The derailment resulted in a release of hazardous materials with explosions and fire. (See figure 1.) About 3,500 people were evacuated from the surrounding area, which included some of the business area of Eunice. No one was injured during the derailment of the train or the subsequent release of hazardous materials. Total damages exceeded $35 million.

Figure 1. Looking west at accident scene.

Accident Narrative

At 6:00 a.m. central daylight time on May 27, 2000, a two-person train crew consisting of an engineer and conductor went on duty at Beaumont, Texas, to take UP freight train QFPLI-26 to Livonia, Louisiana. (See figure 2.) Train QFPLI-26 was a run-through train,[2] and the crew received the train directly from the inbound crew. The train

[1] All times referenced in this report are central daylight time.

was made up of 3 locomotives, 87 loads, and 26 empties, and it departed Beaumont without the locomotives or cars being changed. According to the train consist,[3] 56 cars required hazardous material placards. Of these, 40 cars were loaded, and 16 contained residue.[4] The train carried several types of hazardous materials, including numerous liquids and flammable gases. According to the train-dispatching records, the train arrived at Beaumont at 6:02 a.m. and departed at 8:17 a.m.

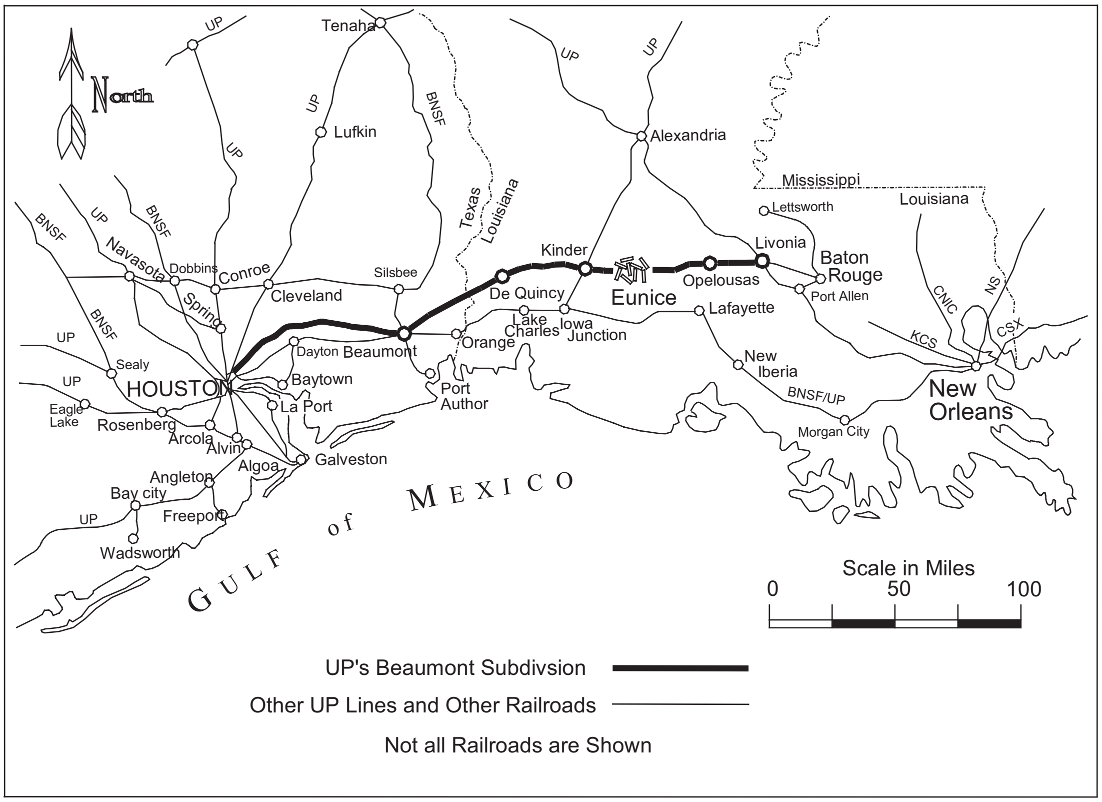

Figure 2. The Union Pacific's Beaumont Subdivision

During the next 3 1/2 hours, the train traveled about 109 miles. The engineer and conductor told Safety Board investigators that during this time, the trip was without

[2] Train QFPLI is a regularly scheduled freight train that originates in Freeport, Texas. On the day of the accident, train QFPLI-26 stopped at Beaumont only to change crews. (See the "Train and Operations" section of this report for more information.)

[3] A train *consist* is an organized list of the train cars, indicating the location of all of the cars and other equipment. A consist also provides hazardous materials information.

[4] *Residue* is the hazardous material that remains in a tank car that has been unloaded but has not been cleaned or purged. In tallies of loads and empties, a residue car is counted as an empty.

incident. The engineer said that he had had no difficulties with brakes or slack action[5] and that the train was a "good handling train."

The engineer said that between milepost (MP) 556.75 and MP 557.0, he slowed the train from 40 to 25 mph to comply with a temporary speed restriction that had been imposed because of track conditions. He said that after the rear car was beyond the temporary speed restriction, he accelerated the train back to the designated track speed of 40 mph. According to engineer statements and event recorder data, the wayside signals were displaying a *clear* signal,[6] the locomotive throttle was in the eighth notch, and the train was moving about 40 mph[7] as it approached Bridge 567.9, a nine-span precast concrete bridge. (See figure 3.)

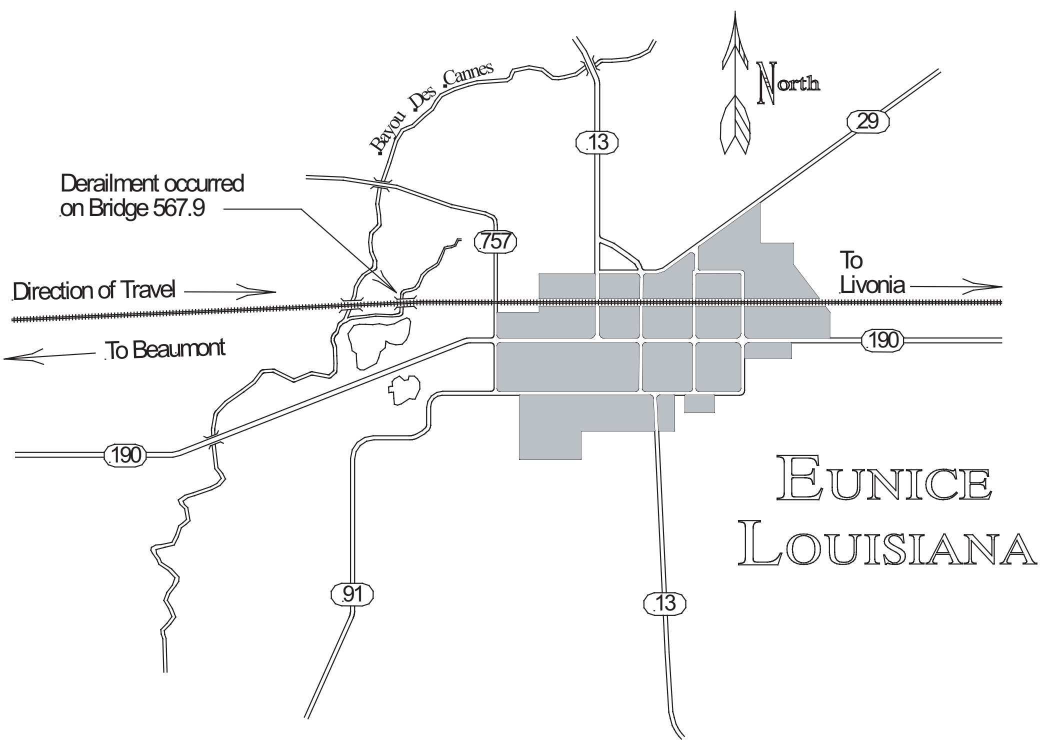

Figure 3. Location of the derailment.

[5] *Slack* in a train can be expressed as the difference between the length of the train when it is compressed and when it is stretched. Train slack can be affected by the free movement between couplers and the amount of play in the draft gear. Excessive train slack will affect train handling and can sometimes be of concern.

[6] A *clear* signal indicates that a train may proceed at track speed. Trains receiving a *clear* signal will not be diverging at the next signal location and will not have a signal more restrictive than *approach* at the next signal.

[7] According to the lead locomotive event recorder data, the speed varied between 39 and 41 mph. The event recorder on the second locomotive indicated a constant speed of 40 mph.

The engineer stated that as his train approached the bridge, he saw a section of misaligned or broken rail about 50 feet in front of the locomotive. The defect was in the south rail, which was the rail under the engineer's side of the cab. The conductor, who was sitting on the opposite side of the locomotive, said he did not see the misalignment in the rail but he heard the engineer say they were about to pass over a broken rail, and he felt the engine pitch toward the south side. Both crewmembers reported the sound of a "thud" as the locomotive passed over the spot where the engineer had seen the misalignment. As the train passed over the defect, the train derailed and separated, which placed the train brakes in emergency.[8]

The engineer said that he felt an increase in the train's rolling resistance, and then he saw the cars derailing and piling up behind him, instantly producing fire and smoke. The engineer said that he immediately contacted the UP train dispatcher in Spring, Texas, on the locomotive radio. According to the transcript of the call, the engineer told the dispatcher that the train had derailed and that there was a fire. The engineer asked for urgent emergency assistance and said he believed the train had passed over a broken rail.

With the train in emergency braking, the lead locomotive stopped at MP 568.1, and after a brief moment of discussion, the crew decided to uncouple the three locomotive units from the train. After the conductor separated the last locomotive from the first car of the train, the engineer moved the locomotives eastward to a grade crossing at MP 568.75 and waited for emergency crews to arrive.

Postaccident investigation revealed that all three locomotives and the first nine cars passed over the location of the reported track defect without derailing. The rear truck of the 10th car derailed, and the train separated behind this car. Of the 33 cars that derailed, 17 were hazardous materials cars. Two contained a residue of thiapentanal; one each contained acrylic acid, dichloropropane, dicyclopentadiene, molten phenol, and pentanes; two each contained toluene diisocyanate, methyl chloride, and hexanes; and four carried a corrosive liquid. Five additional hazardous materials cars did not derail but were exposed to the heat of the fire. The five included three cars loaded with styrene monomer and two thiapentanal residue cars. The derailed freight cars that carried no hazardous freight included covered hoppers carrying plastic pellets and other cars carrying feed, dyes, and glycol.

Emergency Response

The St. Landry Parish 911 Center received the first call at 11:48 a.m. The call came from someone at the Eunice Country Club with a cellular telephone. The caller stated that a train had derailed, that a tank car was on fire, and that there was a cloud of black smoke.

[8] Train brakes are applied in response to reductions in trainline air pressure. Normally, the locomotive engineer initiates a reduction of trainline air pressure, but a broken or disconnected trainline (such as occurs when a train separates) results in an instantaneous loss of air pressure that causes an application of the emergency brakes.

The 911 operator transferred the caller to the Eunice Police Department and remained on the line while the caller told the police the location of the fire. The caller informed the Eunice Police Department that the fire was in the area of the railroad tracks behind the country club. The police dispatcher told the caller that the Eunice Fire Department had been dispatched.

The UP's Risk Management Communications Center received the initial notification at approximately 11:49 a.m. and notified the local police, fire, and emergency medical services within 2 minutes. The UP Police Department was notified and began to respond within 10 minutes of the initial notification. Within 30 minutes, the UP's environmental and hazardous material personnel had begun to respond.

The St. Landry Parish 911 operator called the Louisiana State Police and the Louisiana State Police Hazardous Materials Unit. The 911 operator also contacted the sheriff's offices of St. Landry Parish and Evangeline Parish.[9] By 11:55 a.m., the Eunice police and fire departments had arrived on scene and had begun to evacuate the immediate area. About 12:15 p.m., the Eunice police and members of the St. Landry Parish Sheriff's Office expanded the evacuation to include all people within a 1 mile radius of the derailment.

The Louisiana State Police established a command post at Eunice High School at 2:11 p.m. The command post was subsequently relocated at 4:15 p.m. to a Louisiana State University campus in Eunice.

The emergency response organizations that responded to the incident included the Louisiana State Police Troop I, the Louisiana State Police Hazardous Materials Unit, the Eunice Police Department, the Eunice Fire Department, the St. Landry Parish Sheriff's Office, the Evangeline Parish Sheriff's Department, the Acadia Parish Sheriff's Department, the Acadia Ambulance Service, the Basile Police Department, the Mamou Police Department, the UP Police Department, and the U.S. Coast Guard.

At 8:00 a.m. on Sunday, May 28, a St. Landry Parish official declared a state of emergency and extended the evacuation area to 2 miles east of the derailment. The boundaries of the evacuated area varied over time. At its largest, the evacuation area was 2 miles to the east, 1 mile to the north, 1/2 mile to the south, and 2 1/2 miles to the west. At 9:50 a.m., the Eunice police reported that the evacuation had been completed.

At 5:30 a.m. on Monday, May 29, the command post was moved from the Louisiana State University campus to Eunice Junior High School. That afternoon, Evangeline Parish evacuated residents who resided 2 1/2 miles west of the derailment. During the following days, law enforcement officers escorted residents of the evacuated area to their homes so they could get food and medicine and could care for their animals. UP police told Safety Board investigators that 22 UP officers were in the Eunice area to assist the local police where necessary, including patrolling the evacuated areas at night.

[9] The boundary between St Landry Parish and Evangeline Parish is about 0.4 mile west of the location of the derailment.

At 4:00 p.m., on June 1, the evacuation area was reduced to 1/2 mile. The majority of the residents returned to their homes, and businesses were reopened. At 6:00 p.m. on June 2, the Louisiana State Police released the accident site to the Louisiana Department of Environmental Quality.

UP officials told Safety Board investigators that the railroad provided assistance to residents who were affected by the evacuation. Investigators observed UP representatives processing requests for assistance by local citizens. Such assistance included compensation for hotels, meals, clothes, and other expenses.

Injuries

No one was injured during the derailment of the train. Safety Board investigators visited local hospitals and asked hospital staff members to identify anyone who had been treated for ailments related to the fire or release of hazardous materials. The investigators found no indication that anyone had gone to the facilities with complaints related to the derailment. UP officials told the investigators that they did not have any evidence that anyone had received medical treatment for injuries sustained as a result of the evacuation or the release of hazardous materials.

Damage

Track and Structures

The UP determined track damage to be $988,617. The derailment destroyed about 1,200 feet of the main track. Much of the damaged track material, track ballast, and sub ballast was contaminated by the hazardous materials and was removed from the site. The derailment destroyed most of the bridge, which accounted for $877,177 in structure damages.

Three private fiber optic cables ran along the UP right-of-way. One cable was partially severed in the derailment. All three cables were rerouted around the derailment site in preparation for the ground excavation that was anticipated during the hazardous materials mitigation and wreck-clearing operations.

Equipment

The UP estimated that the monetary damage to the railroad equipment exceeded $1.87 million. Lading damage was estimated to be in excess of $2 million. The cost of wreckage clearing was about $700,000.

Hazardous Material Tank Cars

All of the hazardous materials involved in this accident were being transported in tank cars. The derailment and the resultant fire and explosions destroyed all of the cars that were in the general pileup.

The derailment involved five pressure tank cars (four class DOT 105J and one class DOT 114J). All of the pressure cars survived the derailment without being breached; three of those failed in the resulting fire. Of the 12 non-pressure tank cars, 7 were breached during the derailment.[10]

In general, pressure tank cars are designed to provide greater damage protection through use of increased wall thickness and head shields. They are used to transport flammable gases and other materials determined by the U.S. Department of Transportation (DOT) to present the greatest hazards if released during transportation. Pressure tank cars are also required to have a thermal protection and a pressure relief system that will allow the car to survive a pool fire for 100 minutes, which allows time for emergency responders to evacuate the area. Witnesses stated that in this accident, the first of two major explosions occurred 1 hour and 43 minutes after the derailment and fire. The two explosions likely involved the two tank cars filled with methyl chloride (a flammable gas). Both of these cars were found torn in half, and portions of the cars were found to have been thrown from 50 to 700 feet from their original resting positions. (See figure 4.)

[10] Hazardous materials in pressure tank cars: methyl chloride (2 cars); pentanes; and toluene diisocyanate (2 cars). Hazardous materials in non-pressure tank cars: acrylic acid; 1, 2 dichloropropane; molten phenol; dicyclopentadiene; hexanes (2 cars); corrosive liquid, NOS (4 cars); and 4, thiapentanal residue (2 cars).

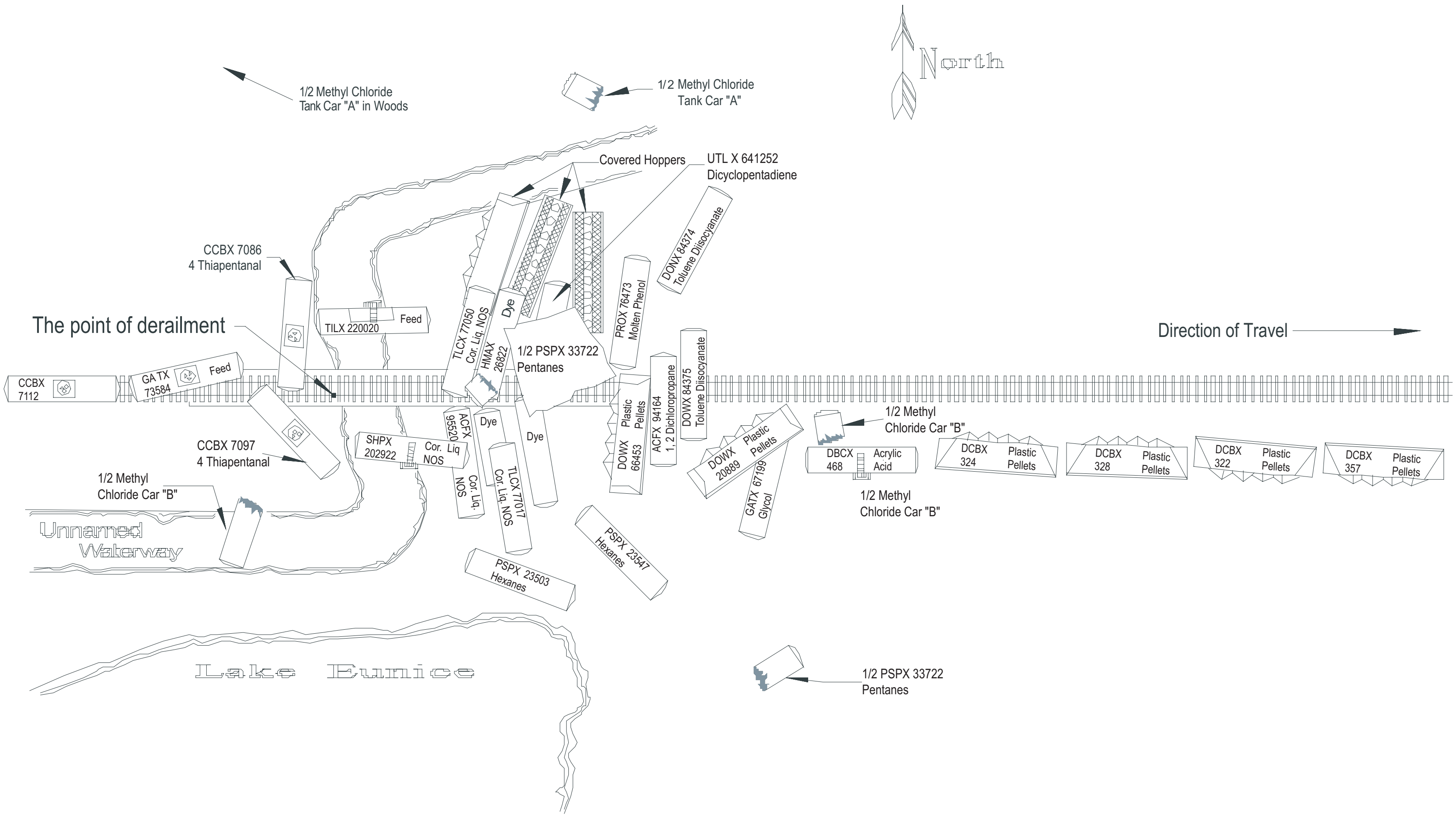

Figure 4. Wreckage

Non-pressure tank cars are intended to carry materials considered by the DOT to present a lesser hazard if released in transportation. These cars generally do not have the same wall thickness as the pressure tank cars, and most are not required to have thermal protection or head shields. The non-pressure tank cars on train QFPLI-26 carried flammable liquids, corrosives, and a poisonous solid (molten phenol). Several of these cars released their contents after being crushed and/or punctured during the derailment.

Environment

Damage to the tank cars caused by the derailment and by the subsequent fire resulted in the release of most of their contents. The tank cars released about 43,700 gallons of flammable gas, 944,150 pounds of corrosive liquids, and 167,685 gallons of miscellaneous flammable liquids and poisons. To eliminate the risks posed by damaged cars that were still loaded with hazardous materials, one car of acrylic acid and two cars of toluene diisocyanate were explosively breached by emergency responders. Most, if not all, of the released product from these three cars was burned.

Some hazardous material was recovered during the cleanup. About 7,500 gallons of corrosive liquid were recovered from one tank car, and some phenol was recovered from pits near the derailment site. During the excavation of the site, the Louisiana Department of Environmental Quality directed that the UP remove contaminated soil, burned trees, and water. Records provided by the Louisiana Department of Environmental Quality[11] list 71,140 tons of contaminated soil, 1,593 tons of contaminated and burned trees, and 1.68 million gallons of contaminated water that were removed from the site. These materials were sorted according to their chemical contamination and sent to suitable facilities for disposal as hazardous waste. The testing and monitoring of the site will continue under the direction of the Louisiana Department of Environmental Quality. The UP estimated the cost of the environmental damage and cleanup at more than $26 million.

Train and Operations Information

The derailment occurred on the Beaumont Subdivision, a component of the UP's Southern Region. The Beaumont Subdivision is one of the 30 subdivisions listed in the UP's Houston Area Timetable. This trackage was formerly owned and operated by the Missouri Pacific, with the ownership of the right-of-way being absorbed by the UP on December 22, 1983, when the UP and the Missouri Pacific merged.

The Beaumont Subdivision extends westward from Gulf Coast Junction, near Houston, Texas, (MP 378.0) to Livonia, Louisiana, (MP 621.0) a distance of 243 miles. It is primarily a single-track railroad and has 20 passing sidings for the meeting and passing of trains. Train operation is controlled by centralized traffic control (CTC)[12] and is under

[11] These figures were given to the Safety Board totaling the amount of materials recovered as of December 2001.

[12] *Centralized traffic control* is a block signal system that uses wayside signal indications to authorize train movements. The train dispatcher has the ability to control trains by displaying controlled signals and lining track switches from a centralized, remote location.

the direction of the UP train dispatcher in Spring, Texas. All engines on the accident train were equipped with standard radios for communication with the train dispatcher.

Because it is more efficient to "fleet" trains that operate in the same direction on the mostly single-track subdivision, trains that operate on the Beaumont Subdivision are generally eastbound trains. Although there are no limitations or restrictions to the operation of a westbound train on the subdivision, this type of "one-way" operation avoids the process of trains that are of opposing directions having to wait for one another in sidings. Westbound UP trains between Livonia and Beaumont generally operate over a joint UP/Burlington Northern Santa Fe Subdivision, which parallels the UP's Beaumont Subdivision to the south.

Twelve freight trains pass through Eunice on an average day. In addition, two local freights pass through town each day, placing and pulling cars at local industries. No regularly scheduled passenger trains operate on the Beaumont Subdivision.

In 1998, the annual gross tonnage on the Beaumont Subdivision was about 18.29 million gross tons. In 1999, the Beaumont Subdivision handled a gross tonnage of about 22.13 million gross tons, or 21 percent more than in 1998.

The UP operates a train with the symbol "QFPLI" each day of the week except Monday. The train originates at the UP yard in Freeport, Texas, and terminates at the UP facility in Livonia. Because of the various chemical-related industries that are located along the Gulf Coast of Texas and Louisiana, a QFPLI usually carries hazardous materials.

The UP provides all train crews with a consist that provides hazardous materials information and emergency response information for the materials being transported in the various cars of the train. The consist for QFPLI-26 identified the train as a "key" train, which requires special handling considerations because of the hazardous materials transported. The consist information for each hazardous materials car included the commodity, the car identification, emergency contact information, and the location of the car in the train.

Investigators found that the placement of cars carrying hazardous materials conformed to the UP's hazardous materials instructions. The UP also requires that a key train have an operable end-of-train telemetry device.[13] According to the UP special instructions and the UP's "Instructions for Handling Hazardous Materials," a key train must not exceed 50 mph. The exact order and identification of the cars that were listed in the computer-generated consist was verified by an AEI[14] reader in Beaumont.

The Association of American Railroads (AAR), in AAR Circular No. OT-55-B, *Recommended Railroad Operating Practices for Transportation of Hazardous Materials*,

[13] An *end-of-train telemetry device*, or EOT, transmits to the lead unit (head-end locomotive) the brake pipe pressure at the rear of the train and other pertinent information. Brake pipe pressure can also be displayed on a digital readout on the flashing rear-end device itself.

[14] AEI is an abbreviation for "automatic equipment identification." This is a system of car identification by wayside scanners that records the identification of the cars of a passing train. Such information can be used to update the exact order and identification of the equipment in a train. It is commonly used to generate an accurate train consist.

defines and recommends limits on key trains and key routes. The AAR defines "key train" as follows:

> Any train with five tank car loads of Poison Inhalation Hazard [PIH] (Hazard zone A or B) or 20 car loads or intermodal portable tank loads of a combination of PIH (Hazard zone A or B), flammable gas, Class 1.1 or 1.2 explosives (Class A), and environmentally sensitive chemicals.[15]

UP train QFPLI-26 did not meet the AAR definition of a key train but, as noted above, the train did meet the UP's definition and was handled accordingly.

The AAR defines "key route" as follows:

> Any track with a combination of 10,000 car loads or intermodal portable tank loads of hazardous materials, or a combination of 4,000 car loadings of PIH (Hazard zone A or B), flammable gas, Class 1.1 or 1.2 explosives (Class A), and environmentally sensitive chemicals, over a period of one year.

UP stated that the route from Freeport, Texas, to Livonia, Louisiana, was a key route.

The train consist indicated that the train was 6,708 feet in length and had a gross weight of 11,999 tons. Three locomotive units were on the head-end of the train. The lead locomotive was the UP 3909, an EMD (manufactured by the Electromotive Division of General Motors) SD40-2 that is rated at 3,000 horsepower. The two following units were manufactured by General Electric and owned by the Norfolk Southern Railway. Each of them is rated at 4,000 horsepower. The middle unit was NS 8766, a GE C40-8, and the last unit was NS 8738, a GE C40-9. The trailing unit was isolated,[16] and the diesel engine was shut down at the time of the derailment. The train had an operating two-way end-of-train telemetry[17] device.

Operating crews of the trains on the Beaumont Subdivision were governed by the *General Code of Operating Rules*, Fourth Edition, effective April 2, 2000; the UP air brake and train handling rules; and the safety rules. Other instructions and references included the UP "System Timetable," the "Houston Timetable No. 1," the UP's system special instructions, and the UP's "Instructions for Handling Hazardous Materials." Train crews were also governed by the applicable general orders and the instructions from the train dispatcher.

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[15] AAR Circular OT-55 was modified to revision C on October 20, 2000, and to revision D on August 23, 2001. Revision D incorporates the transportation of spent nuclear fuel and high -level radioactive waste and updates the list (provided with the circular) of poison inhalation hazard materials and environmentally sensitive chemicals that are subject to OT-55.

[16] An *isolated* locomotive is set up so that it may be moved in a train but will not produce tractive effort. An isolated locomotive will not provide dynamic braking, but all aspects of the pneumatic braking systems (automatic, independent, and actuating) will function in unity with the other locomotive(s). The diesel engine of an isolated locomotive may or may not be operating.

[17] A *two-way end-of-train device* is capable of initiating an emergency brake application at the rear of the train upon receiving a signal from the head end.

Automated train records note the passage of trains by certain locations. These records indicate that QFPLI-26 passed the timetable station of Hub, MP 544.4, at 11:03 a.m., about 45 minutes before the derailment. Using the recorded times for two other trains as they passed Hub, investigators added 45 minutes to the “Hub times” to approximate the times that the two preceding trains had passed through the Eunice area. (Both trains, according to the train dispatching records, were eastbound, as is the usual practice.) One train was an intermodal train, IHONO-26, with 26 cars, that passed through Eunice about 2:10 a.m.; the other train was a miscellaneous freight train, QDYLIX-26, with 103 cars, that passed through Eunice about 4:22 a.m. According to UP officials, neither train reported a track defect or rough ride when it passed over the point at which the accident train subsequently derailed.

Personnel Information

UP crew dispatching records indicate that the conductor had been off duty for at least 8 hours and that the engineer had been off duty for at least 10 hours before reporting for duty at 6:00 a.m. on the day of the accident. Both men had had the required amount of time off duty before beginning their tours of duty and were in compliance with the Federal hours-of-service law.

After the accident, both crewmembers were toxicologically tested as required under 49 *Code of Federal Regulations* (CFR) Part 219, Subpart C, “Post-Accident Toxicological Testing.” The results for both employees were negative.

Engineer

The 53-year-old engineer began his railroad career as a brakeman with the Missouri Pacific Railroad in Dequincy, Louisiana, on June 30, 1978. He attended the Missouri Pacific’s school for locomotive engineers in Little Rock, Arkansas, in 1980 and was promoted to locomotive engineer in March 1981. He has worked as an engineer since then and came to the UP following its merger with the Missouri Pacific.

Under 49 CFR Part 240, all locomotive engineers must be certified. Records indicate that the engineer had most recently attended a safety and operating rules class and successfully passed an examination on the General Code of Operating Rules on November 11, 1998. His last physical exam was on June 3, 1999. His most recent check-ride before the accident was on May 6, 2000. He had most recently attended training in a locomotive simulator on May 19, 1999. During the 2 years before the accident, he attended six UP training classes, five of which were safety-related.

Conductor

The 28-year-old conductor began his railroad career with the UP in August 1997 and became a conductor on November 24, 1997. Records indicate that he had most recently passed an examination on the General Code of Operating Rules on January 12,

1999. Training records indicate that he had attended numerous training classes and had passed an examination on hazardous materials on August 20, 1997. His last physical exam was a preemployment exam on July 15, 1997.

Site Description and Track Information

Location of Derailment

The derailment occurred in St. Landry Parish, about 2 miles west of the downtown section of Eunice, and about 0.4 mile east of the St. Landry Parish and Evangeline Parish line. The cars derailed in an area that was generally flat and marked by a mixture of farm fields and woods. To the north of the derailment was a section of deciduous woods. To the south of the derailment area was the wooded property of the Eunice County Club, including a golf course, swimming pool, and Lake Eunice. A driving range that was several acres in size was to the southeast, adjacent to the country club.

The pileup of cars was centered around a bridge over a tributary that emptied into Bayou Des Cannes. The track in this area had an approximate compass direction of east-west, which matched the east-west direction that was specified in the timetable. Milepost numbers increased from west to east. The bridge, which had nine spans and was made of precast concrete, was 189 feet long and had a maximum height of about 12 feet above the waterway. The eastern end of the bridge was at MP 567.9. The alignment of the track was tangent for several miles west of the bridge and remained tangent over the bridge. At MP 568.0, the track began a 1-degree curve to the right. The grade of the right-of-way in the Eunice area was undulating, and track gradients were 0.4 percent or less. The track was level at the point of the derailment. The track was on an earthen fill about 12 feet above the ditch line at the east end of the bridge.

The track at the accident location was jointed track supported with granite ballast that was approximately 18 inches deep under the crossties. The 115-pound rail was manufactured in 39-foot lengths and joined together with two 36-inch joint bars (one on each side of the rail joint) that had 3 bolts per rail end. The manufacturer's stamping identified the rail as 115 RE CC CF&I, rolled in January 1951. The double-shoulder tie plates were 8 inches wide and 13 inches long. Six-inch chisel-cut track spikes secured the rail and tie plates to the crossties. The spiking pattern varied between 2 to 4 spikes per tie plate. When two spikes per tie plate were used, one spike was on the field side[18] and one spike was in the gage side[19] in the rail holding position. When four spikes per tie plate were used, there was an additional spike in the gage-side rail holding position and one additional spike on the field-side plate holding position. Wooden crossties were installed with an average spacing of 19.5 inches, yielding 24 crossties per rail length. Every third or fourth tie was box anchored.[20]

[18] The *field* side of a rail or rail joint is the side toward the outside of the track.

[19] The *gage* side of a rail or rail joint is the side toward the center of the track.

Three fiber optic cables were located on the UP's right-of-way in the area of the derailment. Two cables were on the south side of the track, and one cable was on the north side of the track. No other utilities were on the UP right-of-way.

Speed Restrictions

The maximum speed (for non-key trains) on the majority of the Beaumont Subdivision was 60 mph; however, a maximum timetable speed of 50 mph was specified between MP 544.8 and MP 588.5, approximately corresponding to the 44-mile segment[21] of the subdivision that used jointed rail. (The balance of the subdivision used continuous welded rail, or CWR. See the "Jointed Rail in Main Tracks" section of this report for more information on CWR versus jointed rail.)

To supplement and update timetable instructions, the railroad issues general orders that contain specific instructions to operating crews. Such instructions cover a wide range of operating considerations, including train speed, track speed, and the required speed of equipment in various situations. A general order for the Beaumont Subdivision specified a maximum allowable train speed of 40 mph between MP 544.8 and MP 589.0,[22] which corresponded with the jointed rail portion of the subdivision and included the accident area. Because the track had a maximum allowable operating speed of 40 mph for freight trains, the track was required to meet the Federal Railroad Administration's (FRA's) requirements for class 3 track.[23]

Signal System

The signal system in use on the Beaumont Subdivision displayed wayside signal indications to the operating crews of trains. The signal system components pass an electric current through the rails to determine whether the track is clear of trains or occupied by railroad equipment. Because of the electrical current carried in the rails, the signal system also detects continuity of the rails and rail joints. A disruption in the electrical circuit could be associated with a break in the rail or a break in a bond wire at a rail joint.[24] A wayside signal can display a *clear* indication only if the two consecutive blocks in advance of the signal are clear of trains and have no loss of rail continuity. The engineer and conductor of the accident train said that they had observed a *clear* indication at the last signal before the derailment and that previous signal aspects had also displayed a *clear* indication. Safety Board investigators examined the signal system for information that

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[20] The term *box anchored* indicates that rail anchors are applied on both sides of the tie, resulting in a rectangular box pattern.

[21] The actual location of this jointed rail was between MP 544.3 and MP 588.5.

[22] UP officials informed Safety Board investigators that this speed restriction is reissued annually in the spring to coincide with the change to daylight savings time. This particular general order was effective May 10, 2000.

[23] The track safety standards, contained in the CFR, allow for increased train speed as the track meets increasing standards of construction, maintenance, and inspections. Freight trains can operate at a maximum speed of 10 mph on class 1 track, 25 mph on class 2 track, and 40 mph on class 3 track. Succeeding higher classes of track allow for higher train speeds.

[24] A *bond wire* bridges the rail joint to provide electrical continuity from one rail section to the next.

could be used to determine whether the signal system had detected a loss of continuity of the rails before the arrival of the accident train. No loss of continuity was detected.

Except for a section of automatic block signals and yard limits, train movements on the greater part of the Beaumont Subdivision are governed by the signal indications of the CTC system. The CTC system controls train movements through the use of three-aspect color light signals, displayed singularly or in combination, along the track wayside. The wayside signals are controlled by Electro Code 2 and Electro Code 4 electronic coded track circuits. Signals are arranged for train movement in either direction. On the Beaumont Subdivision, the signal system is operated with the help of a computer-aided dispatching (CAD) system to assist the train dispatcher.

Postaccident Inspection

Equipment

Two days after the derailment, the 69 rear cars of the accident train were moved from the accident site to Basile, Louisiana, where they were given a mechanical inspection and an initial terminal air brake test. Investigators found that there was no air brake leakage. They did discover two mechanical defects: one worn composition brake shoe and a car with air brakes that released on the rear of the car.[25] They also noted that the seven east cars were covered in soot from the fire.

The head nine cars were moved from the accident site about 1/2 mile eastward, where they were given a roll-by inspection, a mechanical inspection, and an initial terminal air brake test. The roll-by inspection was performed as the cars were pulled from the wreckage; there was no evidence of any component dragging, binding, or fouling. No air brake train line leakage was noted during the air test.

In the general pileup area, investigators observed wheels, axles, and other car parts that exhibited visible evidence of having been deformed by the heat of the fire. Heat and explosive forces had visibly damaged the tank car shells. Safety Board investigators examined the several derailed cars at the east end of the derailment; those cars had departed the roadbed to the south and had escaped the direct effects of the explosions and fire. No preaccident defects were identified on these cars.

Signals

During an inspection from MP 569 to a signal control point near MP 572, investigators found all signal units and signal bungalows to be locked and secured. Investigators found no indication that any of the signal equipment had been vandalized or tampered with. Testing indicated no grounds or short circuits on any of the equipment, and no obstructions were identified that would hinder a train crewmember's ability to see the

[25] The brakes did apply on the car; however, after a time, the truck-mounted brake on the rear of the car released.

wayside signals. The investigators looked at the track connections and insulated joints and found three broken bond wires. At the control point, track circuits were verified, and investigators used track shunts to simulate train movements as a method of testing the system. Switch and signal locking tests were also performed. All electric lock locations were tested and verified. Signal indications were found to correspond with one other.

The UP signal maintenance, inspection, and test records indicate the equipment was in working condition and listed no exceptions that would prevent the signal equipment from operating properly. Investigators reviewed the records of the most recent testing of the signal equipment in the vicinity of the accident. Postaccident data was also obtained from the CAD computer log at the control center in Spring. The records and data revealed some anomalies with the signal system, but none that would have had a bearing on the derailment.

Wayside defect detectors were located approximately every 10 to 15 miles along the Beaumont Subdivision. The last two defect detectors that the train passed before the derailment were at MP 546.7 and MP 558.8. The detectors were designed to detect overheated journals and dragging equipment and had radios that enabled them to transmit information about the trains that passed. Each defect detector had an event recorder. Safety Board investigators examined the downloaded data from the detector stations and noted that neither detector had recorded any defect when train QFPLI-26 traveled over it.

Track

Investigators examined the accident site and found that a major portion of the track structure was totally destroyed by the pileup of the cars and the resulting fire and explosions. The bridge was severely damaged, and only the western end remained standing. Trees near the roadbed showed evidence of blast and fire damage.

The engineer stated that he had seen a misalignment in the south rail just before passing over it, but he said he was not sure if the misalignment was at a rail joint or if it was due to a broken rail. After the derailment, the recovered sections of rail were arranged in a linear fashion; the relative order was determined by matching ends of the rails and joint bars. Some of the rails had been bent and twisted by the extreme heat, and postaccident overstress fractures were found. Investigators could find no evidence of a preaccident rail failure.

In jointed rail territory, the individual rails are joined to one another by joint bars. (See figure 5.) The Beaumont Subdivision used a common form of rail joint that consists of two joint bars plus six track bolts, nuts, and spring washers. Two joint bars, one on each side of the rail ends, are considered to be a pair. Oval-shouldered track bolts, typically 1 inch in diameter, are arranged in an alternating pattern through holes in the joint bars and rail. When the bars are matched up to form a rail joint, one on the gage side and one on the field side of the rail, the bolts are tightened and the joint bars are drawn toward each other, squeezing them toward the side of the rail. In addition to joining the rail ends together, the joint bars act as a beam that distributes over several adjacent ties the downward vertical load that is imposed on the rail joint by the weight of the train.

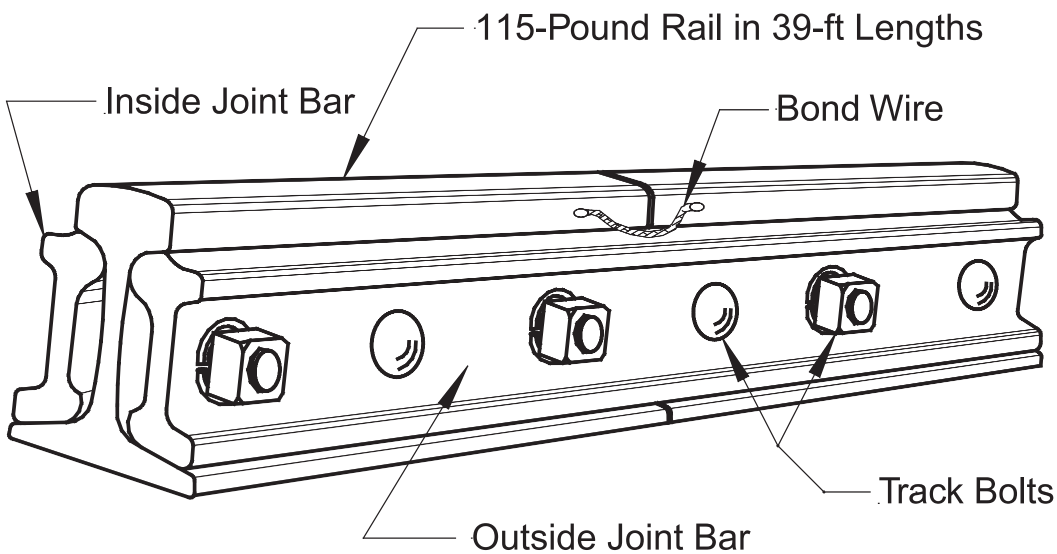

Figure 5. Sketch of a typical joint bar.

During the postaccident inspection of the derailment area, portions of two broken joint bars, still bolted to the end of a section of the south rail, were found on the bridge at about the fourth span. Each joint bar portion had a break in the transverse plane at the center of the joint bar, near the end of the rail. Later, portions of another pair of broken joint bars were found. These bars also had remained bolted to a piece of rail and had breaks in the transverse plane at the center of the joint bar. The fractured surfaces of the two pairs of broken joint bar pieces matched one another in both the location of the broken surfaces and the type of fracture.

When investigators examined the second pair of broken joint bar pieces and the rail to which the bars were bolted, they discovered that the top corner of the end-face of the rail exhibited visible evidence of having been deformed by impact.[26] This rail end-face deformation was consistent with the deformation and appearance that would have been caused if railroad wheels had hammered the blunt end of the receiving rail instead of rolling over the top of it. This type of deformation can occur when a misalignment or gap between the two rails allows the wheels to drop below the surface of the delivering rail and hammer against the end of the receiving rail as they roll over the end corner of the rail. Both broken joint bars and the rail ends to which they were attached were sent to the Safety Board's Materials Laboratory for further examination. (See the "Tests and Research" section of this report for more information.)

On the day after the derailment, Safety Board investigators inspected the track west of the derailment site with a Hy-Rail vehicle.[27] A walking inspection was conducted

[26] The word "batter" is sometimes used to describe this type of deformation. In this instance, "deformation" is used to describe marks and indentations that result from wheels passing over the end face of the rail when the rails are separated by a greater distance than is normally expected.

east of the derailment site. During the walking inspection, joint bars with visible vertical cracks were found. Subsequent inspections during the following days identified additional cracked and broken joint bars on either side of the derailment area. (See table 1.)

Table 1. Track defects noted in the accident area.

Joint bar defects found by UP track maintenance crews east of the derailment location				
Inspection Date	**Milepost Locations**	**Miles Inspected**	**Number of Cracked Bars**	**Number of Broken Bars**
05/28/00	561.25 to 566.0	4.75	54	1
05/29/00	552.0 to 561.25	9.25	65	2
05/30/00	544.49 to 552.0	7.51	97	1
Joint bar defects found by UP track maintenance crews west of the derailment location				
Inspection Date	**Milepost Locations**	**Miles Inspected**	**Number of Cracked Bars**	**Number of Broken Bars**
05/28/00	570.4 to 571.8	1.4	12	
05/29/00	571.8 to 576.25	4.45	35	2
05/30/00	576.25 to 578.5	2.25	21	
05/31/00	578.5 to 586.5	8.0	66	3
06/01/00	586.5 to 588.2	1.7	16	1
Joint bar defects found by FRA chief inspector west of the derailment location				
Inspection Dates	**Milepost Locations**	**Miles Inspected**	**Number of Cracked Bars**	**Number of Broken Bars**
06/06/00 06/07/00	568.0 to 574.76	6.76	27	

Total of Inspections and Defects Found				
Inspection Dates	**Total Miles Inspected**	**Total Number of Cracked Bars**	**Total Number of Broken Bars**	**Total Number of Defective Bars**
05/28/00 Through 06/07/00	46.07	393	10	403

The investigators noted that the cracks they found in the joint bars were not visible to a track inspector using a Hy-Rail vehicle. An inspector driving such a vehicle across a rail joint could see only the tops of the two joint bars on the driver's side and the joint bar on the gage side of the track on the passenger side. The joint bar on the field side of the track on the passenger side of the vehicle was not visible.

[27] A *Hy-Rail vehicle* is a maintenance-of-way highway vehicle, in this case a pickup truck, that is equipped with flanged wheels that can be lowered to allow the vehicle to travel along the railroad tracks.

The vehicle the track inspector used during his track inspections was a 1996 Chevrolet 1-ton super-cab pickup truck with Fairmont Hy-Rail equipment. Although forward visibility will vary somewhat depending on the seat adjustment and the height of the driver, an inspector in the driver's seat cannot see a track component that is less than about 28 feet in front of the vehicle. With a newer model of pickup truck (having a shorter hood), the track component is not visible unless it is at least 19.5 feet in front of the operator. With a flat-front inspection vehicle, an operator can see a track component at a distance of about 9.5 feet.

On May 28, after the track conditions were initially observed by the track group, the Federal Railroad Administration (FRA) chief inspector inspected the track between MP 573.3 and MP 573.45 for compliance with the Federal track safety standards. He discovered seven track defects, including two cracked joint bars, three locations of defective track ties, and two locations of insufficient bolts.

On May 29, the FRA chief inspector reviewed the UP's track inspection records for the period January 1 to May 26, 2000. They revealed that the track inspector had identified defective switch ties[28] at the east end of Lawtell, MP 585.0, on March 11, on April 8, and on April 15, but that the inspector had not taken remedial action as required by 49 CFR 213.233(d).[29] Because of the lack of remedial action, the FRA chief inspector reported a violation on his inspection report. On May 31, 2000, Safety Board investigators and FRA personnel did a walking inspection and identified the defective switch ties that the track inspector had previously reported. The chief inspector reported a violation because the ties had still not been repaired.

Safety Board investigators and FRA personnel also inspected the track at the east end of an interlocking and siding switch between MP 573.4 and MP 573.7. The FRA chief inspector reported a joint with insufficient track bolts, a tread portion of a frog that was worn beyond allowable limits, and eight loose guard bolts on the north-side guard rail.

In addition to the track group's walking inspections, the UP track maintenance crews conducted a 5-day walking inspection of the joint bars on the 44 miles of jointed rail territory. They discovered 376 defective joint bars, of which 366 were cracked and 10 were broken. After the UP had replaced the defective joint bars, the FRA chief inspector conducted a walking track inspection between MP 568 and MP 574.8. He found an additional 27 cracked joint bars and 42 rail joint locations that lacked effective crossties.

[28] *Switch ties* support switches and turnouts and are longer than standard ties, commonly reaching lengths of more than 16 feet.

[29] Title 49 CFR 213.233(d) states, "If the person making the inspection finds a deviation from the requirements of this part, the inspector shall immediately initiate remedial action."

UP Inspection of Beaumont Subdivision Track

Routine track inspections are normally conducted by walking the tracks or by riding along the track in a Hy-Rail vehicle. Other inspections, such as those intended to identify internal rail defects or to check track geometry, are performed using specially equipped rail cars.

Hy-Rail Inspections

Federal regulations (49 CFR Part 213) set the requirements for track geometry and inspections. As noted earlier, in the area of the derailment, trains traveled over the Beaumont Subdivision at 40 mph, a speed that required class 3 track. Federal requirements for inspections of class 3 track stipulate that the track be inspected twice per week with at least one calendar day between inspections.[30] The UP's general practice called for the mainline track on the Beaumont Subdivision to be inspected six times per week.

The UP track inspector explained that his inspection territory consisted of about 84 miles of the Beaumont Subdivision, from MP 507 to MP 590.75, which he inspects using a Hy-Rail vehicle. He stated that he tried to inspect the main track four times a week and explained that he normally inspected the main track on Saturdays, Sundays, Mondays, and Tuesdays. He used Wednesdays for yard track inspections. A relief inspector, usually the track foreman, inspected the track on Thursdays and Fridays, the regular track inspector's off days. The inspector said that he usually traveled from west to east because the majority of train traffic operated in that direction. (An inspection vehicle that proceeds in the same direction as the train traffic generally experiences fewer delays.) When performing an inspection, the inspector observes the track, searching for defective track components or changes in track geometry. The track inspector stated that he did the track inspections at speeds between 20 and 25 mph on CWR track and between 15 and 20 mph on jointed rail.

Safety Board investigators examined track inspection records for the jointed rail territory of the Beaumont Subdivision. Investigators discovered that during the week before the derailment, the records itemized three separate instances of broken joint bars. According to the records, each instance involved a rail joint in which both joint bars had broken, as had been the case with the joint bars later found near the derailment.

In the first instance, which was on May 20, 1 week before the derailment, the UP track inspector found a pair of broken joint bars at MP 579.1. In the second instance, 4 days before the derailment, the track inspector found a rail joint in which both joint bars had broken at MP 571.1, about 3.1 miles east of the derailment location. In the third instance, 3 days before the derailment, the track inspector discovered a rail joint at which both joint bars were broken at MP 587.1, about 17 miles east of Eunice. According to track inspection records, a total of 128 cracked or broken joint bars had been discovered in the 5 months before the derailment.

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[30] This requirement is for track that had more that 10 million gross tons of traffic in the preceding year. In 1999, the Beaumont Subdivision carried in excess of 22 million gross tons.

The relief inspector inspected the track on Thursday, 2 days before the derailment, and on Friday, the day before the derailment. He did not note any track defects on Thursday. On Friday, he replaced some track bolts at MP 575. He also inspected the switches at Lawtell, MP 585.0, and Powel, MP 573.6. He did not note track defects at either location.

Walking Inspections

In addition to the Hy-Rail inspections, UP policy required that the subdivision's track be walked annually and visually inspected for cracks and breaks. The UP manager of track maintenance stated that the annual walking track inspections had been instituted before he was assigned to the Beaumont Subdivision in April 1997. He stated that he let the track inspector determine how and when to do the walking inspections. Inspectors were not required to keep written records of the dates or locations of their walking inspections.

The chief engineer stated that in early 2000, he had issued oral instructions that the walking inspections of all track, whether in jointed rail territory or CWR territory, be done twice a year instead of once. He stated that he had instituted the walking inspection program after the UP reported to the FRA that a derailment in California had been caused by a pair of broken joint bars. He was unsure of exactly when he had issued the instructions, and other maintenance-of-way employees interviewed by investigators were also unsure of the exact date of the origin of this instruction.

The chief engineer did not require that written records be kept of the dates or locations of the twice-yearly walking inspections. The UP track inspector told the Safety Board that while no written record of the walking inspections was kept, if a cracked or broken joint bar was found during the walking inspection, that finding would be recorded on the track inspection form.

The track inspector stated that his most recent walking inspection before the accident was on January 3, 5, and 12, 2000. On those 3 days, the investigators found, the track inspector had inspected 10 miles of track. He stated that during the walking inspection, he had had track workers following behind him to make repairs.

The relief inspector stated that he had done his last walking inspection in December 1999. He said he had inspected 7 miles of track, from MP 572 to MP 565, and had found more than 20 cracked joint bars. This 7-mile segment of track included MP 567.9, the location of the derailment.

Since the Eunice derailment, the UP has increased the frequency of its walking inspections of jointed track. The chief engineer told investigators that he now requires that jointed rail territory that carries over 10 million gross tons and has class 2 or higher track be inspected on foot four times a year. He also said that the locations of the walking inspections must be recorded on the inspection reports.

Other Inspections

The line on which the derailment occurred was a key route by both AAR and UP definition. In its *Recommended Railroad Operating Practices for Transportation of Hazardous Materials*, the AAR states:

> Main Track on 'Key Routes' must be inspected by rail defect detection and track geometry inspection cars or any equivalent level of inspection no less that two times each year; and sidings must be similarly inspected no less than one time each year.

The UP chief engineer told investigators that on the Beaumont Subdivision, the rail was inspected for internal defects twice a year. The UP had done the last rail inspection for internal defects on the main track with its DC-9 test car on April 11 and had found five rail defects. According to its summary report of rail detector car results on the Beaumont Subdivision for 1999, the UP, using rail test cars, had conducted internal rail inspections on April 20, July 22, and October 12. According to the UP record of rail service failures,[31] one rail failure was found between MP 567 and MP 568. No rail failures were found between MP 568 and MP 569.

On February 2, 2000, the UP did a track geometry inspection between MP 556 and MP 584 and did not find any track geometry defects within the area of the derailment.

Oversight of Track Inspections

The manager of track maintenance had almost 30 years of railroad service and had been promoted to positions of increasing responsibility. He had been the manager of track maintenance of the Livonia Service Unit, which included the Beaumont Subdivision, since April 1997. His territory consisted of about 277 miles of track. He told investigators that he had Hy-Railed over the Beaumont Subdivision about a month before the derailment. He also told investigators that the track inspector was a hard worker and that he did a good job.

UP track inspectors on the Beaumont Subdivision are not dedicated exclusively to the inspection of track; they are also expected to make repairs to track defects if they are qualified and equipped to do so. Track inspectors are expected to replace defective joint bars that they find during their inspections. More extensive repairs are performed by maintenance crews.

The manager of track maintenance told investigators that he reviewed the records of daily track inspection at the end of each month but that he did not scrutinize the records. He also had conversations with the track inspector when the inspector found larger maintenance problems that he could not solve by himself; in such instances, the manager of track maintenance arranged for other track employees to make the repairs.

[31] A *service failure* is the occurrence of a broken rail or a rail defect being discovered under normal operating conditions or routine track inspections.

FRA Inspection of Beaumont Subdivision Track

Investigators examined the data gathered by the FRA's T-10 test car[32] as it had traveled over the Beaumont Subdivision on April 10. No track geometry defects were noted for class 3 track within the area of the derailment. This inspection car is not designed to inspect individual track components such as joint bars.

The FRA track inspectors had inspected the track on the Beaumont Subdivision on January 26 and 27, 1999, and had done a follow-up inspection on March 16, 1999. These were the last FRA inspections before the accident. The FRA regional administrator had arranged for the January inspection to be sure that the main track complied with FRA regulations because a special train hauling napalm for the military was expected to use the track. Two FRA track inspectors inspected the Beaumont Subdivision independently, one between MP 507 and MP 569, the other between MP 569 and MP 578.

Between MP 507 and MP 569, the FRA track inspector reported six locations with defective ties. The inspector also wrote on the inspection report that "ties are weak and marginal in various locations between Kinder and Eunice, LA." Between MP 569 and MP 578, the track inspector reported three locations with defective ties and five locations with cracked or broken joint bars. A note on the inspection report reads "weak tie condition between milepost 569 and milepost 578." The ties must support the load that is imposed on the rail and joint bars in the area of the rail joint and transmit this load to the ballast with diminished unit load. Tie spacing, weak ties, or missing ties may place a bending load on the joint bar and rails and require the adjacent ties to distribute the additional load to the ballast.

The FRA track inspector who did the March follow-up inspection inspected the track between MP 556 and MP 591. He stated that he did the follow-up to see whether the conditions that he had reported in January had been corrected and to inspect other locations. He stated that the previously reported defects had been repaired but that he found defective tie conditions at 11 other locations. He identified cracked joint bars at two locations.

Safety Board investigators also examined the FRA inspection reports for 1997 and 1998. The reports noted that the Beaumont Subdivision was FRA class 4 track with an operating speed of 50 mph. Most of the observed track defects were defective joint bars, improper cross-level elevation (the relative heights of the two rails), and insufficient or loose track bolts. The reports did not note weak tie conditions.

The investigators also examined the FRA track inspection reports for 1995 and 1996. The FRA track inspector had noted numerous track defects. No problematic defects were noted in the immediate area of the derailment. Most of the reported track defects were deviations in cross-level, crossties not effectively distributed over a 39-foot segment

[32] The T-10 test car utilizes electronic sensing technology to record eight critical track measurements for each linear foot of track. The T-10 can objectively identify problems in track gage, surface, and alignment and can accurately locate problematic conditions that are difficult to detect by visual inspection.

of rail, no effective support crossties within the prescribed distance from a joint, missing track bolts, and cracked/broken joint bars.

The FRA regional chief inspector stated that depending on what was observed from a Hy-Rail truck, an FRA inspector might decide to return for a follow-up walking inspection. He had done a walking inspection during the 1996 inspections of the Beaumont Subdivision. According to his inspection reports, he had found 36 cracked/broken joint bars. At two locations, he had found rail joints in which both joint bars were cracked.

According to the track safety standards in 49 CFR 213.121(c): "If a joint bar is cracked or broken between the middle two bolt holes it shall be replaced." The track can remain in service, at 10 mph, for a period of 30 days while repairs are made.

Tests and Research

Joint Bars

The broken joint bars that were found at the accident scene were shipped to the Safety Board's Materials Laboratory for further examination. An overall view of the rail pieces is shown in figure 6. The examination of the rail, joint bars, and bond wires included optical and scanning electron microscopy and energy dispersive x-ray spectroscopy of the fracture surfaces. The microstructures of each joint bar were examined, and a chemical analysis was performed on the joint bar on the field side.

Raised characters on each joint bar identified the bars as having been manufactured in 1951 by the Colorado Fuel & Iron Corporation. Although some of the fracture surface was obliterated by postfracture damage, a portion of the remaining fracture surface of each joint bar showed the chevron patterns and radial marks that are typically found in overstress fractures. From these markings, the initiation of the overstress region in each bar could be traced to a relatively smooth, dark region with a curving boundary, which is typical of fatigue.

On the field-side joint bar shown in figure 7, the fatigue region was on the upper portion. A portion of the boundary was visible on the east surface, as indicated by the dashed line. Ratchet marks were visible on the west surface, indicating multiple origins at the top of the bar in the area marked by bracket "O." The depth of the fatigue region was approximately 0.813 inch. On the gage-side joint bar shown in figure 8, the fatigue region was on the lower gage-side corner of the bar. For each mating surface shown in figures 7 and 8, a dashed line indicates the fatigue boundary, and bracket "O" indicates the fatigue origin area. The depth of the fatigue region was approximately 0.308 inch.

Figure 6. The accident joint bars. The east and west sections of the joint bars are indicated by “E” and “W.” The location of the bond wires is indicated by “B.” The bond wires are on the field side (outside) of the joint.

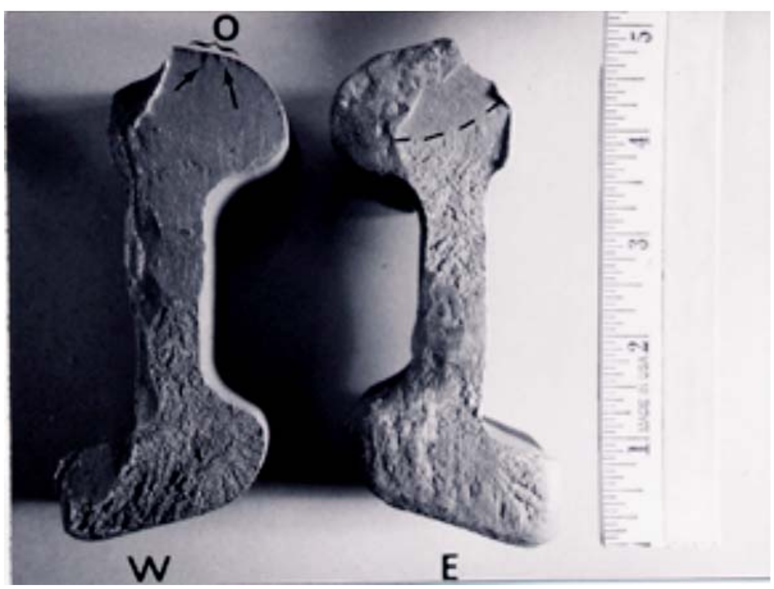

Figure 7. The field side (outside) joint bar from the accident joint. The area of the fatigue crack boundary is shown as a dashed line. The letter “O” indicates the fatigue origin area.

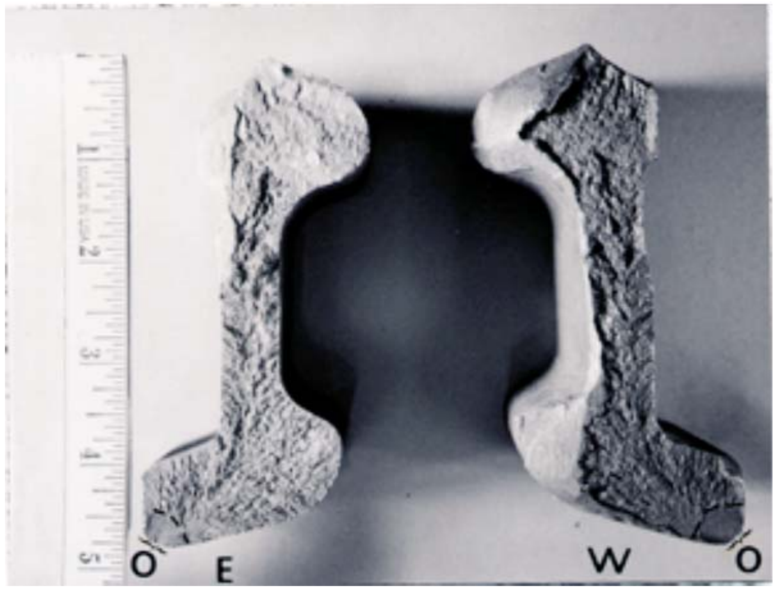

Figure 8. The gage side (inside) joint bar from the accident joint. The area of the fatigue crack boundary is shown as a dashed line. The letter "O" indicates the fatigue origin area.

An examination of the surface of the fractured areas of the joint bars revealed that both fractured surfaces displayed evidence of contact damage to the mating fractured surface. In general, the greater damage was on the field side of the west surfaces and on the gage side of the east surfaces, indicating that the separated joint bars had shifted in relation to each other after they had fractured.

Investigators chemically analyzed for carbon and phosphorus the field-side joint bar material that had been sampled approximately 2 inches west of the fracture surface. The result was 0.499 percent carbon and 0.014 percent phosphorus. According to the *AREA* (American Railway Engineers Association) *Manual for Railway Engineering*, "Specifications for High-Carbon-Steel Joint Bars" (1969), the carbon content must be greater than 0.45 percent, and the phosphorus content in the finished bar must be less than 0.05 percent. The phosphorus and carbon levels of the tested material met those specifications.

Safety Board investigators measured the hardness on a cross-section of the accident joint bars.[33] The AREA manual requires that the steel used in joint bars have a minimum tensile strength of 85,000 pounds per square inch (psi). The investigators found that the corresponding tensile strengths were 121,000 psi for the joint bar on the gage side and 112,000 psi for the joint bar on the field side.

[33] The Wilson Conversion Table was used to convert hardness to the estimated tensile strengths corresponding to the measured hardness values.

The pair of broken joint bars found at the derailment exhibited visual indications that the fracture surface of both failed joint bars originated at a previously formed fatigue crack. After the derailment, more than 400 defective joint bars were identified and removed from the Beaumont Subdivision's 44-mile stretch of jointed track. Two hundred of these defective bars were transported to the UP's research and development laboratory in Omaha, Nebraska, for examination and testing under the supervision of Safety Board staff. The majority of the defective joint bars had fatigue cracks across the center of the bar, roughly parallel to the rail ends. This type of defect is similar to the fatigue cracks that were found to have existed before the total failure of the pair of broken joint bars that were found at the location of the derailment.

The purpose of the Omaha testing was to determine the relative strength of joint bars that were found to have fatigue cracks of various lengths in the center. Investigators also tested the strength of a new, as-manufactured, joint bar and of a nondefective joint bar that had been in service for about 48 years.

During testing, these joint bars were mounted in a fixture that was designed to replicate the direction and location of the bending forces that a joint bar is expected to withstand in normal use. In the test, a hydraulic press was used to create bending forces that would exceed those normally found in the field so that the strength of the bar could be measured. In individual testing of a new joint that had never been in service, the bar deformed under a peak load of 120,000 pounds. In individual testing of a nondefective joint bar that was manufactured and had been in service since 1952, the bar deformed under a peak load of 110,000 pounds. Neither bar cracked or broke under testing.

In addition to the nondefective joint bars, Safety Board staff selected 17 other joint bars with varying types of fatigue cracks and had them tested in a manner that subjected them to bending forces that could be measured. Three of the defective bars were tested individually, as were the two nondefective bars. These three bars fractured, with little or no deformation, under peak loads of 34,200 pounds, 43,400 pounds, and 16,600 pounds. The remaining 14 defective bars were paired and tested as a unit. Of the 14 paired bars, 8 fractured during testing with little or no deformation. These bars fractured under peak loads ranging from 16,000 to 138,000 pounds, with an average peak load at failure of about 79,375 pounds.

Rail

As shown in figure 6, the top surface of the end face of the east rail "E" showed damage consistent with receiving rail end deformation, and the gage side of the head was rounded. The web portion of the rail end face was deformed on the gage side, and the corner of the gage side of the base was missing. The top surface at the end face of west rail "W" was rolled over. This type of damage is consistent with trailing rail end deformation.

Bond Wires

Bond wires are attached to the ends of each rail at a rail joint to connect the rails electrically. With all of the rails "bonded" in this fashion, segments of track make up circuits in the railroad signal system. A break in a rail or a broken bond wire can cause the signal system to detect an interruption in the circuit.

The Safety Board laboratory used optical microscopy to examine the separated ends of the wires to determine whether the wires had been broken before, or had been broken by, the derailment. Examination of the wires attached to west rail section revealed that most of the ends were necked adjacent to the fracture surface, which is typical of ductile overstress fracture. For the wires attached to east rail section, examination revealed that the shorter wires also appeared necked. The longer wires appeared to be flattened near the end, consistent with a longitudinal compression of the wire.

Other Information

Beaumont Subdivision Track Maintenance

Recently Completed Maintenance. Larger maintenance projects on the Beaumont Subdivision included the 1998 installation of 20 miles of 133-pound CWR between MP 608.5 and MP 588.5, which is east of Eunice. In mid-1999, 88 carloads of ballast were distributed between MP 544.5 and MP 590.0, which corresponds to the 44-mile portion of jointed track between MP 544.3 and MP 588.5.

After the ballast was spread, the track was surfaced. In addition to the surfacing, some of the road crossings were improved. In 2000, before the derailment, the UP installed 116 crossties to break up defective tie clusters and repaired an additional 21 battered rail joints.

Planned Maintenance. The UP maintains a long-range plan, called a "5-year plan," for major capital work in track maintenance. The plan is predominantly concerned with rail and tie replacement. During any particular 5-year period, projects may be accelerated or deferred. Adjustments are made according to changing conditions. The chief engineer explained that the planned projects are usually selected in the spring. He added, "Then, in December, we follow up with another planning conference where we look out the 5 years." The projects are prioritized according to relative necessity and the changing conditions.

The chief engineer told investigators that the 5-year plan, as of May 2000, did not include a tie replacement program for the Beaumont Subdivision. Such a tie project for the subdivision had been discussed, however. The chief engineer informed investigators that after the derailment, an average of 1,200 crossties per mile had been replaced on the Beaumont Subdivision. After the new crossties were installed, the jointed rail was replaced by CWR.

Jointed Rail in Mainline Tracks

Rail used for mainline railroad tracks can be divided into two types: CWR and jointed rail. For mainline tracks with heavy traffic, CWR is the most common, although a significant number of heavy-use mainlines continue to use jointed rail. Jointed rail was used exclusively before technological advancements made possible the installation and welding of rails into seamless 1/4-mile sections. Most welded rail track also has some joint bars,[34] which have the same characteristics and fastening methods as the joint bars found in jointed track. After the accident, the UP replaced the Beaumont Subdivision's 44 miles of jointed rail with CWR.

The UP Senior Director of Derailment Prevention stated that by the end of 1999 (the last year of record before the derailment), the UP had 33,078 miles of mainline track. The track comprised 23,698 miles of CWR and 9,380 miles of jointed rail. As of the end of 2001, the UP had 32,682 miles of mainline track, including 6,688 miles of jointed rail.

Other large railroads were surveyed to determine the amount of jointed rail on their mainline tracks at the end of 2001. The Burlington Northern Santa Fe had 29,043 miles of mainline track, which included of 5,026 miles of jointed rail. CSX had 19,043 miles of mainline track, including 4,295 miles of jointed rail. The Norfolk Southern had 21,807 miles of mainline rail, of which 3,114 miles were jointed rail.

Rail Joints as a Cause of Derailments

The Nation's railroads reported to the FRA that there were 48 broken joint bar incidents that caused derailments between 1995 and 1999. A search of the FRA database resulted in the information shown in table 2, which lists the number of derailments that are caused by broken joint bars.

Table 2. Accidents that were reported to the Federal Railroad Administration that were attributed to broken joint bars compared with total train accidents.

Year	Total No. of Accidents	No. of Track-Caused Accidents	No. of Accidents Attributable to Broken Joint Bars
1995	2,459	856	6
1996	2,443	905	16
1997	2,397	879	9
1998	2,575	900	8
1999	2,768	995	9
2000	2,983	1,035	12
2001	3,134	1,094	11

[34] Joints are commonly found near turnounts and special track work. Insulated joint bars are installed at certain locations to isolate the electric circuits used for railroad signal systems and grade crossing warning devices. Temporary joints are commonly installed during maintenance activities and are welded at a later time.

Analysis

General

The engineer and conductor were qualified in their operational responsibilities and were familiar with the territory. The event recorders indicate no abnormalities with train handling or other operational considerations. The train was traveling eastward, in good weather, with a proper wayside signal indication and was operating about 40 mph, which was within the specified speed limit for the track. Postaccident testing of the train crewmembers for alcohol and specific drugs was negative. Therefore, the Safety Board concludes that there was no evidence of alcohol or drug use, and weather, train crew qualifications, and the operation of the train were not factors in this accident.

The engineer told investigators that he had no difficulties with brakes or slack action and that all equipment had worked normally. The train had passed over wayside defect detectors 21.2 miles and 9.1 miles before the derailment. The detectors were designed to detect overheated journals and dragging equipment and had event recorders, both of which indicated that the train had no defects. An examination of the records that indicated the placement of loaded and empty cars in the train and the maximum car weights revealed nothing that contributed to the severity of the derailment.

Investigators examined the locomotives and freight cars that did not derail and did an air brake test. No defects were found that could have caused or contributed to the derailment. A mechanical inspection of the derailed cars that were not involved in the general pileup revealed nothing that could have caused the accident. Explosions and fire damaged most of the derailed equipment in the general pileup, and the damage was so extensive that determining the mechanical condition of the cars before the derailment was not possible. However, because of the number of cars that derailed in advance of the general pileup, any causal mechanical defect would probably have been in the first several cars to derail, and not in the general pileup of destroyed cars. The 10th car, the car that had remained coupled to the head end of the train after the derailment, was thoroughly examined and had no significant defects. The wheels, trucks, and couplers of the 11th, 12th, and 13th cars were also inspected, and no causal defects were identified. The Safety Board therefore concludes that the mechanical condition of the cars in the train did not cause or contribute to the derailment.

The engineer and conductor of the accident train informed Safety Board investigators that they observed a *clear* signal indication at the last signal before the derailment, and that prior signal aspects had also displayed a *clear* indication. A wayside signal can only display a *clear* indication if the two consecutive blocks ahead are clear of trains and have no loss of rail continuity. Safety Board investigators examined and tested the signal system and found it to be functioning properly. The Safety Board therefore concludes that the signal system in the accident area did not contribute to the accident.

The derailment involved 5 pressure tank cars and 12 non-pressure tank cars carrying various hazardous materials. All of the pressure cars survived the derailment without being breached, although three of those failed in the resulting fire. These cars had greater wall thickness than non-pressure cars and were equipped with head shield and thermal protection. Based on the fact that the first explosion was reported to have occurred 103 minutes after the derailment, the three pressure tank cars that failed exceeded the required minimum 100-minute exposure to fire before failing. Of the non-pressure tank cars, seven were breached during the derailment. The level of damage sustained in this accident by both pressure and non-pressure tank cars is consistent with that found in similar accidents involving a derailment at relatively high speed (in this case, about 40 mph).

The Accident

The engineer of the accident train said that he had seen a track defect in the south rail just before passing over it. The conductor, although he had not seen the defect, stated that he had felt the engine pass over a track abnormality. Both employees heard an unusual sound as the engine passed over the location where the engineer had reported the defect. According to the transcripts of the emergency radio broadcast to the train dispatcher just after the derailment, the engineer had indicated that the train had passed over a broken rail.

During wreck-clearing operations, a rail with pieces of two broken joint bars attached to its east end was found on the south side of the bridge. The following day, investigators located a similar rail with broken pieces of joint bars attached. Metallurgists at the site indicated that the two pairs of broken joint bars matched, which was later reaffirmed by a closer examination at the Safety Board's Materials Laboratory.

Investigators were more confident that the broken pair of joint bars had played a role in the derailment after observing that the top corner of the end face of the rail exhibited visible evidence of having been deformed by the impact of wheels moving over the top corner of the rail end. This is significant in that it demonstrates that the separated rail and joint bars had, for a time, remained in place while the wheels of a moving train passed over them. Such damage would not have been present if the joint bars had broken as a result of forces generated during the derailment.

Based on the engineer's statements, on the physical evidence exhibited by the broken joint bars and the damage to the end face of the rail that is consistent with wheel impact, and on the laboratory examination of the joint bars, the Safety Board concludes that the joint bars found at the point of the derailment had broken before the arrival of the accident train, which allowed the rail to become misaligned. The joint bars had most probably failed when the previous freight train had passed through the area. Just as a number of the cars of the earlier train had been able to pass over the misaligned rails without incident, the 3 locomotives and first 10 cars of the accident train passed over the track defect without derailing. Investigators believe that the 11th car was probably the first to derail and that it pulled laterally on the trailing end of the 10th car, causing it to also derail.

Mechanical Suitability of Joint Bars

Many of the joint bars in the 44-mile section of jointed rail territory of the Beaumont Subdivision were removed because of cracks that were detected during inspections following the accident. To determine the mechanical suitability of the joint bars, a series of mechanical tests was conducted to determine whether the steel from which the joint bars were made was substandard or had flaws or defects that may have contributed to the cracking. The results of the tests showed that the material properties were not substandard. During laboratory testing, the strength of a new joint bar was compared with that of a noncracked joint bar that had been in service for some 48 years. The strength of the materials was found to be similar. But testing also showed that even a small crack in the center of the joint bar significantly reduced the bar's strength.

Investigators found no material defects at the origin areas of the fractured surfaces. Chemical composition was within specifications, and hardness results indicated that the approximate tensile strength was also within specifications. The failures in the accident joint bars resulted from metal fatigue.

UP Track Inspections

Frequency of Inspections

Trains were operated at 40 mph in the area of the derailment, and Federal regulations specify that for a speed of 40 mph, the track must meet the track safety standards for class 3 track. Regulations require that for the annual tonnage supported by the Beaumont Subdivision, class 3 track must be inspected twice a week at intervals of at least one calendar day. During its investigation, the Safety Board found that the UP was inspecting the mainline track of the Beaumont Subdivision six times a week.

Adequacy of Inspections

Observing track from a moving inspection vehicle is the most common method of inspecting track; however, this method is inadequate for detecting defective joint bars. When the track inspector's vehicle is operated in an eastward direction, as was the case generally for the Beaumont Subdivision, the inspector cannot see any part of the outside joint bar on the south side of the track, nor can he see any part except the tops of the two joint bars on the north rail. Even those joint bars that can be partially seen by the inspector may have small fractures that are extremely difficult, if not impossible, to see from a moving vehicle.

Investigators found that in the 5 months before the derailment, UP track inspectors had detected and replaced 128 defective joint bars. However, after the derailment, various walking inspections of the entire 44-mile section of jointed rail revealed 403 defective joint bars, indicating that regular track inspections had resulted in a significant number of defective joint bars remaining undetected.

As evidenced by the numerous joint bars that were found with fatigue cracks of varying lengths, a joint bar with a fatigue crack can remain in service for some time before failing completely. And although fatigue crack growth rates will vary depending on the type and frequency of forces exerted upon the joint bars, a fatigue crack, once initiated, can be expected to grow until it causes complete failure of the bar. Laboratory examination of the pair of broken joint bars found at the derailment site revealed that the fractures in those bars resulted from fatigue cracks, and while it cannot be determined when the cracks were initiated, they were certainly evident in the bars for some time before the bars failed in this accident. The Safety Board concludes that the UP track inspection procedures in use before the derailment were inadequate in that inspectors identified only a small proportion of the cracked or broken joint bars on the subdivision, with the result that defective joint bars that should have been replaced were allowed to remain in service.

Inspection Reports

After each inspection, the UP track inspector or the relief inspector completed a daily track inspection report form. Although the completed form itemized the various times and the location of the track inspection, the form did not specify whether any part of the inspection was a walking inspection. The form listed the types and locations of repairs that the inspector had made and the locations of the track deficiencies that he could not correct. The Safety Board considers that the daily track inspection report has value, both as a record of track abnormalities and as a means of allowing supervisors to evaluate track conditions as well as review inspection activities and repairs made by the inspectors.

Investigators who reviewed track inspection records made before the derailment and compared them with the results of a walking inspection of the 44-mile section of jointed rail after the derailment found a serious disparity between the condition of the track as listed on the track inspection reports and the actual condition of the track.

In addition to the defective joint bars, investigators became aware of defective switch ties that were itemized on track inspection reports 6 weeks before the derailment, on March 11, April 7, and April 15. These switch ties remained in service, notwithstanding the six inspections per week for the 6-week period between April 15 and the derailment on May 27. The FRA chief inspector also located areas of defective crossties and joint bolt defects.

After the derailment, a thorough inspection of the jointed rail territory revealed track conditions that did not meet the requirements of class 3 track, and these conditions had likely existed for some time. As noted earlier, the inspection method used by UP track inspectors was inadequate to detect the significant number of cracked or broken joint bars in the inspection area, and Federal rules require that such defective bars be replaced if the track is to maintain its class 3 classification and be approved for 40 mph operations. Therefore, the Safety Board concludes that had the track of the Beaumont Subdivision been properly assessed, trains would not have been permitted to operate at a speed of 40 mph until appropriate repairs were made.

Walking Inspections

Early in 2000, the UP chief engineer issued oral instructions that the number of walking inspections of all joints, whether in jointed rail territory or CWR territory, be increased from once to twice yearly. He said he had made the change primarily to increase the chances of finding defective joint bars. Neither the regular track inspector nor the relief inspector had used the railroad's track inspection reports to document the times and locations of their walking inspections. The track inspector referred to some of his own written notes and stated that his last walking inspections were in January 2000. With no written notes, the relief inspector relied on his memory and provided the milepost locations of his most recent walking inspections. He stated that his most recent track inspections were in December 1999 and had included the area of the derailment. Safety Board investigators totaled up the miles of track that were itemized by the track inspector and relief inspector and found that a walking inspection had taken place on 17 miles of track during the months of December and January.

The manager of track maintenance told investigators that it was up to the inspectors to determine how and when to do the walking inspections and that they were not required to keep records of those inspections. The Safety Board notes that without a written record of the time and location a walking inspection is made, it is difficult or impossible to determine exactly when and where a walking inspection has occurred. As a consequence, track inspectors may inadvertently duplicate walking inspections in some areas while neglecting others completely.

Since the derailment, the UP has added to the *Union Pacific Engineering Track Maintenance Field Manual* the requirement that jointed rail territory that carries more than 10 million gross tons and is class 2 track or higher be subject to quarterly walking inspections. Included in the manual is an explanation of the proper method of inspecting rail joint bars and the requirement that the dates and locations of walking inspections be recorded on the track inspection reports. Also, since the derailment, track inspectors have been required to record the date and locations of their walking inspections on the inspection reports.

Oversight of Track Inspections

UP Management Oversight

Despite inspection methods that were generally inadequate to identify all defective joint bars, enough defects were noted to demonstrate that defective joint bars were a frequent and persistent problem on the subdivision. For the 2-month period before the derailment, there were numerous records of defective joint bars and of joint bars with missing or defective bolts. For example, in the week before the derailment, the UP track inspector found three rail joints at which both joint bars had broken, which is the same type of failure that was found at the location of the derailment.

The manager of track maintenance told investigators that he reviewed the track inspection reports at the end of each month, but he did not scrutinize them. Had he done so, he may have noted the recurring problems associated with joint bars. The three broken pairs of joint bars that were found and replaced just days before the derailment should have alerted management to the potential for other occurrences of total joint bar failure. This is especially true given that, as noted above, joint bars normally provide evidence, such as cracks, of impending failure before complete failure actually occurs. Managers who reviewed the track reports closely would have been aware that track inspections were not always identifying weakened joint bars in time to prevent future failures and potential risk to trains. The Safety Board therefore concludes that if UP management had thoroughly examined track inspection reports, they may have determined that track inspections were not identifying joint bar defects that could, over time, lead to complete joint bar failure.

The Safety Board believes that the UP should change its track inspection programs to ensure that managers are making use of all available information about track condition, including railroad and FRA track inspection reports, to identify trends or problem areas and to monitor the effectiveness of daily track inspections.

FRA Track Inspections

The FRA track inspector's duties include monitoring the accuracy of the railroad track inspectors' reporting of track conditions. The FRA's records for the 5 years preceding the accident document a history of weak tie conditions and cracked joint bars in the jointed rail section of the Beaumont Subdivision. During a walking inspection in 1996, the FRA discovered 36 broken joint bars and identified areas with weak crossties. FRA inspectors inspected the track in January 1999 and discovered areas with insufficient crossties and defective joint bars. An inspector returned for a follow-up inspection in March 1999 and found that the situation had been corrected; however, he found defective tie conditions at 11 locations and 2 cracked joint bars.

Although the FRA did not conduct a regular track inspection on the Beaumont Subdivision in the 13 months before the derailment, it did do a track geometry car inspection 47 days before the derailment. The track geometry car did not detect an unusual amount of poor track surface or alignment. The car did not, and was not designed to, detect track component defects—such as fatigue cracks in joint bars or defective crossties—that did not affect track geometry.

The Safety Board notes that hazardous materials can be expected to traverse most mainline rail routes. However, certain lines, like the Beaumont Subdivision, are known to support a high volume of hazardous materials. The FRA had inspected Beaumont

Subdivision track in 1999 because the military was planning a shipment of napalm. But other, possibly equally hazardous, products are routinely transported over the subdivision, and these materials can constitute a serious risk to the public if they are transported over track that does not comply with the Federal track safety standards. The Safety Board concludes that the frequency and type of track inspections routinely performed by the FRA on the Beaumont Subdivision were inappropriate given the fact that this was a key route that carried large volumes of hazardous materials. Therefore, the Board believes that the FRA should modify its track inspection program to incorporate the volume of hazardous materials shipments made over the tracks in determining the frequency and type of track inspections.

AAR Recommended Practices for Key Routes

UP officials stated that the route from Freeport, Texas, to Livonia, Louisiana, was designated a key route because of the types and volumes of hazardous materials carried over it. The AAR, in its Circular No. OT-55-B, *Recommended Railroad Operating Practices for Transportation of Hazardous Materials*, states that mainline track on key routes "must be inspected by rail defect detection and track geometry inspection cars or any equivalent level of inspection no less than two times each year."

As noted earlier, inspections conducted by UP and FRA inspectors using special cars designed to detect internal rail defects or variances in track geometry did not and could not identify cracks or breaks in joint bars that did not affect track geometry. The Safety Board concludes that inspections of jointed rail using rail defect detection or track geometry cars are inadequate to identify the types of joint bar defects that led to this accident. The Safety Board therefore believes that the AAR should revise the guidance in its Circular No. OT-55 to recommend that all key routes be subjected to periodic track inspections that will identify cracks or breaks in joint bars.

Emergency Response

The Eunice Police and Fire Departments arrived on the scene within about 7 minutes of the accident. The local responders acted quickly, decisively, and effectively in the early stages of the response. After State responders arrived, the local residents were quickly and effectively evacuated. The evacuation area was enlarged as the situation warranted and remained flexible as the circumstances changed.

The Louisiana State Police established a command post near the scene less than 2 1/2 hours after the derailment. The emergency response information was exchanged efficiently, and emergency agencies assembled at the scene quickly. The Safety Board notes that the UP's train consist contained the required hazardous materials information. In interviewing the train crewmembers and the local emergency responders who were first to arrive at the scene, investigators detected no fault with the postaccident actions of the train crew or the information that was contained in the train consist.

As part of the response, three tank cars were explosively vented, and emergency responders burned the released material. The evacuation zone was reduced as the risk posed by the hazardous chemicals was lessened and a more thorough inspection of the site could be performed. Five days after the derailment, the evacuation area was reduced to 1/2 mile, and the majority of residents returned to their homes. The Louisiana State Police maintained control of the derailment scene until turning it over to the Louisiana Department of Environmental Quality 6 days after the accident. The Board concludes that the emergency responders to the accident responded quickly and handled the accident effectively.

Environmental Remediation

Most of the hazardous material was not directly recovered. Except for some corrosive liquid and some phenol, most of the hazardous material was consumed by fire or leaked into the soil. Contaminated soil was removed from the site as part of the remediation activities. After being removed from the site, the various contaminated materials were sorted according to their chemical contamination and sent to a facility that could handle it. The testing and monitoring of the site will continue under the direction of the Louisiana Department of Environmental Quality.

Conclusions

Findings

1. There was no evidence of alcohol or drug use, and weather, train crew qualifications, and the operation of the train were not factors in this accident.

2. The mechanical condition of the cars in the train did not cause or contribute to the derailment.

3. The signal system in the accident area did not contribute to the accident.

4. The emergency responders to the accident responded quickly and handled the accident effectively.

5. The joint bars found at the point of the derailment had broken before the arrival of the accident train, which allowed the rail to become misaligned.

6. The Union Pacific track inspection procedures in use before the derailment were inadequate in that inspectors identified only a small proportion of the cracked or broken joint bars on the subdivision, with the result that defective joint bars that should have been replaced were allowed to remain in service.

7. If Union Pacific management had thoroughly examined track inspection reports, they may have determined that track inspections were not identifying joint bar defects that could, over time, lead to complete joint bar failure.

8. Had the track inspection of the Beaumont Subdivision properly assessed the condition of the track, trains would not have been permitted to operate at a speed of 40 mph until appropriate repairs were made.

9. Inspections of jointed rail using rail defect detection or track geometry cars are inadequate to identify the types of joint bar defects that led to this accident.

10. The frequency and type of track inspections routinely performed by the Federal Railroad Administration on the Beaumont Subdivision were inappropriate given the fact that this was a key route that carried large volumes of hazardous materials.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the May 27, 2000, derailment of Union Pacific train QFPLI-26 was the failure of a set of joint bars that had remained in service with undetected and uncorrected defects because of the Union Pacific Railroad's ineffective track inspection procedures and inadequate management oversight.

Recommendations

As a result of its investigation of this accident, the National Transportation Safety Board makes the following safety recommendations:

To the Federal Railroad Administration:

> Modify your track inspection program to incorporate the volume of hazardous materials shipments made over the tracks in determining the frequency and type of track inspections. (R-02-13)

To the Union Pacific Railroad:

> Change your track inspection programs to ensure that managers are making use of all available information about track conditions, including railroad and Federal Railroad Administration track inspection reports, to identify trends or problem areas and to monitor the effectiveness of daily track inspections. (R-02-14)

To the Association of American Railroads:

> Revise the guidance in your Circular No. OT-55, *Recommended Railroad Operating Practices for Transportation of Hazardous Materials*, to recommend that all key routes be subjected to periodic track inspections that will identify cracks or breaks in joint bars. (R-02-15)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

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Member

Adopted: April 2, 2002

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Appendix A

Investigation and Public Hearing

The National Transportation Safety Board was notified of the Eunice, Louisiana, accident during the afternoon of May 27, 2000. An investigative team was dispatched with members from the Washington, D.C.; Atlanta, Georgia; and Chicago, Illinois; offices. Groups were established to investigate railroad operations, track, mechanical, signal, and hazardous materials issues.

Participating in the investigation were representatives of the Federal Railroad Administration, the Union Pacific Railroad, the Eunice Police Department, the Louisiana State Police, and the Louisiana Department of Environmental Quality.

No public hearings were held.

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