

Collision of Two CN Freight Trains
Anding, Mississippi
July 10, 2005



ACCIDENT REPORT

NTSB/RAR-07/01
PB2007-916301



**National
Transportation
Safety Board**

Railroad Accident Report

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PB2007-916301
Notation 7870A
Adopted March 20, 2007**



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

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Abstract: On Sunday, July 10, 2005, about 4:15 a.m., central daylight time, two CN freight trains collided head on in Anding, Mississippi. The collision occurred on the CN Yazoo Subdivision, where the trains were being operated under a centralized traffic control signal system on single track. Signal data indicated that the northbound train, IC 1013 North, continued past a *stop* (red) signal at North Anding and collided with the southbound train, IC 1023 South, about 1/4 mile beyond the signal. The collision resulted in the derailment of 6 locomotives and 17 cars. About 15,000 gallons of diesel fuel were released from the locomotives and resulted in a fire that burned for about 15 hours. Two crewmembers were on each train; all four were killed. As a precaution, about 100 Anding residents were evacuated; they did not report any injuries. Property damages exceeded \$9.5 million; clearing and environmental cleanup costs totaled about \$616,800.

The safety issues discussed in this report are the lack of a positive train control system that would stop trains when authorized limits are exceeded, the absence of a requirement for alerters on the leading locomotive of freight trains, the lack of accurate and timely train consist information for emergency responders, the lack of procedures ensuring railroads, States, and communities conduct joint emergency response planning for hazardous material releases, and the need for locomotive cab voice recorders.

As a result of its investigation of this accident, the National Transportation Safety Board makes recommendations to the Federal Railroad Administration, the Pipeline and Hazardous Materials Safety Administration, the Occupational Safety and Health Administration, the CN, and all Class I railroads.

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Acronyms and Abbreviations

AAR	Association of American Railroads
AEI	Automatic Equipment Identification
BNSF	BNSF Railway Company
BVFD	Bentonia Volunteer Fire Department
CFR	<i>Code of Federal Regulations</i>
CHEMTREC®	CHEMical TRansportation Emergency Center
CSX	CSX Transportation
CTC	centralized traffic control
CVR	cockpit voice recorder
DOT	U.S. Department of Transportation
EOTD	end-of-train device
ETMS	Electronic Train Management System
FEMA	Federal Emergency Management Agency
FRA	Federal Railroad Administration
FreightScope™	FreightScope™ HAZMAT System
HCN	hydrogen cyanide
HMEP	Hazardous Materials and Emergency Preparedness
IC	Illinois Central Railroad
LEPC	local emergency planning committee
MP	milepost
NRT	National Response Team
NRT-1	<i>Hazardous Materials Planning Guide</i>
ODEL	On-Demand Equipment Lookup
OMB	Office of Management and Budget
OSHA	Occupational Safety and Health Administration
PHMSA	Pipeline and Hazardous Materials Safety Administration
PTC	positive train control
RTC	Rail Traffic Control
TRANSCAER	Transportation Community Awareness and Emergency Response
UP	Union Pacific Railroad

Executive Summary

On Sunday, July 10, 2005, about 4:15 a.m., central daylight time, two CN freight trains collided head on in Anding, Mississippi. The collision occurred on the CN Yazoo Subdivision, where the trains were being operated under a centralized traffic control signal system on single track. Signal data indicated that the northbound train, IC 1013 North, continued past a *stop* (red) signal at North Anding and collided with the southbound train, IC 1023 South, about 1/4 mile beyond the signal. The collision resulted in the derailment of 6 locomotives and 17 cars. About 15,000 gallons of diesel fuel were released from the locomotives and resulted in a fire that burned for about 15 hours. Two crewmembers were on each train; all four were killed. As a precaution, about 100 Anding residents were evacuated; they did not report any injuries. Property damages exceeded \$9.5 million; clearing and environmental cleanup costs totaled about \$616,800.

The National Transportation Safety Board determines that the probable cause of the July 10, 2005, collision in Anding, Mississippi, was the failure by the crew of the northbound train (IC 1013 North) to comply with wayside signals requiring them to stop at North Anding. The crew's attention to the signals was most likely reduced by fatigue; however, due to the lack of a locomotive cab voice recorder or the availability of other supporting evidence, other factors cannot be ruled out. Contributing to the accident was the absence of a positive train control system that would have stopped the northbound train before it exceeded its authorized limits. Also contributing to the accident was the lack of an alerter on the lead locomotive that may have prompted the crew to be more attentive to their operation of the train.

As a result of its investigation of this accident, the Safety Board identified the following safety issues:

- The lack of a positive train control system that would stop trains when authorized limits are exceeded,
- The absence of a requirement for alerters on the leading locomotive of freight trains,
- The lack of accurate and timely train consist information for emergency responders,
- The lack of procedures ensuring railroads, States, and communities conduct joint emergency response planning for hazardous material releases, and
- The need for locomotive cab voice recorders.

As a result of its investigation of this accident, the National Transportation Safety Board makes recommendations to the Federal Railroad Administration, the Pipeline and Hazardous Materials Safety Administration, the Occupational Safety and Health Administration, the CN, and all Class I railroads.

Factual Information

Accident Synopsis

On Sunday, July 10, 2005, about 4:15 a.m., central daylight time,¹ two CN freight trains collided head on in Anding, Mississippi. (See figure 1.) The collision occurred on the CN Yazoo Subdivision, where the trains were being operated under a centralized traffic control (CTC) signal system on single track. Signal data indicated that the northbound train, IC² 1013 North, continued past a *stop* (red) signal at North Anding and collided with the southbound train, IC 1023 South, about 1/4 mile beyond the signal. The collision resulted in the derailment of 6 locomotives and 17 cars. About 15,000 gallons of diesel fuel were released from the locomotives and resulted in a fire that burned for about 15 hours. Two crewmembers were on each train; all four were killed. As a precaution, about 100 Anding residents were evacuated; they did not report any injuries. Property damages exceeded \$9.5 million; clearing and environmental cleanup costs totaled about \$616,800.



Figure 1. Accident location.

¹ Unless otherwise noted, all times in this report are central daylight time.

² *IC* were the initials of the Illinois Central Railroad, which was acquired by the CN in 1999.

Accident Narrative

Preaccident Events

Northbound Train,³ IC 1013 North. The two-person (engineer and conductor) crew of the northbound train, IC 1013 North, reported for duty about 12:30 a.m. on July 10, 2005, at the CN Yard in Jackson, Mississippi. Their train had arrived in Jackson the previous evening from New Orleans, Louisiana. The crew boarded two BNSF Railway Company (BNSF) locomotives that had been detached from the train and placed near the yard office. They moved the locomotives to the engine service facility for fueling. The crew then added two IC locomotives, moved the four units back to the yard, and coupled them to the train. They then set out⁴ a defective car in the yard, and a faulty end-of-train device (EOTD)⁵ was replaced. The crew departed from Jackson about 3:38 a.m. This was a regularly scheduled work trip for the northbound train crew. They normally went on duty between 11:00 p.m. and 1:00 a.m. and operated a train northbound toward Memphis. They would meet and exchange trains with a southbound Memphis crew somewhere near the middle of the 219-mile Yazoo Subdivision, depending on the progress of each train. After the exchange, they would operate the southbound train back to Jackson while the Memphis crew also returned to their originating terminal.

On the morning of the accident, the northbound train crew did not have any cars to set out or pick up en route. Data from the signal system indicated that they passed Cynthia about 3:50 a.m. and Flora about 3:58 a.m. Two witnesses indicated that they heard a train whistle being sounded at the crossing in Flora at the time the northbound train passed. The train passed the south end of Anding siding about 4:11 a.m. Based on elapsed times between control points and at a wayside defect detector, the northbound train was operated at or under allowed average speeds until it approached North Anding.⁶ (See figure 2.)

Signal data recorders indicated that the signal at South Anding displayed *approach* (yellow over red) and required the northbound train crew to approach the next signal (at North Anding) prepared to stop. Data indicated that the northbound signal at North Anding displayed *stop* and the north siding switch was aligned for the opposing southbound train to enter the siding. This signal required the northbound train to stop at North Anding. However, the northbound train continued past the *stop* signal and damaged the North Anding siding switch. Recorded signal data showed that the switch went out of

³ CN designates timetable directions on the Yazoo Subdivision as north and south. Timetable direction may vary from actual compass direction.

⁴ Train crews may *set out* or switch cars to another track for repair or for routing to other destinations.

⁵ The *EOTD* marks the end of a train with a red reflector and flashing light. It also allows the engineer to monitor air brake pressure at the rear of the train.

⁶ Only average speeds are available because the northbound train event recorders were destroyed in the collision and subsequent fire. Average speeds were determined from the train's travel time between CTC signal locations as recorded on signal data loggers.

correspondence⁷ at 4:14:35 a.m. (See appendix B for a time line of events for the northbound train's accident trip.)

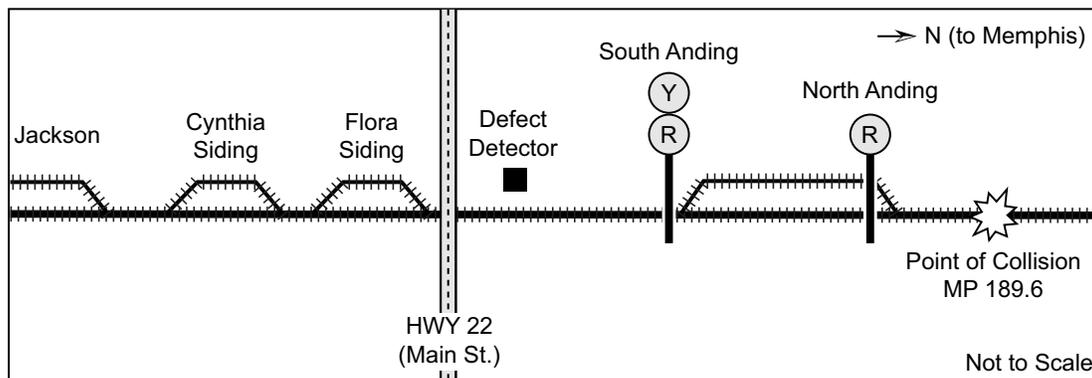


Figure 2. CN railroad: Jackson to accident site.

At the time of the accident, the northbound train consisted of 4 locomotives and 137 cars, including 118 empty cars, 11 loaded cars, and 8 residue⁸ cars. Five of the loaded cars contained hazardous materials. The train weighed 6,511 tons, and its length was 8,461 feet.

Southbound Train, IC 1023 South. The southbound train, IC 1023 South, departed Memphis, Tennessee, about 9:25 p.m. on July 9. The first train crew on board met and exchanged trains with a second train crew in Lambert, Mississippi (146 miles north of Jackson, Mississippi). The second train crew (the southbound accident crew) had begun their tour of duty about 6:45 p.m. in Jackson. The second crew took charge of the southbound train and departed from Lambert on their return trip toward Jackson about 11:30 p.m. The two-person (engineer and conductor) crew stopped in Greenwood, Mississippi, where they performed scheduled work that involved setting out 21 cars and picking up 9 others. They placed the nine cars in front of four hydrogen cyanide (HCN) cars, thereby creating the required “buffer”⁹ for the HCN cars and making them the 10th through 13th cars on the train. After completing this work, the crew continued southbound toward Jackson.

Signal data indicated that about 2 miles in advance of Anding, the southbound train crew encountered an *approach diverging* (yellow over green) signal. The *approach diverging* signal required the southbound train to approach the next signal (North Anding) and enter the siding without exceeding 25 mph. Event recorder data indicated that the

⁷ Not in the commanded position.

⁸ Tank cars last loaded with hazardous materials contain a residual amount of those materials after off-loading and therefore are listed on train consists as “residue: last contained” cars.

⁹ Regulations at 49 *Code of Federal Regulations* 174.85 require that these loaded hazardous materials cars be separated from the locomotives by 5 non-hazardous cars, if train length permits.

southbound train had slowed to 23 mph to enter the siding when the train was placed into emergency braking about 3 to 5 seconds before the collision.

When the collision occurred, the southbound train consisted of 2 locomotives and 107 cars, including 53 loaded cars, 52 empty cars, and 2 residue cars. Fifteen of the loaded cars contained hazardous materials, including four tank cars of HCN, a poison inhalation hazard. The train weighed 8,628 tons, and its length was 6,495 feet.

Collision

About 4:15 a.m., shortly after the northbound train passed the *stop* signal at North Anding, the two trains collided head on about 1/4 mile north of the north siding switch. (See figure 3.) The estimated point of collision was milepost (MP) 189.6 in the community of Anding. Most of this area was undulating agricultural land. The track was relatively straight with occasional curves, one of which was the curve at the accident site. The CN timetable limited freight train speed on this curve to 40 mph.



Figure 3. Aerial view of small portion of accident site.

The track was located in an excavated ravine, and trees restricted the view as trains rounded the curve at the accident site. The southbound train was placed into emergency braking about 3 to 5 seconds before the collision, and it was traveling about 23 mph with the throttle in position 6 (of 8). The event recorders on the northbound train were destroyed because of extensive collision and fire damage to the locomotives. However, signal system data indicated that the northbound train was traveling about 45 mph as it passed the North Anding *stop* signal just before the collision.

Emergency Response and Train Consist Information

The Yazoo City Emergency Services Dispatching Center received a call reporting the collision about 4:24 a.m. and notified the Tri-Community Fire Department. The Bentonla Volunteer Fire Department (BVFD), whose jurisdiction encompasses the community of Anding, was notified about 4:32 a.m. The BVFD chief said that, upon arriving at the accident scene about 4:41 a.m., he realized that a train had derailed and flames had engulfed the area around the locomotives and derailed cars. The BVFD chief took charge as incident commander, and he immediately contacted the Yazoo County dispatcher and requested train consist information. Initial efforts were aimed at rescuing any injured crew and assessing the nature of the fire and commodities involved. The initial approach was suspended and an evacuation of residents was begun when one or more of the residue tank cars began venting¹⁰ about 5:00 a.m. As a precaution, about 100 residents were evacuated.

When the first CN official arrived at the scene about 5:25 a.m., he did not have train consist information. Therefore, initially, he could not provide information about whether hazardous materials were on the trains. The CN official did say that he thought the accident might have been a head-on collision involving two CN trains and four crewmembers, all of whom were unaccounted for. Personnel on scene said that they assumed that the locomotives along with the train consists kept on board by the crew were completely destroyed and consumed by the fire that continued to engulf the locomotives. About 5:40 a.m., the CN official called the CN train dispatcher on a cell phone for the consist information and proceeded to write down the information that was being provided to him for the derailed cars on the northbound train. Before any information on the southbound train was received, cell phone service was disrupted.

The CN official then relayed the information about the northbound train to the fire chief by 5:45 a.m. The chief, having made an earlier request through the county dispatcher, again requested copies of both train consists from the CN official. About 5:50 a.m., the chief said, he instructed emergency response personnel to prepare for search and rescue operations. Neither the fire chief nor the CN official indicated that any further attempts were made to obtain accurate consist information for the southbound train from the CN Homewood Rail Traffic Control (RTC) Center.¹¹

An hour later, about 6:45 a.m., a CN clerk arrived from Jackson, Mississippi,¹² and delivered multiple printed copies of both the northbound and southbound train consists to the incident commander on scene, the BVFD chief. It was not until CN representatives later attempted to create a map of the derailment site that they realized that the derailed cars from the southbound train did not match those listed on the train consist. This prompted CN representatives to take a closer look at both consists, which revealed that

¹⁰ These tank cars were designed to automatically relieve internal pressure buildup by venting through a safety valve. Venting is audibly loud and may produce a visible flare, as occurred in this accident.

¹¹ The CN Homewood RTC Center is located in Homewood, Illinois, which is near Chicago.

¹² It is CN policy that in the event of a major derailment a clerk from CN Transportation hand delivers multiple printed copies of the train consist(s) to the incident commander at the accident scene.

although the northbound consist was accurate, the southbound consist did not reflect the scheduled work (setouts and pickups) completed at Greenwood, which is located north of Anding. In the absence of an accurate consist for the southbound train, attempts were made to identify hazard placards and car stenciling at the accident site. Accurate information on derailed southbound train cars involved in the fire was eventually developed by a site survey of the scene.

By 8:00 a.m., the CN official and emergency responders were able to visually identify the four red and white HCN tank cars¹³ and determine that they had not derailed. Earlier, when preparing to uncouple and remove the cars that had not derailed, CN personnel had placed locomotives next to the last railcar on each of the accident trains. By 8:10 a.m., the HCN tank cars and all of the other cars that did not derail had been pulled away from the wreckage.

Accuracy of Train Consist Information

The train consist information provided for the northbound train was accurate because the train make-up had not changed since the train left Jackson Yard.

The train consist provided for the southbound train was accurate for the train as it departed Memphis, which was its originating terminal. However, it did not reflect changes to the train make-up since the train had departed Memphis. According to the CN yardmaster in Memphis, once the train was assembled, the train consist was generated using car information stored in the CN Homewood RTC Center computer. The train consist listed cars in order from first to last, included applicable hazardous materials information, and identified the cars scheduled to be set out in Greenwood. The yardmaster stated that when the train crew reported for duty, they received a printed copy of the train consist, reviewed it for mistakes, noted the scheduled work to be done at Greenwood, and departed. The train consist remained in the locomotive cab with the crew for the duration of their trip.

When the crew arrived in Greenwood, they performed their scheduled work: setting out 21 cars and picking up 9 others. They then placed the nine cars in front of four HCN cars, thereby moving the HCN cars back to the 10th through 13th positions behind the locomotives.

Before the crew proceeded from Greenwood, they were required to update their train consist to reflect the new positions of hazardous materials cars. Federal regulations at 49 *Code of Federal Regulations* (CFR) 174.26 mandate the following:

The train crew must have a document that reflects the current position in the train of each rail car containing a hazardous material. The train crew must update the document to indicate changes in the placement of a rail car within the train. For example, the train crew may update the document by handwriting on it or by appending or attaching another document to it.

¹³ HCN tank cars are painted white with a red stripe to distinguish them from other tank cars.

The updated consist must be kept in the cab with the crew. Changes to a train consist resulting from setouts and pickups are not typically reported to the CN train dispatcher, and there is no on-board capability for the train crew to make real-time updates to the consist maintained at the CN Homewood RTC Center other than via voice radio or telephone communication. Typically, the only time train consists are electronically updated in the CN computer system is when a train passes by an Automatic Equipment Identification (AEI) reader. AEI readers identify cars on a train by reading identification tags as they pass by, and then they automatically relay information back to the central CN computer. (For more information about AEI readers, see the report section titled “Automatic Equipment Identification.”)

The southbound train had passed two AEI locations between Memphis and Jackson; however, they were both north of Greenwood. The next AEI reader that the southbound train would have passed was south of Anding, beyond the accident location. Consequently, the consist for the southbound train had not been updated electronically after the crew set out and picked up cars at Greenwood.

Fire Suppression Activities

About 8:25 a.m., fire suppression efforts commenced using aqueous film forming foam on the diesel fire. (See figure 4.) After about 25 minutes, the initial supply of foam (approximately 65 gallons) was exhausted, suppression efforts were suspended, and the fire continued to burn. Wreck-clearing equipment began arriving on scene about 9:00 a.m., and an access road was created to move equipment to the accident site. While efforts were made to obtain additional fire-fighting foam, some of the derailed tank cars were rerailed and moved away from the fire. The CN’s contractor, U.S. Environmental Services, began efforts to obtain additional foam. It took until about 4:40 p.m. to obtain enough foam and related equipment to resume fire suppression activities. Fire suppression efforts resumed about 6:00 p.m., and the fire was declared suppressed about 7:40 p.m. (See appendix C for a time line of emergency response events.)



Figure 4. Firefighters applying foam during early evening fire suppression effort.

Injuries

The two crewmembers on the northbound train and the two crewmembers on the southbound train were killed. No Anding residents or emergency responders reported sustaining any injuries.

Damage

During the collision, a total of 6 locomotives and 17 cars were derailed, including 4 locomotives and 8 cars on the northbound train and 2 locomotives and 9 cars on the southbound train. Seven residue tank cars containing hazardous materials were among the cars that derailed. Five of those cars contained a residue of propylene, one contained a residue of isopropylamine, and one contained a residue of carbamate pesticide. One or more of the propylene tank cars vented due to pressure buildup from the extreme heat of the diesel fuel fire that followed the derailment.

CN provided the following cost estimates: \$9,600,000 for equipment (locomotives and cars); \$65,000 for track and signals; \$316,800 for lading and environmental cleanup; and \$300,000 for wreck clearing. Property damage associated with the accident totaled about \$9,665,000. Clearing and environmental cleanup costs totaled about \$616,800.

Personnel Information

Northbound Train Engineer

The northbound train engineer, age 58, was hired in 1969, and he had worked as a locomotive engineer for more than 30 years. Prior to the accident, he had passed his last rules examination on December 30, 2004. His last engineer certification checkride took place on February 12, 2004. His engineer certification card had been issued on December 30, 2004, and it was current at the time of the accident.

Northbound Train Conductor

The northbound train conductor, age 58, was hired in 1968. He was promoted to conductor in 1972. Prior to the accident, he had passed his last rules examination on September 10, 2002.

Southbound Train Engineer

The southbound train engineer, age 53, was hired as a brakeman in 1973. He was promoted to conductor in 1980. He had worked as an engineer for more than 18 years. Prior to the accident, he had passed his last rules examination on March 4, 2005. His last engineer certification checkride took place on November 10, 2004, and his certification was current at the time of the accident.

Southbound Train Conductor

The southbound train conductor, age 23, was hired as a brakeman in 2002. He was qualified as a conductor in 2004. Prior to the accident, he had passed his last rules examination on April 27, 2004.

Work/Rest Cycles

Work/rest information for the northbound crew was developed from CN personnel records and interviews with family members. Information for the southbound crew was developed solely from CN personnel records.

Northbound Train Engineer. On Saturday, July 9, 2005, the northbound train engineer worked from 12:30 a.m. to 11:15 a.m. He returned to his house just before 12:00 p.m. on Saturday, which was a little earlier than usual for him. After arriving home, he took a nap for about 45 minutes, woke up, and then ate lunch. About 2:00 p.m. on Saturday, he and his wife attended a funeral service and returned home about 5:00 p.m. The engineer went to bed about 5:15 p.m., likely falling asleep about 5:20 p.m. He slept until he was called for work about 10:30 p.m. At that time, he woke up, showered, and made caffeinated coffee, which he took with him on his drive (about 45 minutes to 1 hour) to Jackson Yard. According to his son, the engineer called home from the terminal about 12:00 a.m. and spoke with him. The son indicated that the engineer sounded normal during their telephone conversation.

On Friday, July 8, the northbound train engineer arrived home about 1:00 p.m. after being on duty from 12:30 a.m. to 12:15 p.m. He ate a meal, and he and his wife were at a funeral home from 4:30 p.m. to 5:20 p.m. After returning home, he immediately went to bed, likely falling asleep around 5:30 p.m. He slept until he was called for work about 10:30 p.m.

On Thursday, July 7, the northbound train engineer worked from 1:00 a.m. to 12:55 p.m. His routine that day was reported to be similar to those described above. He went to bed about 4:00 p.m., and he slept until he was called for work about 10:30 p.m.

The northbound train engineer typically worked 6 days a week. Monday was his regularly scheduled day off. Most often, he went on duty between 12:00 a.m. and 1:00 a.m., and he was usually on duty for 11 to 12 hours. The engineer had been working this shift schedule for at least a year. When he reported for duty on the accident trip, it was his sixth consecutive day of work. He had worked with the accident conductor on the four previous trips. When the accident occurred, he had been on duty about 3 hours 45 minutes.

Northbound Train Conductor. On Saturday, July 9, 2005, the northbound train conductor had worked from 12:30 a.m. to 11:15 a.m., and he arrived home about 12 p.m. Per his usual routine, he ate dinner about 4:00 p.m., and he was in bed about 5:00 p.m. He likely fell asleep about 5:15 p.m., and he slept until he was called for work about 10:30 p.m. He made decaffeinated coffee before leaving for work. He did not indicate to his wife that he felt tired.

On Friday, July 8, the northbound train conductor arrived home in the early afternoon about 1:00 p.m. after working from 12:30 a.m. to 12:15 p.m. He stayed at home watching television until he ate dinner between 4:30 p.m., and 5:00 p.m. He went to bed

right after dinner and fell asleep sometime between 5:00 p.m. and 5:30 p.m. The conductor slept until he was called for work about 10:30 p.m.

On Thursday, July 7, the northbound train conductor worked from 1:00 a.m. to 12:55 p.m. He then returned home about 1:30 p.m. His off-duty time and sleep schedule on that day were described as “routine.”

The northbound train conductor typically worked 6 days a week. Most often, he went on duty between 12:00 a.m. and 1:00 a.m., and he was usually on duty for 11 to 12 hours. The conductor had been working this shift schedule for at least a year. When he reported for duty on the accident trip, it was his sixth consecutive day of work. He had worked with the accident engineer on the four previous trips. When the accident occurred, he had been on duty about 3 hours 45 minutes.

Southbound Train Engineer. On the 3 days leading up to the accident, the southbound train engineer went on duty between 6:45 p.m. and 8:00 p.m., and he was on duty for 9 1/2 to 12 hours each day. He worked with the southbound accident train conductor on all of those days. During the 2 weeks prior to that, he regularly went on duty at 9:00 a.m. and remained on duty for 11 to 12 hours. When he reported for duty on the accident trip, it was his third consecutive day of work. He had been on duty about 9 hours 30 minutes when the accident occurred.

Southbound Train Conductor. On the 3 days leading up to the accident, the southbound train conductor went on duty between 6:45 p.m. and 8:00 p.m., and he was on duty for 9 1/2 to 12 hours each day. A week before that, the conductor regularly went on duty at 4:45 p.m., and he worked about 10 hours each day. During the week prior to that, he regularly went on duty at 6:45 a.m. and remained on duty for about 10 hours. When he reported for duty on the accident trip, it was his third consecutive day of work. He had been on duty about 9 hours 30 minutes when the accident occurred.

Track and Site Information

The Yazoo Subdivision runs generally in a north-south direction between West Junction, Tennessee, (just outside Memphis) and Jackson, Mississippi, which is a distance of about 219 miles. The rail line through Anding was originally constructed as part of the Yazoo and Mississippi Valley Railroad in 1882. The Illinois Central Railroad later acquired control of the operation, and the CN subsequently acquired the Illinois Central Railroad.

The point of collision was on single main track on a 2.63° right-hand curve (for southbound movement). The track was designated as Class 3 track¹⁴ with a maximum

¹⁴ Railroads determine how they will classify various segments of their track. As the class designation increases, the track must meet increasingly higher Federal standards for construction, maintenance, and inspection. Federal regulation also establishes maximum train speeds for each class of track.

allowable speed of 40 mph for freight trains. The straight (tangent) main track at Anding was designated as Class 4 track with a maximum allowable speed of 60 mph for freight trains. The turnout speed for trains entering or leaving the north end of Anding siding was 25 mph. The apex of a mild 0.5 percent grade was near the north end of Anding siding. When the collision occurred, the northbound train had crested the grade and a portion of the train was traveling down the grade.

Method of Operation

Trains on the Yazoo Subdivision were operated by a CTC signal system. Between South Greenwood and Jackson (Anding is located between these two points), the Yazoo Subdivision was single track with sidings that allowed trains to meet and pass. (See figure 5.) Train movements in the accident area were authorized by wayside CTC color light signals. A train dispatcher at the CN Homewood RTC Center directed train movements on the Yazoo Subdivision by requesting routes. In response to dispatcher requests, the CTC signal system moved switches and displayed signals to crews who in turn were required to operate their trains on the designated routes according to the indications of the color light signals. During a typical 24-hour period close to the date of the accident, there were about 20 to 25 train movements per day on the Yazoo Subdivision. Two of those trains were the northbound and southbound *City of New Orleans* passenger trains that are operated by Amtrak over CN track.



Figure 5. North Anding siding switch viewed from south, facing north (viewpoint of northbound train, IC 1013 North).

Train operations on the Yazoo Subdivision were governed by the *Canadian National/Illinois Central Railroad U.S. Operating Rules* 2nd edition, dated June 2, 2002; CN Central Division Timetable No. 1, dated December 12, 2004; CN U.S. System Special Instruction No. 5, dated December 12, 2004; and various other rules, bulletins, and periodic notices.

Meteorological Information

At the time of the accident, the weather at Hawkins Field (about 24 miles south of Anding) in Jackson, Mississippi, was reported as dry and clear. The temperature was 73° F. No weather-related impediments to visibility were reported at ground level.

Medical and Toxicological Information

The Yazoo County coroner obtained toxicological samples from the conductor and the engineer of the southbound train. The samples were sent to a laboratory approved for such testing by the Federal Railroad Administration (FRA). Results of the tests were negative for drugs. Tests for alcohol were consistent with natural post mortem alcohol production. There was no indication that the southbound train crewmembers had ingested alcohol.

The coroner was unable to recover samples suitable for testing from the northbound train crew.

Information obtained from the medical records maintained by the CN on the deceased southbound train crew indicated that the engineer had passed his last company medical examination on March 4, 2005. The examination records indicated that he wore corrective lenses. The records also showed that he was 5 feet 7 inches tall and weighed 167 pounds.

The southbound train conductor had passed his last company medical examination on May 24, 2004. The examination was required in order for him to serve as a remote control operator. The examination records indicated that he wore prescription glasses. The records also showed that he was 5 feet 6 inches tall and weighed 184 pounds.

Medical records maintained by the CN on the deceased northbound train crew indicated that the engineer had passed his last medical examination on November 9, 2004. The examination records indicated that he was required to wear corrective lenses while operating a train. His records also indicated that he was taking two medications, Atacand and Norvasc, for high blood pressure. The records showed that he was 5 feet 10 inches tall and weighed 268 pounds.

The northbound train engineer's June 2004 medical records from his private physician indicated that he had been taking two medications for high blood pressure for several years: Avapro, 300 mg per day, and Norvasc, 10 mg per day. According to these records, he was not prescribed any other medication.

The northbound train engineer's family told investigators that he was in good health, and was "never sick." They stated that he snored at night when he slept on his back, and stopped snoring when he slept on his side. They also stated that he would fall asleep about 5 minutes after lying down.

The northbound train conductor passed his last company medical examination on June 14, 1999. No exceptions were noted in his records.

The northbound train conductor's medical records from his private physician indicated that his last visit was on March 13, 2005. He was prescribed medication for bronchitis. There was no indication that he had been prescribed medications for any other medical conditions. His family told investigators that he was healthy, that he had not been sick prior to the accident, and that he had not been taking any over-the-counter medications. His family said that he smoked, and according to his medical records, he was a social drinker.

Tests and Research

Signal System

FRA personnel began a postaccident field inspection about 5:00 p.m. on the day of the accident. The FRA inspectors found all the signal units and the signal cases locked and secured at Anding. There was no evidence of tampering with or vandalism to any of the signal equipment. Safety Board investigators joined the field inspection about 7:00 p.m.

Investigators noted damaged rods and wheel marks on the backside switch point at North Anding consistent with the northbound train trailing through¹⁵ a switch that was lined for the southbound train to enter the siding. Inspectors also observed that the switch machine internal locking mechanism was still locked and that the contacts of the circuit controller were centered.

All signal relay positions were found to be in accordance with the physical location of the accident trains, the switch position, and the displayed signal aspects.

Ground tests¹⁶ were performed and the results met Federal standards. Signal cables were meggered¹⁷ at North and South Anding, and all cables tested within acceptable limits

¹⁵ *Trailing through* a switch means traversing a switch not properly lined for that movement.

¹⁶ A *ground test* involves taking a voltage and current reading from the battery bus to ground. Vital signal circuits must operate ground free.

¹⁷ *Meggering* is an insulation resistance test to ensure that there is no electrical leakage to ground.

except for one that read 125,000 ohms. That cable provided the circuit for the green aspect displayed to northbound trains leaving the Anding siding.¹⁸ The cable was replaced.

Cable test records were reviewed. The cables at North and South Anding were tested in August 1994 when they were originally installed. The cables should have been retested in August 2004, but they were not. The FRA issued defect reports to the CN for noncompliance with cable testing requirements.

The signal lamp voltages were measured and one exception was noted. The red aspect displayed to northbound main line trains at North Anding was measured at 7.4 volts. The signal bulbs were rated at 10 volts. Industry standards suggest that lamp voltage should be set at 85 percent of the rated voltage of the lamp for maximum visibility and bulb life. After the accident, the CN increased the lamp voltage for this aspect to 9.0 volts.¹⁹ All the signal aspects tested, including the 7.4-volt lamp at North Anding, were readily visible from an approaching train.

The relay current for the track circuits was checked at both ends of North and South Anding. The current on two relays at South Anding was found to be higher than the industry standard. Federal regulations at 49 CFR 236.8 require that signal relays be maintained in accordance with the limits within which the relay is designed to operate. The FRA issued a defect report to CN for the two relays, and the CN adjusted the currents to the proper level.²⁰

Track connections and insulated joints at both North and South Anding were visually inspected. No exceptions were noted.

Information developed from the signal system data loggers (both at the CN Homewood RTC Center and wayside) was consistent with the physical positions of relays and track switches in the field. The data indicated that for about 22 minutes prior to the accident, the North Anding switch was aligned for the siding, the adjacent northbound signal displayed *stop* (red), and the northbound signal at South Anding displayed *approach* (yellow over red). The data also indicated that the signal for the southbound train at North Anding displayed *diverging approach* (red over yellow) for about 17 minutes prior to the accident.

Signal trouble reports also were reviewed for North and South Anding. There were no reports of any condition that would have resulted in an improper signal indication.

The information from a defect detector located at MP 192.7 (Bentonia) was downloaded for the northbound train. There was no record of a defect being detected on

¹⁸ This signal did not govern the movement of either of the accident trains.

¹⁹ Before the Safety Board's sight-distance observations were conducted, the out-of-tolerance adjustment for the red aspect was adjusted to 7.4 volts in order to simulate as closely as possible the conditions that existed on July 10, 2005. After the observations were conducted, the voltage was properly adjusted.

²⁰ Relay current was also reset before the sight-distance observations in order to simulate the accident conditions. After the observations were conducted, the relay current was restored to the proper level.

the northbound train. The data indicated that the northbound train entered the detector circuit traveling about 41 mph and it exited traveling about 46 mph.

Table 1 contains signal system data about the time it took the northbound train to pass various points using the calculated average speed.²¹

Table 1. Signal data for the northbound train's trip from Jackson to Anding.

Location	Distance	Time	Speed
North Jackson to South Cynthia	24,073 feet	658 seconds	24 mph
South Cynthia to North Cynthia	9,243 feet	110 seconds	57 mph
North Cynthia to South Flora	27,724 feet	321 seconds	58 mph
South Flora to North Flora	10,542 feet	133 seconds	54 mph
Entering milepost 192.7 detector			41 mph
Exiting milepost 192.7 detector			46 mph
North Flora to South Anding	63,291 feet	844 seconds	46 mph
South Anding to North Anding	9,571 feet	143 seconds	46 mph
North Anding signal to switch	400 feet	6 seconds	45 mph

Track

Investigators conducted a track inspection on both sides of the collision area. The siding switch at North Anding previously had been aligned for a movement into the siding. The left-hand switch point had wheel markings on the backside indicating that wheels had damaged the points, forcing them over. Investigators also noted that the various rods connected to the switch points were damaged. Other than the damage to the track at the point of collision, no other track defects were noted.

Mechanical Tests and Inspections

Both trains were given airbrake tests prior to departing their originating terminals. No defects were noted on the southbound train. During the airbrake test conducted on the northbound train, a communications link could not be established between the leading BNSF locomotive and the EOTD. The train was authorized to proceed with an inoperative EOTD, and a 30-mph speed restriction was imposed. No other exceptions were noted during the predeparture airbrake tests conducted on the northbound train in New Orleans.

A second defect on the northbound train developed between New Orleans and Jackson and was discovered when the train tripped a wayside defect detector. One of the cars was found to have sticking brakes, and they were deactivated on that car. The accident crew later set out that car after they took charge of the train in Jackson. Two IC locomotives were added, and the EOTD was changed in Jackson. A communications link was established with the replacement EOTD, and an airbrake test was conducted in Jackson with no exceptions noted.

²¹ Average speed is less precise for shorter distances, such as between the signal and the switch.

The portion of the northbound train that did not derail was inspected on July 11, 2005, and ineffective air brakes were noted on five nonconsecutive cars.²² The portion of the southbound train that did not derail also was inspected, and ineffective air brakes were noted on four nonconsecutive cars. Because of extensive collision and fire damage, the air brakes could not be tested on the derailed cars from either train.

Maintenance and inspection records for all locomotives were obtained from the CN. The IC 1013, the lead locomotive on the northbound train, was last inspected on July 9, 2005, before it departed from Jackson. No exceptions were noted, and the condition of the brake system was listed as “good.” Work orders indicated that the IC 1013 exhaust system had been inspected for leaks on July 6, 2005, in Woodcrest, Illinois, with no exceptions noted.

The IC 1023, the lead locomotive on the southbound train, was last inspected on July 9, 2005, before it departed from Memphis. No exceptions were noted. The IC 1023 had been in the shop for repairs in Memphis on July 8, 2005, and work orders indicated that all the repairs were completed on that day. The condition of the brake system was listed as “good.” Work orders also indicated that the exhaust system had been inspected for leaks with no exceptions noted.

The engineers who most recently had operated both trains prior to the accident were contacted, and they reported no exceptions to the condition or operation of the locomotives. Locomotive engineer trouble reports and other maintenance records did not contain any reports of exhaust leaks or any other problems that would have compromised the air quality in either operating cab.

Event Recorders

The primary fuel for the postcollision fire was diesel and lube oil. The fire was extremely intense, and it burned for about 15 hours. About 8 hours after it was suppressed, the temperature of some locomotive components measured nearly 400° C. Melted aluminum and copper components also were found in the wreckage. (See figure 6.) According to the *Handbook of Chemistry and Physics*,²³ the melting point of copper is 1084° C, which is higher than the melting point for aluminum or aluminum alloys. According to CN records, all six locomotives involved in the collision were equipped with event recorders. The substantial collision damage and subsequent fire destroyed all but one.

No event recorders were recovered from the northbound train, nor could any remnants of event recorder wreckage be identified due to the extensive damage from the intense, prolonged fire. A Pulse Electronics²⁴ Train Trax solid-state type event recorder was recovered from IC 1014, the trailing locomotive unit on the southbound train. It was shipped to the NTSB Vehicle Recorder Division Laboratory in Washington, D.C. Event

²² FRA regulations allow up to 15 percent of airbrakes on freight trains to be nonoperational between terminals.

²³ D.R. Lide, ed., *Handbook of Chemistry and Physics*, 82nd ed. (Boca Raton, FL: CRC Press, 2001).

²⁴ *Pulse Electronics* is now known as Wabtec Railway Electronics.

recorder data were downloaded using the Safety Board's data analysis software. The data were verified for accuracy by examining previously recorded operating characteristics of the locomotives. The data were consistent with and within the operating range and limitations of the locomotive. The data showed a number of throttle position changes on the southbound train during the 10 minutes preceding the collision.



Figure 6. Melted aluminum (top) and copper (bottom) recovered from IC 1013 locomotive on northbound train.

The event recorder recovered from IC 1014 and the other event recorders destroyed in the accident were manufactured before the FRA issued its October 1, 2005, final rule²⁵ regarding event recorder crash and fire protection standards. The nature of this accident reinforces the need to equip locomotives with crashworthy event recorders designed to protect the recorded information from impact damage and fire.

Sight-Distance Observations

Sight-distance observations were conducted on July 14, 2005, to approximate the conditions that the crews experienced prior to the collision. The observations were conducted using locomotives similar to those involved in the accident. The time of day and the weather and lighting conditions during the observations also were similar to those reported at the time of the accident. Some elements of the accident sequence could not be duplicated, specifically any unusual conditions that may have occurred within the operating cabs. Investigators noted some light haze when the sight-distance observations were made.

²⁵ This is the date of the FRA final rule on event recorders. Compliance dates for the installation or manufacture of event recorders meeting these standards vary significantly. See 49 CFR 229 for more information.

Investigators determined that the signal at the South Anding siding displaying *approach* was visible from an approaching northbound locomotive on the main track for about 6,900 feet. Based on the 46-mph measured speed of the northbound accident train at the MP 192.7 defect detector, the northbound crew would have had more than 100 seconds to recognize and react to the *approach* signal.

The signal at North Anding displaying *stop* was visible from an approaching northbound locomotive on the main track for about 5,822 feet in the conductor's position and for about 3,122 feet in the engineer's position. The difference in sight distance was due to maintenance-of-way equipment stored on a spur track parallel to the main track.²⁶ The same equipment also had been stored on the spur track at the time of the accident. Based on the average speed of the northbound train, the crew would have had about 88 seconds from the conductor's vantage point and about 47 seconds from the engineer's vantage point to recognize and react to the *stop* signal.

As the sight-distance testing continued, both observation locomotives were stopped at the point of collision, MP 189.6, and backed away from each other in increments until observers on each locomotive lost sight of the other locomotive, which occurred when they were 652 feet apart. The sight-distance observations and the event recorder and signal system speed data indicated that the crewmembers on both trains would have had about 6 seconds to recognize the impending collision. However, investigators noted that emergency response and wreck-clearing activities had resulted in trees and other vegetation around the point of collision being substantially cut back. As a result, the sight-distances in the actual accident sequence were less than those observed by investigators.

Radio Broadcast Test

While the sight-distance observation locomotives were en route to the accident site from Jackson, a radio reception test was conducted to determine if there was an audible cue available to the northbound train crew signifying the location of the southbound train. On the day of the accident, the southbound accident train had activated an equipment detector radio broadcast at MP 177.6. During the test, the detector radio broadcast was triggered five times. The broadcasts were not detected on the northbound test locomotives.

Use of Cellular Phones by Operating Crews

The Safety Board obtained records of cellular telephone activity for the numbers belonging to the crewmembers on each of the trains involved in the collision. The last telephone call before the collision listed for the phones belonging to the northbound crew was received at 3:18 a.m. This was prior to the train's departure from Jackson. The Memphis engineer, who was to exchange trains with the northbound crew, placed the call. He was interviewed and stated that he called to get an idea of the northbound crew's

²⁶ Railroad operating rules require whichever crewmember observes a signal first to call out the indication to the other.

progress. He said that the conductor answered his call to the engineer's phone and that the engineer was probably busy operating the locomotive to set out a defective car to a yard track. A short conversation ensued, and the Memphis engineer said he did not notice anything unusual about the conductor's voice or statements.

Interviews with family members of the northbound train conductor and engineer provided information about the hours those crewmembers were sleeping before reporting for duty on the morning of the accident. Safety Board investigators reviewed the records of calls made and received from those crewmembers' cellular telephones and did not find any call activity during the time those crewmembers were reported as sleeping prior to reporting for duty.

Management Oversight

Operational Testing Program

Operational testing²⁷ is one of the methods used to monitor the effectiveness of, and compliance with, the operating rules. The Federal Railroad Safety Act of 1970 requires that railroads have a program of operational tests and inspections. Regulations at 49 CFR 217.9 (a) require that a railroad

conduct operational tests and inspections to determine the extent of compliance with its code of operating rules, timetables, and timetable special instructions in accordance with a written program retained at its system headquarters and at the division headquarters for each division where the tests are conducted.

The FRA enforces these regulations, and the CN operational testing program was submitted and was in compliance with the requirements.

CN Operational Testing of Personnel

Northbound Train Engineer and Conductor. Between March 1 and June 29, 2005, the engineer and the conductor of the northbound train both completed 25 CN operational tests. They were working together when all of the tests were conducted. Eleven tests were related to rules requiring that a critical stop be made, and 14 were related to miscellaneous operating rules. The engineer and the conductor passed all of the tests.

Southbound Train Engineer. Between April 17 and June 29, 2005, the engineer of the southbound train completed 15 CN operational tests. Five tests were related to rules requiring that a critical stop be made, and 10 tests were related to miscellaneous operating rules. The engineer passed all of the tests.

²⁷ *Operational testing* involves management observations of employees, as well as structured scenarios, to verify that rules and procedures are followed.

Southbound Train Conductor. There were no operational test records for the southbound conductor.

Other Information

Locomotive Alerters

Neither lead locomotive involved in the Anding collision was equipped with an alerter.²⁸ There is no FRA regulation requiring that freight locomotives be equipped with alerters. However, there is an FRA regulation requiring that passenger locomotives be so equipped, except when they are operated on tracks controlled by cab signals, automatic train control, or automatic train stop.

The CN operates a U.S. fleet of about 680 locomotives. The CN reported that at the time of the accident, about 295 locomotives (43 percent) in its U.S. fleet were equipped with alerters. Transport Canada²⁹ rules require that all leading locomotives (on both freight and passenger trains) operated in Canada be equipped with alerters.³⁰

CN officials informed the Safety Board that the original CN locomotives were equipped with alerters. However, the IC and the Wisconsin Central locomotives were not so equipped when the CN acquired those railroads and have not been since. At the time of the accident, there were about 286 former IC locomotives in the U.S. fleet, primarily being operated between New Orleans and Memphis. CN officials told Safety Board investigators that they had no plans to retrofit locomotives in their U.S. fleet that are not equipped with alerters. However, they said that it was CN policy to equip all new locomotives with alerters and to remove older locomotives without alerters as the new locomotives are placed in service.

Automatic Equipment Identification

AEI is a system that is widely used on North American railroads. Passive coded tags are mounted on the sides of rail transportation equipment.³¹ Active trackside AEI readers use reflected energy to identify equipment as it passes by. All freight cars operating in interchange service are required to have an AEI coded tag mounted on each side. The information scanned by a reader is automatically directed to the railroad's

²⁸ An *alerter* is a device that monitors the control inputs or other responses by the engineer. If no inputs are received during a preset time period, the alerter sounds an alarm. The timer is speed dependent so that at higher speeds, the time periods between alarms are shorter. If no response is received during a preset time after the alarm, the alerter causes the train brakes to automatically apply.

²⁹ *Transport Canada* is the government agency that regulates railroads in Canada.

³⁰ According Canadian Railway Locomotive Inspection and Safety Rules (revised September 21, 2002) "Controlling, locomotives must be equipped with a safety control system which shall, as a minimum, initiate a full service brake application and remove all tractive effort in the event that the person operating the locomotive becomes inattentive or incapacitated."

³¹ Including locomotives, railcars, intermodal vehicles, and EOTDs.

mainframe computer where it either automatically updates the train consist or is verified by an employee and then updated. Requirements for AEI systems are published in the Association of American Railroads' (AAR's) "Standard for Automatic Equipment Identification (S-918)."³²

Although North American Class I railroads have AEI readers installed along their tracks, there are no published requirements or standards regarding the placement of the readers. Railroads primarily locate the readers based on operational needs. AEI readers are typically installed within 5 to 15 miles of the entry and exit points of most major terminals, many secondary terminals, at interchanges, and at other strategic locations along the tracks.

A railroad is not required to have a specific number of AEI readers. Currently, North American Class I³³ railroads privately maintain hundreds of AEI readers on their networks, and additional readers are continually being installed. Aside from receiving information from these readers, some carriers are also able to receive information from select other railroads' AEI readers.

The majority of short line and regional railroads (Class II and Class III) do not install AEI readers alongside their tracks; however, their equipment must be tagged if operating in interchange service. An American Short Line and Regional Railroad Association representative told the Safety Board that although these railroads could benefit from AEI readers, most do not have the capital needed to purchase them.

On-Board Train Consist Reporting

Two major railroads, Union Pacific Railroad and Norfolk Southern Railway, experimented with on-board computers to update consists but reportedly found them to be cumbersome or ineffective and discontinued their use. Other major railroads have never experimented with or used on-board computers to update train consists. According to the AAR, many railroads rely upon AEI systems for updating consists while trains are en route. Currently, the Safety Board understands that the BNSF and CSX Transportation (CSX) are the only Class I railroads that use some type of additional electronic system to more promptly revise and update consists en route.

According to the BNSF, it electronically updates train consist information via a Voice Train Reporting system. Voice Train Reporting was implemented systemwide in June 2003. Train crews report setouts and pickups to an Interactive Voice Response unit via cellular phone or radio. The Interactive Voice Response unit uses voice recognition to provide real-time updates within the BNSF communications network in as few as 8 seconds.

³² AAR, "Standard for Automatic Equipment Identification (S-918)," *AAR Manual of Standards and Recommended Practices* (Washington, DC: The Association of American Railroads, 2003).

³³ According to the AAR, there are seven major railroads in the United States that meet the Class I criteria. Freight railroads in the United States are classified by the AAR as Class I, Class II, and Class III based on size.

The CSX informed the Safety Board about the use of its on-board electronic reporting system by local train crews³⁴ who routinely stop to pick up and set out cars from trains. The CSX system employs portable handheld cellular devices that transmit consist information from the train to a system computer. After completing a scheduled work activity, the conductor on a local train enters information, such as the freight car number, MP, and code indicating the type of work performed (for example, a setout or pickup), into the handheld device and then transmits the data to a system computer. If there is no cellular coverage in a specific area, the updated information is stored in the device and later transmitted electronically at the crew's off-duty station. When the updated information has been successfully transmitted, the conductor receives electronic confirmation.

According to the CSX, its through train crews³⁵ do not use the electronic reporting system because about 70 percent of them do not stop to pick up or set out cars en route. The remaining 30 percent of the through train crews make only about one work-related stop per work trip. In those instances, the CSX requires the train crew to make the necessary handwritten changes on the consist after completing the setouts and/or pickups. The crew must also call and relay the consist changes to the dispatcher.

The CSX also indicated that new on-board reporting systems are in the design phase and under consideration for possible incorporation into a positive train control system. Norfolk Southern Railway also has stated that it is developing an on-board device to report electronic data.

An American Short Line and Regional Railroad Association representative indicated that the majority of the 549 Class II and Class III railroads operating in the United States do not use on-board systems to update train consists because of the expense.

Hazardous Materials Information Programs

Beginning in 2005, the CSX and the CHEMical TRansportation Emergency Center (CHEMTREC[®]) began a joint effort to improve the availability of hazardous materials information to emergency responders in the event of an accident on the 21,000-mile CSX network. At its operations center, the CSX maintains a secure, web-based Network Operations Workstation that graphically identifies the location of CSX trains traveling on its railroad, the position of railcars within the train, and their contents. The partnership provides CHEMTREC[®] direct access to the Network Operations Workstation, enabling CHEMTREC[®] personnel to quickly identify hazardous materials involvement and retrieve and relay relevant information, including material safety data sheets, to emergency responders.

In September 2006, the FRA launched a pilot program, the FreightScope[™] HAZMAT System (FreightScope[™]), to enhance situational awareness during national emergencies through the availability of timely and accurate information about the location

³⁴ *Local train crews* typically work out from and back to one terminal, usually picking up and setting out cars at multiple points during a trip.

³⁵ *Through train crews* typically operate between terminals with few, if any, setouts or pickups.

and types of hazardous materials shipments traveling by North American short line and regional railroads. FreightScope™ is a centralized information system maintained by the Railinc Corporation that contains near real-time data about thousands of hazardous materials shipments handled by Class II and Class III railroads each day. This system does not include data about shipments on Class I railroads. FreightScope™ may be accessed only by the FRA, the Transportation Security Administration, or other approved parties.

Another goal of FreightScope™ is to improve the availability of emergency response information to local emergency responders. The system includes an On-Demand Equipment Lookup function in which entering any car initial and number retrieves the current location, date and time, proper shipping name, and handling railroad of the hazardous materials shipment. Since December 2006, CHEMTREC® has had complete access to the On-Demand Equipment Lookup function, which has allowed emergency responders to contact CHEMTREC® and request identifying information on any railcar involved in an accident.

Emergency Planning and Preparedness

Overview. The Safety Board has investigated a number of rail accidents in which the coordination of response efforts between the railroads and local communities needed improvement, most recently in Texarkana, Arkansas.³⁶ The issue surrounding the lack of a timely delivery of accurate train consist information that emerged after the accident in Anding has also been a recurring problem. The Board has long advocated joint drills and exercises between the railroads and local communities as measures to improve their respective emergency response efforts.³⁷ Therefore, the Board examined the emergency planning and preparedness practices of local communities and railroads and the oversight role of the Federal Government and the States.

Local emergency planning and preparedness are the responsibilities of the individual localities, with the overall management and quality control function falling under the authority of the States, Territories, or Indian Tribes. The Federal Government is limited to providing guidance to these entities on the overall structure and organization of hazardous materials emergency plans and helping to improve the quality of training provided by local emergency planning committees (LEPCs).³⁸ Federal support is provided through the Hazardous Materials and Emergency Preparedness (HMEP) grant program, which is administered by the Pipeline and Hazardous Materials Safety Administration (PHMSA) within the U.S. Department of Transportation (DOT).³⁹ Under the HMEP

³⁶ National Transportation Safety Board, *Collision of Two Union Pacific Railroad Freight Trains, Texarkana, Arkansas, October 15, 2005*, Railroad Accident Brief NTSB/RAB-06/04 (Washington, DC: NTSB, 2006).

³⁷ According to the CN, from 2003 through 2006, the CN participated in 256 tabletop exercises or mock disaster drills within the United States. Of this number, 55 were conducted in Mississippi and 2 of those exercises and/or drills took place in Yazoo City.

³⁸ LEPCs and State emergency planning committees were established under the provisions of the 1986 Emergency Planning and Community Right-to-Know Act. The purpose of this act was to ensure that communities throughout the United States were informed of the risks from chemicals manufactured, stored, or transported within them.

program, PHMSA awards grants to cities and municipalities for the purposes of developing and implementing hazardous materials emergency plans and hosting training. The LEPCs ultimately use this money to develop site-specific hazardous materials emergency plans for their localities and to organize training exercises in their communities.

Railroads are required to comply with the emergency planning regulations found at 29 CFR 1910.120 that were issued by the Occupational Safety and Health Administration (OSHA). Additionally, the AAR has collaborated with the seven Class I railroads to develop the general organizational structure and subject matter for the railroads' hazardous materials emergency response plans. The FRA has no responsibilities or oversight for these plans.

Under existing policies and procedures, there is no formal system or mechanism to ensure that local communities and railroads jointly preplan and coordinate with respect to hazardous materials emergency response.

Federal Role and Oversight. The National Response Team (NRT) through its subcommittees currently serves as the coordinating Federal body providing technical assistance to the States and local communities. (See figure 7.) The subcommittees of the NRT comprised representatives from numerous Federal departments and agencies, including PHMSA-DOT, OSHA, the Environmental Protection Agency, the Federal Emergency Management Agency (FEMA), the U.S. Department of Energy, and the U.S. Coast Guard. The NRT is organized into several standing committees that develop and implement emergency planning policies.

The NRT Preparedness Committee developed the criteria used for assessing State and local emergency preparedness, including areas such as hazard analysis and authority, organizational structure, communications, resources, and emergency planning. The Training and Curriculum Subcommittee of the Preparedness Committee is responsible for the coordination of the HMEP grant program and is divided into working groups that deal specifically with grant formulation, monitoring, technical assistance, and curriculum development. The HMEP interagency coordination is ultimately accomplished through this subcommittee, which is chaired by PHMSA. PHMSA is also required to develop and update a curriculum for training public sector employees to respond to hazardous materials emergencies and for planning such responses.

³⁹ Under the Hazardous Materials Transportation Uniform Safety Act of 1990, the HMEP grants program was established “to provide financial and technical assistance, national direction, and guidance to enhance State and local hazardous materials emergency planning and training.” The intent of the HMEP program is to provide a hazardous materials transportation perspective to communities implementing the 1986 Emergency Planning and Community Right-to-Know Act.

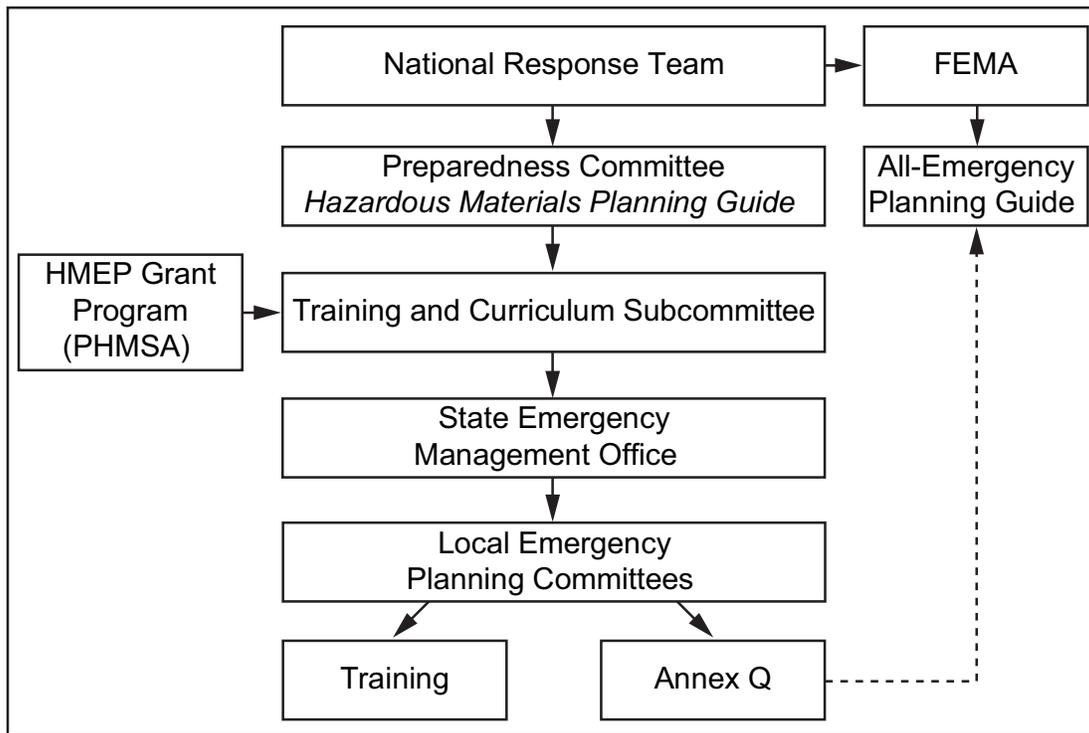


Figure 7. Emergency planning flowchart.

The HMEP grant funds are appropriated by Congress, but they are offset through registration fees paid to the DOT by shippers and carriers of certain hazardous materials. PHMSA and its interagency partners on the Training and Curriculum Subcommittee⁴⁰ developed allocation formulas for awarding planning and training grants to States, Territories, and Indian Tribes based on population size and other risk-related factors. The HMEP funds are distributed through the State emergency management offices to various LEPCs. Approximately 40 percent of funds awarded are for planning and 60 percent are for training. Since 1993, PHMSA has awarded every State, the District of Columbia, and several Territories and Indian Tribes planning and allocation grants totaling \$125 million to train 1.8 million hazardous materials responders, prepare 41,344 emergency plans, conduct 9,252 emergency response exercises, and assist 18,907 LEPCs. PHMSA is currently proposing to increase the registration fee in order to fund the HMEP grant program to \$28 million annually.

The HMEP program provides grantees considerable flexibility in selecting eligible funding activities, and in reporting their planning, training, and grant use data. This flexibility is intended to allow grantees to focus on planning and training activities that best suit their needs, while minimizing the resources spent on reporting. Awarding of grants is not conditional upon the States or local communities conducting joint training or drills with transporters and shippers of hazardous materials in their geographical areas.

⁴⁰ OSHA, FEMA, the U.S. Department of Energy, the U.S. Environmental Protection Agency, the National Response Center, and the U.S. Department of Health and Human Services.

However, in 2005, the Office of Management and Budget (OMB) conducted a review of the HMEP program, which revealed that some States were not meeting the HMEP program goals mainly because there were no formal requirements in place for them to address, nor were they required to track their progress toward program goals. Further, the OMB found that the HMEP program lacked regular independent evaluations of sufficient scope to evaluate the program's effectiveness.

State and Local Emergency Planning. The State emergency planning committee normally serves as the coordinating body for the LEPCs within the State and works with the State emergency management office to direct the HMEP funds to individual LEPCs.

States typically require their counties and municipalities to develop their own specific hazardous materials plans. All hazardous materials emergency plans developed under the HMEP grant program by the LEPCs are done so in accordance with the *Hazardous Materials Planning Guide*, the NRT-1. The NRT-1 is published by the NRT and provides guidance on the organization, content, and scope of a local emergency hazardous materials response plan. The NRT-1 is used by local communities in developing plans unique to their location.

The local hazardous materials emergency response plans are usually designated as "Annex Q" to the local overall emergency plan, which addresses emergencies of any nature. Annex Q addresses the identification of official responsibility for incident notification, response command, evacuation management, the regular updating of this information, and the establishment of training requirements for local response officials. Annex Q also includes requirements for the postaccident review of major hazardous materials or oil spill response operations, exercise plans, commodity flow studies, training, and other vital hazardous materials response information. Ultimately, the local jurisdiction of the county or municipality determines how well its plan performs on the basis of drills and postaccident critiques.

Emergency Planning by Major Railroads. Currently, railroads are subject to OSHA regulations found at 29 CFR 1910.120 that require an employer, including a railroad, to develop an emergency response plan and specific procedures for handling hazardous materials incidents. The emergency response plan mandated by 29 CFR 1910.120 must address the following areas of concern:

- (1) pre-emergency planning and coordination with outside parties, (2) personnel roles, lines of authority, training, and communication, (3) emergency recognition and prevention, (4) safe distances and places of refuge, (5) site security and control, (6) evacuation routes and procedures, (7) decontamination, (8) emergency medical treatment and first aid, (9) emergency alerting and response procedures, (10) critiques of response and follow-up, and (11) personal protective equipment and emergency equipment.

Appendix C of 29 CFR 1910.120 states that each employer "should assure" that its emergency plan is compatible with the local plan. Appendix C then states that the NRT-1 is the major reference used to aid in developing State and local hazardous materials

emergency response plans. Section 1910.120, however, does not provide information about how employers should implement such emergency response plans, evaluate the effectiveness of the plans, or coordinate efforts with outside parties.

Although OSHA does require that an emergency plan be established, it does not examine, review, or maintain file copies of an employer's emergency response plans. OSHA representatives advised Safety Board investigators that OSHA expects railroads and other employers to conduct their own internal reviews for compliance with these requirements.

Postaccident Actions

Since the accident, the CN reported that it has taken a number of actions to improve emergency response to similar incidents. The CN has revised its *Incident Command Logbook* to provide a centralized process for tracking and documenting actions, such as meetings, response activities, and information requests during emergencies. The CN also has equipped 10 mobile offices that can be quickly moved to an incident site with technology allowing a direct link to CN information systems and providing, among other things, the ability to print train consists. The CN has increased its emergency responder training for the Jackson area and the surrounding counties to a quarterly schedule, with additional training provided on request. The CN also has established a "foam bank" capability by using a contractor who maintains 200-gallon containers of aqueous film forming foam, 100-gallon containers of high expansion foam, and application equipment in the Jackson area. The foam and application equipment can be moved to an incident at any point on the CN rail system from Fulton, Kentucky, south to New Orleans, Louisiana. The CN also will make the foam and equipment available to local agencies for response to non-CN incidents on a usage replacement basis. The CN is currently assessing its capability to provide foam to ensure that it has proper coverage levels across its rail system.

Analysis

Exclusions

The track, the signal system, the locomotives, and the railcars were inspected and tested to the extent possible. No defects that would have caused or contributed to the collision were identified. Further, both trains had received initial terminal airbrake inspections prior to the accident, and no discrepancies were noted. Neither crew reported any problems with its trains. Signal system data indicated that the signals were functioning properly at the time of the collision.

The weather was dry, and no visibility problems were reported at ground level.

The coroner provided specimens taken from the deceased southbound train engineer and conductor. All of the test results were negative for drugs and ingested alcohol. The coroner was unable to obtain toxicological samples from either northbound train crewmember. However, Safety Board investigators interviewed several individuals who spoke with the northbound train crew before they departed from Jackson, and none of them reported that the crew had exhibited any signs that they were unfit for duty.

The Safety Board concludes that the following were not factors in the accident: the condition of the track, the locomotives, or the railcars; the weather; or the signal system.

Train Dispatch

Data from the CN Homewood Rail Traffic Control (RTC) Center indicated that the routing signals (holding the northbound train on the main track for the southbound train to enter Anding siding) had been displayed well before the northbound train encountered the *approach* signal at South Anding. Setting up and executing such a meet between trains using the centralized traffic control signal system was a routine event for dispatchers and train crews.

Southbound Train Crew's Actions

Data from the single surviving event recorder and from the signal system data recorders indicated that the southbound train crew had reduced their train's speed to 23 mph. This speed fell just below the siding entry speed of 25 mph, and it was consistent with the requirements of the last signal they had passed. The Safety Board concludes that the actions of the southbound train crew were appropriate and did not contribute to the accident.

Northbound Train Crew's Actions

Based on Safety Board interviews with CN personnel, the northbound train engineer and conductor were considered to be well qualified and competent by their supervisors and peers. They had experience operating CN trains on the Yazoo Subdivision, and they were properly qualified for their positions in accordance with CN standards. Persons who observed or spoke to them on the morning of the accident did not report anything unusual. Other than setting out a defective car in the yard before departure, their trip was apparently routine until they approached Anding.

Because all of the event recorders on the northbound train were destroyed, many details of the crew's operation of the train leading up to the accident could not be reconstructed. However, signal system data did not indicate any abnormalities in the train operation until it approached Anding. Two witnesses reported that the train whistle was sounded for a grade crossing in Flora, about 15 minutes before the accident, indicating that at least one crewmember was active at that time.

As the northbound train approached South Anding traveling about 45 mph, the crew should have been able to see the *approach* signal and would have had ample time to slow the train on the main track and be prepared to stop at the next signal. An appropriate response would have been to reduce throttle and let the upgrade slow the train in anticipation of the North Anding main track signal displaying *stop*. Based on signal data, the northbound train's average speed between South and North Anding shows no indication that the train slowed or that the brakes were applied. The Safety Board could find no reason why the train's brakes would not have stopped the train had they been applied normally. The Safety Board concludes that had the northbound train crew observed and responded appropriately to the *approach* and *stop* signals on the main track at Anding, the accident would not have occurred.

The Safety Board examined the work/rest cycles of the northbound train crew based on CN records and interviews with family members. Both the engineer and the conductor had worked about 11 1/2 hours per night and had been only sleeping about 5 1/2 hours per night for at least the 3 days immediately before the accident. A regularly deficient amount of sleep can impair human performance and alertness. These short sleep periods likely led to the northbound train crew developing a cumulative sleep loss, or sleep debt. Sleep debt occurs when an individual does not obtain sufficient restorative sleep over time.⁴¹ According to one prominent sleep researcher, the tendency of an individual to fall asleep increases progressively in direct proportion to the increase in the sleep debt.⁴²

People are naturally adapted to a circadian rhythm of daytime wakefulness and nighttime sleepiness. Consequently, the time at which the Anding collision occurred, 4:15 a.m., is normally approaching the circadian low in a person's level of alertness. However, people can adapt to other shift work schedules. It takes about a week for the circadian system

⁴¹ W.C. Dement, *The Sleepwatchers*, 2nd ed. (Menlo Park, CA: Nychthemeron Press, 1996).

⁴² Dement, 1996.

to realign to a different schedule.⁴³ The northbound train crew had been working a regular third shift assignment for the past several months. Therefore, it is reasonable to assume that their circadian systems had adapted to their schedule and circadian factors were not an issue.

Irrespective of circadian rhythm issues, the literature⁴⁴ cites several other factors associated with shift work that are likely to cause problems coping with the third shift. At least five of those factors apply to the northbound train crew:

1. Working more than five third shifts in a row without off-time days (*The northbound train crew was working their sixth third shift in a row.*)
2. Working more than four 12-hour night shifts in a row (*The northbound train crew's last four shifts averaged about 11 1/2 hours each.*)
3. Having less than 48 hours of time off after a run of third-shift work (*The northbound train crew typically received 1 day off after 6 successive days of third-shift work.*)
4. Working 12-hour shifts involving critical monitoring tasks (*The northbound train crew's tasks required constant monitoring for signals, broken rail, misaligned switches, etc.*)
5. Working shifts without appropriate shift breaks (*The only "break" the northbound train crew typically received was when they exchanged their northbound train for the southbound train to make the work trip back home.*)

The foregoing factors also indicate that the northbound train crew's alertness may have been diminished by fatigue due to their arduous nighttime work schedule.

The Safety Board previously addressed train crew work scheduling issues in its investigation of the June 28, 2004, accident in Macdona, Texas. As a result of that investigation, the Board made the following recommendation to the Federal Railroad Administration (FRA).⁴⁵

R-06-14

Require railroads to use scientifically based principles when assigning work schedules for train crewmembers, which consider factors that impact sleep needs, to reduce the effects of fatigue.

⁴³ T.H. Monk, "Shift Work: Basic Principles," eds. M.H. Kryger, T. Roth, and W.C. Dement, *Principles and Practice of Sleep Medicine* (Philadelphia, PA: Elsevier Sanders, 2005) 674.

⁴⁴ D.I. Tepas and T.H. Monk, "Work Schedules." ed. G. Salvendy, *Handbook of Human Factors* (New York, NY: John Wiley and Sons, 1987) 819-843.

⁴⁵ As a result of the Macdona accident investigation, the Safety Board also issued Safety Recommendation R-06-16 to UP and Safety Recommendation R-06-17 to the Brotherhood of Locomotive Engineers and Trainmen and the United Transportation Union.

In an October 24, 2006, letter, the FRA responded to the Safety Board by pointing out that although it supports the recommendation, it currently lacks the statutory authority to implement it. The Board is currently reviewing the FRA's response. On February 14, 2007, the FRA offered proposed legislation that would give it the authority to regulate railroad worker hours of service. The FRA and the Board agree that Congress should give the FRA the authority to regulate hours of service.

Despite the five indications of fatigue discussed above, investigators could not rule out the possibility that other factors might also have played a role in this accident. The Safety Board has determined in previous accidents that crewmembers were inattentive to the wayside signals due to human factors other than fatigue, including distraction. In its investigation of a commuter train and passenger train collision near Silver Spring, Maryland,⁴⁶ the Board noted that a conversation between the engineer and conductor likely occurred in the cab control car, which "creates a potential for distraction and interference with the engineer's retention of information, in this case the signal information." The Board determined that the probable cause of the accident was the apparent failure of the engineer and train crew to operate their train according to signal indications due to multiple distractions. Similarly, an engineer and conductor operating a freight train in Placentia, California,⁴⁷ failed to observe a wayside signal and collided with a commuter train. Considering the crewmembers' statements to investigators, the Board found that the engineer and conductor were focusing attention on their conversation rather than on the signals governing the operation of their train.

Unfortunately, the northbound train crew was killed, and the inability to obtain autopsies or toxicological specimens limited the evaluation of medical factors in the Anding accident. Crewmember statements are not available to help reveal what transpired in the locomotive cab during the minutes preceding the collision. The Safety Board concludes that the northbound train crew's attention to the wayside signals was most likely reduced by fatigue; however, without a locomotive cab voice recorder or the availability of other supporting evidence, it cannot be determined whether distraction or some other factor also contributed to the crew's failure to comply with the signals.

Positive Train Control

For more than 30 years, the Safety Board has investigated train collisions that could have been prevented through the deployment of a positive train control (PTC) system. Over the years, the Board has issued a series of relevant recommendations and PTC has remained on the Board's Most Wanted Transportation Safety Improvements list

⁴⁶ National Transportation Safety Board, *Collision and Derailment of Maryland Rail Commuter MARC Train 286 and National Railroad Passenger Corporation Amtrak Train 29 Near Silver Spring, Maryland, on February 16, 1996*, Railroad Accident Report NTSB/RAR-97/02 (Washington, DC: NTSB, 1997).

⁴⁷ National Transportation Safety Board, *Collision of Burlington Northern Santa Fe Freight Train With Metrolink Passenger Train, Placentia, California, April 23, 2002*, Railroad Accident Report NTSB/RAR-03/04 (Washington, DC: NTSB, 2003).

since 1990. The most recent safety recommendation relating to PTC, Safety Recommendation R-01-6, was issued to the FRA as a result of the Board's investigation of a fatal train collision in Bryan, Ohio.⁴⁸ Since its adoption by the Board, Safety Recommendation R-01-6 has been reiterated in two other reports about railroad accidents that took place in Placentia, California,⁴⁹ in 2002 and Chicago, Illinois,⁵⁰ in 2003:

R-01-6

Facilitate actions necessary for the development and implementation of positive train control systems that include collision avoidance, and require implementation of positive train control systems on main line tracks, establishing priority requirements for high-risk corridors such as those where commuter and intercity passenger railroads operate.

Based on a March 27, 2002, letter in which the FRA outlined steps that it had taken toward "achieving the proper atmosphere in the rail industry to allow for the development and implementation of PTC," the Board classified Safety Recommendation R-01-06 "Open—Acceptable Response."

In answer to an April 17, 2003, letter from the Safety Board asking for an update on actions regarding this safety recommendation, the FRA responded, in a May 5, 2003, letter, that it was "moving forward across a broad front to create the conditions under which PTC systems can be more widely deployed on the national rail system." In the letter, the FRA detailed some of the steps the agency was taking in the following areas:

- Providing a radionavigation infrastructure and ensuring adequate spectrum;
- Facilitating PTC through regulatory change;
- Supporting the demonstration and deployment of candidate technologies; and
- Analyzing costs and benefits.

The FRA stated that the agency was "doing everything within its power to prepare the way for PTC and encourage its rapid deployment." In the meantime, the vast majority of railroad operations occur in territory without any automatic means of preventing train collisions.

The Safety Board hosted a seminar on PTC at the NTSB Training Center in March 2005, and the Board is aware of some promising initiatives in the railroad industry to test and implement PTC installations. Effective June 6, 2005, the FRA issued

⁴⁸ National Transportation Safety Board, *Collision Involving Three Consolidated Rail Corporation Freight Trains Operating in Fog on a Double Main Track Near Bryan, Ohio, January 17, 1999*, Railroad Accident Report NTSB/RAR-01/01 (Washington, DC: NTSB, 2001).

⁴⁹ NTSB/RAR-03/04.

⁵⁰ National Transportation Safety Board, *Derailment of Northeast Illinois Regional Commuter Railroad Train 519 in Chicago, Illinois, October 12, 2003*, Railroad Accident Report NTSB/RAR-05/03 (Washington, DC: NTSB, 2005).

a performance standard for processor-based signal and train control systems. The Board is encouraged that on January 8, 2007, the FRA applied these performance standards and approved the BNSF Railway Company's (BNSF's) Product Safety Plan for its Electronic Train Management System (ETMS). The ETMS is capable of automatically controlling train speed and movements. Although the Board remains concerned that it is taking so long for the FRA and the railroad industry to implement such systems, progress is being made as more freight railroads⁵¹ have pilot projects underway to develop PTC technology.

Had a PTC system been in place at Anding, it would have intervened by slowing and stopping the northbound train when the crew did not respond to the signal indications. The Safety Board concludes that had a PTC system with collision avoidance capabilities been in place on the CN Yazoo Subdivision at the time of the accident, the collision would not have occurred. The need for PTC persists, the technology is available, and performance standards have been established. Therefore, the Safety Board believes that the CN should develop and implement a PTC system that includes collision avoidance capabilities on main line tracks, establishing priority requirements for high-risk corridors such as those where passenger trains operate.

Locomotive Alerters

In its investigation of the collision of two Conrail trains in 1988,⁵² the Safety Board found that the accident was caused by the sleep-deprived condition of the crew and their consequent failure to comply with a signal. After examining the role of alerters in that accident, the Board concluded that had the locomotive of the striking train "been equipped with a state-of-the-art alertness device, the train would have been stopped and the collision would have been avoided."

The leading locomotive of the northbound train involved in the Anding collision was not equipped with an alerter to help the crew maintain vigilance, nor was such a device required by any regulation or railroad policy. Based on signal sight-distance observations, the crew would have had about 4 minutes from the time the *approach* signal first became visible until the time the locomotive passed the North Anding *stop* signal, which would have been a sufficient amount of time to stop the train. Signal system data indicated that the northbound train continued traveling at an average speed of 45 mph past these signals and up to the point of collision.

⁵¹ Alaska Railroad, UP, BNSF, Norfolk Southern Railway, and CSX Transportation. The CN has no pilot project underway.

⁵² National Transportation Safety Board, *Head-end Collision of Consolidated Rail Corporation Freight Trains UBT-506 and TV-61 Near Thompsontown, Pennsylvania, January 14, 1988*, Railroad Accident Report NTSB/RAR-89/02 (Washington, DC: NTSB, 1989).

The Safety Board has closely examined the role of alerters. In the collision of two Norfolk Southern Railway freight trains at Sugar Valley, Georgia,⁵³ on August 9, 1990, the crew of one of the trains failed to stop at a signal. The Board concluded that the engineer of that train was probably experiencing a micro-sleep or was distracted. Based on testing, it was determined that as the train approached the stop signal, the alerter would have begun an alarm cycle. The Board concluded that the engineer “could have cancelled the alerter system while he was asleep by a simple reflex action that he performed without conscious thought.” As a result of the investigation, the Board made the following recommendation to the FRA:

R-91-26

In conjunction with the study of fatigue of train crewmembers, explore the parameters of an optimum alerter system for locomotives.

The FRA responded to this recommendation on June 28, 1993, advising that it had “awarded two contracts to develop proposals to modify the existing alerter systems so that they cannot be reset by reflex action.” In a followup letter dated August 12, 1997, the FRA told the Safety Board that while a proposal for a prototype had been developed, the contractor had advised the FRA that “they could not see a market for the device large enough to justify its further development.” The FRA advised the Safety Board that it believed that the lack of a market was due to the FRA’s own “announced determination” to support positive train separation technology. As a result, the Safety Board classified Safety Recommendation R-91-26 “Closed—Unacceptable Action” on November 4, 1997.

The most recent Safety Board recommendations relating to locomotive alerters were made as a result of an investigation into a sideswipe collision between two Union Pacific Railroad (UP) freight trains in Delia, Kansas,⁵⁴ on July 2, 1997. In that accident, a train entered a siding but did not stop at the other end, and it collided with a passing train on the main track. The Board concluded that “had the striking locomotive been equipped with an alerter, it may have helped the engineer stay awake while his train traveled through the siding.” As a result of its investigation, the Board made the following recommendation to the FRA:

R-99-53

Revise the Federal regulations to require that all locomotives operating on lines that do not have a positive train separation system be equipped with a cognitive alerter^[55] system that cannot be reset by reflex action.

⁵³ National Transportation Safety Board, *Collision and Derailment of Norfolk Southern Train 188 with Norfolk Southern Train G-38 at Sugar Valley, Georgia, August 9, 1990*, Railroad Accident Report NTSB/RAR-91/02 (Washington, DC: NTSB, 1991).

⁵⁴ National Transportation Safety Board, *Collision Between Union Pacific Freight Trains MKSNP-01 and ZSEME-29 near Delia, Kansas, July 2, 1997*, Railroad Accident Report NTSB/RAR-99/04 (Washington, DC: NTSB, 1999).

⁵⁵ Currently, all alerters are reset by reflex action or manipulation of the train controls. In 1999, a cognitive alerter was considered to be an alerter that would have required more than a simple reflex action from the crew.

In an April 28, 2000, letter, the FRA advised the Safety Board that it had issued regulations requiring that “each passenger train not equipped with a positive train separation system be equipped with a working dead man or alerter.” Although this was an important safety improvement, the FRA’s regulations neglected to address the critical components of Safety Recommendation R-99-53. The FRA’s regulations applied only to passenger trains, and they did not require the installation of cognitive alerters. On September 25, 2000, the Board responded that it was disappointed that the FRA’s new safety standards applied only to passenger locomotives and not to freight locomotives. Safety Recommendation R-99-53 was classified “Closed—Reconsidered” on August 6, 2002, after the Board concluded that the type of cognitive alerter envisioned at the time the recommendation was issued did not exist.

As a result of its investigation of the Delia accident, the Safety Board also recommended that UP

R-99-59

Install a cognitive alerter system that cannot be reset by reflex action on all locomotives that operate on lines that do not have a positive train separation system.

In a response dated October 31, 2000, UP advised the Safety Board that the alerters it was installing on some existing locomotives and on new locomotives were “cognitive . . . [and] considered to be state-of-the-art in the industry.” The UP letter added that although “the level of cognition is not optimal. . . . there are no more sophisticated alerters available in the market today.” Based on UP’s response, the Board classified Safety Recommendation R-99-59 “Closed—Acceptable Alternate Action” on April 24, 2001. During its investigation⁵⁶ of a collision 3 years later between a UP freight train and a BNSF freight train on November 15, 2003, near Kelso, Washington, the Board was advised by UP that about 67.6 percent of UP locomotives were alerter equipped.

Alerters installed on new locomotives today require about the same level of cognition as those that existed when the Safety Board closed Safety Recommendations R-99-53 and -59. Typically, alerter alarms occur more frequently as train speed increases.⁵⁷ Unlike the Sugar Valley accident in which the train had slowed and entered a siding before overrunning a signal, the northbound train in the Anding collision remained on the main track at higher speeds. Had an alerter been installed, there was a 4-minute time period after passing the *approach* signal during which the alerter would have activated four to five times. It seems unlikely that the engineer could have reset the alerter multiple times by reflex action without any increase in his awareness. Therefore, an alerter likely would have detected the lack of activity on the part of the engineer and sounded an alarm that could have alerted one or both crewmembers. Had the crew been incapacitated or not

⁵⁶ National Transportation Safety Board, *Side Collision of Burlington Northern Santa Fe Railway Train and Union Pacific Railroad Train Near Kelso, Washington, November 15, 2003*, Railroad Accident Brief NTSB/RAB-05/03 (Washington, DC: NTSB, 2005).

⁵⁷ Unless the engineer is manipulating the controls, in which case the alerter resets.

responded to the alarm, the alerter would have automatically applied the brakes and brought the train to a stop. The Safety Board concludes that had an alerter been installed on the lead locomotive of the northbound train, it may have prevented the collision in Anding.

Although the Safety Board considers a safety redundant PTC system to be the preferred method for preventing collisions, it recognizes that fully implementing PTC on the U.S. rail network will take time. The Board notes that in the interim alerters can prevent some train collisions. The FRA's requirement that alerters be installed on passenger trains was a good first step; however, it fell short of extending a readily available means of increasing safety to all trains. Passenger trains and freight trains share the same tracks, and the crews on both train types work similar schedules. Freight trains carry hazardous materials that can have a devastating effect on communities should the materials be released as a result of an accident. Although most freight trains are operated by two crewmembers and many (but not all) passenger trains are operated by a single engineer, the Anding accident and many other freight train accidents investigated by the Board indicate that a second crewmember is no assurance against incapacitation or fatigue-induced inattentiveness. Considering this, expectations of crew alertness for freight and passenger train operations should not be different. Therefore, the Safety Board believes that the FRA should require railroads to ensure that the lead locomotives used to operate trains on tracks not equipped with a PTC system are equipped with an alerter. The Safety Board also believes that all Class I railroads should ensure that alerters are installed on all their lead locomotives used to operate trains on tracks not equipped with a PTC system.

Availability of Train Consist Information

Federal regulations require that an accurate train consist documenting the location and type of hazardous materials in transport be kept and maintained on board the occupied locomotive of every freight train. The train consist is typically electronically generated at a train's origination point. When changes to the consist occur en route as a result of setouts and/or pickups (for example, the southbound train crew setting out and picking up cars at Greenwood), the conductor is required to correct the train consist by hand to ensure it reflects an accurate listing of the cars. Train consists are electronically updated in the CN Homewood RTC Center only when a train passes by an Automatic Equipment Identification (AEI) reader. These readers identify cars on a train by the identification tags on the cars as they pass, and then they automatically relay information back to the central computer to update the master train consist. The southbound train passed two AEI readers en route from Memphis; however, both were located north of Greenwood, where the crew had set out and picked up cars. The next AEI reader that the southbound train would have passed, if not for the collision, was located beyond Anding. Consequently, the only accurate consist for the southbound train was the crew's hand-corrected copy on board the train.

As a result of the collision, derailment, and fire, all four crewmembers were killed, and all six locomotives and both on-board train consist documents were destroyed. When emergency response personnel arrived on the accident scene, about 4:41 a.m., it was dark; the fire was intense; and heavy black smoke prevented them from visually identifying all the hazardous materials tank cars in the wreckage. When the first CN official arrived, about 5:25 a.m., he told emergency responders that he believed two CN trains had collided, but he did not have any train consist documents or knowledge about the hazardous materials on either train.

About 5:45 a.m., the CN official obtained accurate consist information about the derailed cars on the northbound train via cell phone from the CN dispatcher and provided it to emergency responders, but cell phone service was disrupted before any information about the southbound train could be obtained. In the absence of a consist for the southbound train, continuing attempts were made to identify hazard placards and car stenciling at the accident site. Although the CN officials and emergency responders were able to visually identify the four hydrogen cyanide tank cars from their unique paint schemes and determine that they did not derail, they could not identify the derailed cars in the southbound train nor determine the potential hazardous materials threats.

A CN clerk from Jacksonville delivered copies of the consists for both trains about 6:45 a.m., about 2 1/2 hours after the collision occurred and about 2 hours after the fire chief had made his initial request upon arriving at the scene. Yet, the consist that the CN delivered for the southbound train did not accurately reflect the actual makeup of the southbound train at the time of the accident because it did not reflect the cars the crew had set out and picked up at Greenwood. CN representatives did not realize that the cars that had derailed from the southbound train did not match those listed on the consist until they attempted to create a map of the derailment. An accurate listing of the cars that had derailed from the southbound train and were involved in the fire was eventually developed by a site survey of the scene.

Diesel fuel was the cause of the fire in this accident. The limited release of hazardous materials from venting tank cars did not contribute to the severity of the accident. However, the lack of immediately available train consists prevented emergency responders from making a quick assessment of the potential for a hazardous materials release. Train consist documents are a vital source of information for emergency responders when they are trying to determine what hazardous materials might be involved in a derailment. It is essential that the information contained in these documents accurately reflect the current position of each railcar containing a hazardous material. Not having an accurate train consist makes it difficult for emergency responders to properly assess and manage an accident scene. Because the consist for the southbound train was never updated in the CN central computer system, the only up-to-date consist was the on-board document that was destroyed in the accident. The Safety Board concludes that because the CN did not have the capability to provide an accurate consist for the southbound train after the on-board document was destroyed, emergency responders were unable to promptly identify all the hazardous materials cars involved in the accident and timely assess the threat from a hazardous materials release.

The Safety Board previously addressed the importance of timely and accurate train consists in its investigations of the Thermal, California,⁵⁸ and Miamisburg, Ohio,⁵⁹ accidents. The Board addressed the same safety issues in its investigation of a derailment that occurred in Akron, Ohio, on February 26, 1989.⁶⁰ In the Akron accident, as in the accident in Anding, the train consist provided to emergency responders was not accurate in that it did not reflect the setouts and pickups that the crew made between the time the train departed and the time it derailed, and as a result there was confusion about what hazardous materials were involved in the accident. Although the train crew from the Akron accident survived and was eventually able to update their consist information from memory, valuable time was lost and emergency responders were unable to properly assess and manage the accident scene. At the time of the accident, there were no Federal regulations requiring a train crew to maintain an up-to-date listing of the position of each hazardous materials car in the train. As a result, the Board recommended that the FRA

R-90-38

Revise 49 CFR 174.26(b) to require the traincrew to maintain, at all times, a document reflecting the current position of hazardous materials cars in the train.

The FRA responded that it agreed with Safety Recommendation R-90-38; as a result, with the FRA's cooperation, the Research and Special Programs Administration⁶¹ published a final rule on January 8, 1997. The new rule revised 49 *Code of Federal Regulations* (CFR) 174.26 to mandate that a train crew carry an on-board document reflecting the current position of each railcar transporting a hazardous material in a train. The new rule also required that the train crew update the consist when cars are added or removed from a train en route. Based on the FRA's response, Safety Recommendation R-90-38 was classified "Closed—Acceptable Action."

The accident at Anding demonstrates that accurate train consists may not be available if the on-board documents are destroyed in an accident. Also, the death or injury of crewmembers may prevent or hinder emergency response personnel from accessing accurate consist information in a timely manner. Given the critical importance of providing timely and accurate information to emergency responders about the hazardous materials on an accident train, the Safety Board does not consider a railroad's reliance upon the on-board consist as the only up-to-date listing to be prudent or responsive,

⁵⁸ National Transportation Safety Board, *Derailment of Southern Pacific Transportation Company Train No. 01-BSMFF-05, Carrying Radioactive Material, at Thermal, California, January 7, 1982*, Railroad Accident Report NTSB/RAR-83/01 (Washington, DC: NTSB, 1983).

⁵⁹ National Transportation Safety Board, *Hazardous Materials Release Following the Derailment of Baltimore and Ohio Railroad Company Train No. SLFR, Miamisburg, Ohio, July 8, 1986*, Hazardous Materials Accident Report NTSB/HZM-87/01 (Washington, DC: NTSB, 1987).

⁶⁰ National Transportation Safety Board, *Derailment of a CSX Transportation Freight Train and Fire Involving Butane, Akron, Ohio, February 26, 1989*, Hazardous Materials Accident Report NTSB/HZM-90/02 (Washington, DC: NTSB, 1990).

⁶¹ PHMSA was subsequently assigned regulatory jurisdiction over this area after a U.S. Department of Transportation reorganization in 2004.

especially when a railroad is transporting hazardous materials. The Safety Board concludes that to ensure the safety of emergency responders and the public, railroads must have the ability to quickly provide emergency responders complete information about the specific hazardous materials being transported on a train and their location within it, regardless of the availability of the on-board consist.

At the time Safety Recommendation R-90-38 was issued, computer and communications technologies were far less advanced than they are today. Although some railroads have experimented or are experimenting with various electronic technologies to maintain available and up-to-date consist information, other railroads have not. Electronic tracking systems and modern computer and communication systems can provide a railroad with the flexibility and capability to generate, maintain, retrieve, and promptly deliver up-to-date consists for any of its operating trains to emergency responders. Therefore, the Safety Board believes that the Pipeline and Hazardous Materials Safety Administration (PHMSA) should, with the assistance of the FRA, require that railroads immediately provide to emergency responders accurate, real-time information regarding the identity and location of all hazardous materials on a train. The Safety Board believes that the FRA should assist PHMSA in developing regulations to require that railroads immediately provide to emergency responders accurate, real-time information regarding the identity and location of all hazardous materials on a train.

Emergency Planning and Preparedness

State and local community emergency planning for hazardous materials incidents occurs largely through the Hazardous Materials and Emergency Preparedness (HMEP) grant program administered by PHMSA through the National Response Team (NRT). The HMEP program was established with the intent of enhancing State and local hazardous materials emergency planning and training by providing local communities with the necessary resources and tools to develop plans, training programs, drills, and exercises. However, awarding of the grants is not contingent upon local communities conducting joint training or drills with transporters and shippers of hazardous materials in their geographical areas. Consequently, States and local communities are not compelled to conduct planning, drills, or exercises with railroads and other transporters of hazardous materials in their localities.

Awarding the grants without specific expectations raised problems that also were addressed by the Office of Management and Budget's (OMB's) 2005 study of the HMEP program. Although the HMEP program was designed to provide the States and local communities the flexibility to develop their own emergency plans and training programs, the OMB determined that this flexibility had led to a lack of accountability and some States and local communities were not meeting their program goals. The OMB found that the States and local communities were not required to address or track progress toward their goals and that there was no formal, independent evaluation by PHMSA or any other Federal body to determine whether specific grants improved emergency planning or increased its effectiveness.

The Occupational Safety and Health Administration (OSHA) requires that railroads develop and implement a hazardous materials emergency response plan in accordance with the provisions of 29 CFR 1910.120. However, the regulations address only the structure and content of an emergency plan by requiring that the plans cover 11 areas of concern, including “pre-emergency planning and coordination with outside parties” and “critique of response and follow-up.” The regulations do not include any additional standards or instructions about how to evaluate the effectiveness of an emergency plan through drills and exercises with “outside parties.” Appendix C of the OSHA regulations states that an employer “should assure” that its emergency plan is compatible with the established local plan and further notes that the major reference used to develop local emergency plans is the *Hazardous Materials Emergency Planning Guide*, the NRT-1. OSHA does not oversee or review any of these emergency plans, but rather relies upon employers to certify their own plans. Railroads are not specifically required under OSHA regulations to coordinate with communities about hazardous materials emergency planning.

Nevertheless, through their respective industry associations, transporters, including the railroads, and shippers of hazardous materials have made efforts to reach out to communities through programs, such as Transportation Community Awareness and Emergency Response (TRANSCAER),⁶² to enhance community awareness about the transportation of hazardous materials. TRANSCAER workshops typically provide a 1-day course to the local emergency planning committees (LEPCs) consisting of familiarization with a cargo tank and its components and an exercise involving a simulated chemical release and practice using various containment techniques to plug or patch a leak on a cargo tank or railcar. Although TRANSCAER workshops provide valuable training for local emergency responders, the workshops alone do not provide the level of effective planning that is needed between the railroads and local communities.

Effective emergency planning is an issue that has been addressed by the Safety Board as a result of several railroad accidents dating to the mid-1980s. Most recently, after the Texarkana, Arkansas, accident⁶³ that occurred in 2005, the Board issued the following recommendation to the International Association of Fire Chiefs:

I-06-2

Notify your members about the circumstances of the accident in Texarkana, Arkansas, on October 15, 2005, and urge them to coordinate with all regional and local transporters of hazardous materials, such as railroads and trucking companies, to establish effective communications and coordination through joint emergency response drills and exercises.

⁶² TRANSCAER is an outreach program intended for the hazardous materials transportation industry to work with LEPCs and provide unique hands-on training using actual transportation equipment. TRANSCAER develops training tools, helps participants establish relationships with industry contacts and emergency responders, and conducts numerous training events. TRANSCAER sponsors include the American Chemistry Council; the American Association of Railroads; the Chemical Educational Foundation; the CHEMical TRANsportation Emergency Center (CHEMTREC[®]); The Chlorine Institute, Inc.; and the National Tank Truck Carriers, Inc.

⁶³ NTSB/RAB-06/04.

It is the Board's position that effective emergency planning between railroads and local communities should foster the voluntary exchange of emergency response plans, the maintenance of the plans by all parties, and the evaluation of the plans' effectiveness. Further, effective planning demands that the railroads and local communities jointly organize and participate in drills and exercises as a way of becoming familiar with each other's plans and as a means of testing the plans' overall effectiveness. Currently, PHMSA's HMEP program and OSHA's regulations provide parallel but independent processes for developing and implementing emergency response plans. Although PHMSA and OSHA are both members of the NRT emergency preparedness committee, more can be done to integrate local community emergency response and railroad emergency planning, including verification that local jurisdictions and railroads are conducting joint drills and exercises. Consequently, the Safety Board concludes that there are no mechanisms in place to verify that local jurisdictions that receive HMEP grant funds and railroads are conducting effective emergency planning for hazardous material releases resulting from rail accidents.

As interagency partners on the NRT Training and Curriculum Subcommittee, PHMSA and OSHA could better coordinate to ensure that more effective emergency planning occurs. For example, under the HMEP program, grants could be awarded on the condition that local communities be required to conduct joint training exercises and drills with railroads and other transporters of hazardous materials operating in their communities. OSHA also could strengthen its regulations to require and then verify that railroads are coordinating with local communities. PHMSA and OSHA also could jointly endeavor to specify in the NRT-1 emergency planning guidance that local communities and railroads conduct joint training drills and exercises. Therefore, the Safety Board believes that PHMSA should require and verify that States and their communities that receive funds through the HMEP grant program conduct training exercises and drills with the joint participation of railroads and other transporters of hazardous materials operating within their jurisdictions as a means of evaluating State, regional, and local emergency hazardous materials response plans. The Safety Board also believes that OSHA should require and verify that railroads transporting hazardous materials participate in joint training exercises and drills with the States, regions, or communities in which they operate as a means of evaluating the railroads' emergency hazardous materials response plans.

Locomotive Cab Voice Recorders

The Safety Board has a long history of investigating railroad accidents involving human performance failures of train crewmembers. Knowing crewmembers' actions in these cases would have helped reveal the key circumstances leading up to the accident; however, frequently their recollection of events was limited, or they were not available to be interviewed. As a result of its investigation of the collision between a Maryland Rail Commuter train and an Amtrak train near Silver Spring, Maryland, on February 16, 1996,⁶⁴ in which there were no surviving operating crewmembers, the Board recommended that the FRA:

⁶⁴ NTSB/RAR-97/02.

R-97-9

Amend 49 *Code of Federal Regulations* Part 229 to require the recording of train crewmembers' voice communications for exclusive use in accident investigations and with appropriate limitations on the public release of such recordings.

After the Safety Board investigated another railroad accident in which there were no surviving crewmembers that occurred in 1999 in Bryan, Ohio,⁶⁵ the Board reiterated Safety Recommendation R-97-9 to the FRA. The FRA responded to the Board in a letter dated May 5, 2003, that it

has reluctantly come to the conclusion that this recommendation should not be implemented at the present time. . . . FRA appreciates that, as time passes and other uses are found for recording media that may create synergies with other public and private purposes, the Board's recommendation may warrant re-examination. However, for the present FRA requests that the Board accept FRA's judgment with respect to overall railroad safety priorities and place this recommendation in the status of "Closed—Reconsidered."

Based on this response and further meetings, the Board classified Safety Recommendation R-97-9 "Closed—Unacceptable Action."

Beyond the value gained during accident investigations from analyzing the verbal communication between operating crewmembers, investigators have used voice recorders to analyze nonverbal sounds originating from the vehicle. From these sounds, parameters, such as engine rpm, system failures, speed, and the time at which certain events occur, can often be determined. Safety Board investigators have used voice recordings to analyze specific events that were not captured by any other measures. For instance, investigators used the cockpit voice recorder (CVR) recovered from the 1982 Air Florida accident in Washington, D.C.,⁶⁶ to analyze the engine sounds and determine an approximate engine power ratio⁶⁷ throughout takeoff and determine that the anti-ice systems had not been activated. During the investigation of the 1988 Pan Am 103 bombing over Lockerbie, Scotland, the CVR provided critical evidence that there was nothing wrong with the aircraft or unusual with the flight crew, and investigators were able to identify the loud noise on the aircraft as an explosion. The CVR also has been used in conjunction with the flight data recorder to help analyze an event. In the investigation of the 1994 USAir accident near Aliquippa, Pennsylvania,⁶⁸ investigators noted three "grunts" or "explosive exhalations" from the first officer. When compared to data from the flight data recorder,

⁶⁵ NTSB/RAR-01/01.

⁶⁶ National Transportation Safety Board, *Air Florida, Inc., Boeing 737-222, N62AF, Collision With 14th Street Bridge Near Washington National Airport, Washington, DC, January 13, 1982*, Aviation Accident Report NTSB/AAR-82/08 (Washington, DC: NTSB, 1982).

⁶⁷ CVRs are often used in accident investigations to analyze engine sounds.

⁶⁸ National Transportation Safety Board, *Uncontrolled Descent and Collision With Terrain, USAir Flight 427, Boeing 737-300, N513AU, Near Aliquippa, Pennsylvania, September 8, 1994*, Aviation Accident Report NTSB/AAR-99/01 (Washington, DC: NTSB, 1999).

investigators matched the first officer's exhalations with particular control movements and suggested that the flight officer was straining in an attempt to manipulate the controls of the aircraft to override uncommanded rudder movements.

Likewise, locomotives produce distinctive sounds associated with various functions that may help identify problems with the equipment or determine the actions of the crew. For example, such sounds might include those made by an operating engine, brake application, throttle manipulations, and alarms, or sounds made by other activities, such as crewmembers moving about the cab or opening doors to electrical equipment, the bathroom, or the exterior. Identifying sounds external to the locomotive also may be relevant to an investigation. Such sounds might include noises made while operating over crossovers, turnouts, switches, or broken rails or noises from crossing gate bells and whistles or horns from other trains in the area. Locomotive cab voice recorders could provide investigators with a wealth of valuable data not currently available that would better define the circumstances of each accident.

The value of voice recorders extends beyond accidents in which crewmembers suffer serious or fatal injuries. During postaccident interviews, surviving crewmember testimony to investigators regarding preaccident conversations or other activities may be validated with sounds recovered from the voice recorders. Further, the presence of voice recorders in the operating compartment may further compel crewmembers to be more forthcoming during their testimony to investigators and motivate greater crew discipline and adherence to prescribed operating procedures.

Eleven years have passed since the Silver Spring accident that originally prompted the Safety Board to recommend that locomotive cabs be equipped with voice recorders. As noted previously, on May 5, 2003, the FRA told the Safety Board that this recommendation should not be implemented at that time. However, since then, the Board has continued to investigate accidents in which voice recorders would have provided valuable information to help determine probable cause and develop safety recommendations. For example, in the Gunter, Texas, accident,⁶⁹ recordings of conversations between the engineer and conductor on the southbound train might have helped investigators understand the crew's error in operating their train contrary to the information contained in their track warrant. The Gunter, and Anding accidents, as well as many other railroad accidents⁷⁰ investigated by the Board in which crew actions or communications could not be confirmed, further validate the need for voice recorders.

⁶⁹ National Transportation Safety Board, *Collision Between Two BNSF Railway Company Freight Trains Near Gunter, Texas, May 19, 2004*, Railroad Accident Report NTSB/RAR-06/02 (Washington, DC: NTSB, 2006).

⁷⁰ (a) National Transportation Safety Board, *Collision of Union Pacific Railroad Train MHOTU-23 With BNSF Railway Company Train MEAP-TUL-126-D With Subsequent Derailment and Hazardous Materials Release, Macdona, Texas, June 28, 2004*, Railroad Accident Report NTSB/RAR-06/03 (Washington, DC: NTSB, 2006). (b) National Transportation Safety Board, *Collision of Two Union Pacific Railroad Freight Trains, Texarkana, Arkansas, October 15, 2005*, Railroad Accident Brief NTSB/RAB-06/04 (Washington, DC: NTSB, 2006).

As a result of the accident in Anding, all crewmembers on both trains were killed, and autopsies with toxicological tests could not be performed on the northbound train crewmembers. Consequently, the Safety Board was unable to determine if there was any incapacitating change in the northbound train crewmembers' physical conditions during the accident sequence. Further, the Board was not able to gain an understanding of the northbound train crewmembers' actions and decision-making processes that resulted in their train passing the *stop* signal at North Anding.

A voice recorder would have been useful in this rail accident investigation and others conducted by the Safety Board. However, the usefulness of a voice recorder depends not only on its presence but also on its capabilities, such as crashworthiness, fire resistance, and extended recording of the cab environment and radio communications. Over the years, the Safety Board has investigated aviation accidents in which pertinent CVR information was overwritten and lost because of a 30-minute recording limitation. Experience has shown that most of the significant events leading up to an accident are usually recorded within the final minutes, but this is not always the case. The Board also has investigated accidents in which the damage to the vehicle was not severe enough to interrupt the power supply to the recorder and some or all of the useful information was subsequently overwritten. The Board notes that railroad accidents often occur in remote locations and there may be a significant delay before the recorder information can be retrieved. Therefore, the length of time recorded by a voice recorder should be of sufficient duration to avert the constraints imposed by 30-minute recordings. To address this problem, the aviation industry has begun equipping airliners with a minimum 2-hour continuous loop CVR. Further, the Board notes that although the length of the sound recording was a problem in the past due to technology constraints, it is not an issue with current flash memory technology.

Collected voice recorder data could be critical in determining probable cause or identifying safety issues calling for recommendations. The Independent Safety Board Act of 1974, as amended, specifically addresses surface vehicle recordings and limits the circumstances under which information gathered from them may be divulged.⁷¹ This statutory safeguard is similar to the safeguard established for CVRs.

⁷¹ SURFACE VEHICLE RECORDINGS AND TRANSCRIPTS.--

(1) CONFIDENTIALITY OF RECORDINGS.--The Board may not disclose publicly any part of a surface vehicle voice or video recorder recording or transcript of oral communications by or among drivers, train employees, or other operating employees responsible for the movement and direction of the vehicle or vessel, or between such operating employees and company communication centers, related to an accident investigated by the Board. However, the Board shall make public any part of a transcript or any written depiction of visual information that the Board decides is relevant to the accident--

(A) if the Board holds a public hearing on the accident, at the time of the hearing; or

(B) if the Board does not hold a public hearing, at the time a majority of the other factual reports on the accident are placed in the public docket.

(2) REFERENCES TO INFORMATION IN MAKING SAFETY RECOMMENDATIONS.--This subsection does not prevent the Board from referring at any time to voice or video recorder information in making safety recommendations.

Knowing the communication (or possible lack thereof) between the northbound train conductor and the engineer and knowing the circumstances that led to the crew passing a *stop* signal are important factors in understanding this accident. The Safety Board concludes that had a locomotive cab voice recorder been installed in the northbound train and had it survived the collision and fire, its data would yield a better understanding of the cause of the accident and of the ways it might have been prevented. The technology for locomotive cab voice recorders is readily available. In fact, the Board notes that many railroads are installing recorders that capture external sounds and video images ahead of their locomotives. In 2003, the FRA acknowledged to the Board that as time passed, the need for locomotive cab recorders may warrant reexamination. Since then, the railroad industry has continued to experience serious accidents in which locomotive cab voice recorders would have provided crucial information to help determine what happened and how to prevent future accidents. Therefore, the Safety Board believes that the FRA should require the installation of a crash- and fire-protected locomotive cab voice recorder, or a combined voice and video recorder, (for the exclusive use in accident investigations and with appropriate limitations on the public release of such recordings) in all controlling locomotive cabs and cab car operating compartments. The recorder should have a minimum 2-hour continuous recording capability, microphones capable of capturing crewmembers' voices and sounds generated within the cab, and a channel to record all radio conversations to and from crewmembers.

Conclusions

Findings

1. The following were not factors in the accident: the condition of the track, the locomotives, or the railcars; the weather; or the signal system.
2. The actions of the southbound train crew were appropriate and did not contribute to the accident.
3. Had the northbound train crew observed and responded appropriately to the *approach* and *stop* signals on the main track at Anding, the accident would not have occurred.
4. The northbound train crew's attention to the wayside signals was most likely reduced by fatigue; however, without a locomotive cab voice recorder or the availability of other supporting evidence, it cannot be determined whether distraction or some other factor also contributed to the crew's failure to comply with the signals.
5. Had a positive train control system with collision avoidance capabilities been in place on the CN Yazoo Subdivision at the time of the accident, the collision would not have occurred.
6. Had an alerter been installed on the lead locomotive of the northbound train, it may have prevented the collision in Anding.
7. Because the CN did not have the capability to provide an accurate consist for the southbound train after the on-board document was destroyed, emergency responders were unable to promptly identify all the hazardous materials cars involved in the accident and timely assess the threat from a hazardous materials release.
8. To ensure the safety of emergency responders and the public, railroads must have the ability to quickly provide emergency responders complete information about the specific hazardous materials being transported on a train and their location within it, regardless of the availability of the on-board consist.
9. There are no mechanisms in place to verify that local jurisdictions that receive Hazardous Materials and Emergency Preparedness grant funds and railroads are conducting effective emergency planning for hazardous material releases resulting from rail accidents.
10. Had a locomotive cab voice recorder been installed in the northbound train and had it survived the collision and fire, its data would yield a better understanding of the cause of the accident and of the ways it might have been prevented.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the July 10, 2005, collision in Anding, Mississippi, was the failure by the crew of the northbound train (IC 1013 North) to comply with wayside signals requiring them to stop at North Anding. The crew's attention to the signals was most likely reduced by fatigue; however, due to the lack of a locomotive cab voice recorder or the availability of other supporting evidence, other factors cannot be ruled out. Contributing to the accident was the absence of a positive train control system that would have stopped the northbound train before it exceeded its authorized limits. Also contributing to the accident was the lack of an alerter on the lead locomotive that may have prompted the crew to be more attentive to their operation of the train.

Recommendations

As a result of its investigation of the July 10, 2005, collision between two CN freight trains in Anding, Mississippi, the National Transportation Safety Board makes the following safety recommendations:

To the Federal Railroad Administration:

Require railroads to ensure that the lead locomotives used to operate trains on tracks not equipped with a positive train control system are equipped with an alerter. (R-07-1)

Assist the Pipeline and Hazardous Materials Safety Administration in developing regulations to require that railroads immediately provide to emergency responders accurate, real-time information regarding the identity and location of all hazardous materials on a train. (R-07-2)

Require the installation of a crash- and fire-protected locomotive cab voice recorder, or a combined voice and video recorder, (for the exclusive use in accident investigations and with appropriate limitations on the public release of such recordings) in all controlling locomotive cabs and cab car operating compartments. The recorder should have a minimum 2-hour continuous recording capability, microphones capable of capturing crewmembers' voices and sounds generated within the cab, and a channel to record all radio conversations to and from crewmembers. (R-07-3)

To the Pipeline and Hazardous Materials Safety Administration:

With the assistance of the Federal Railroad Administration, require that railroads immediately provide to emergency responders accurate, real-time information regarding the identity and location of all hazardous materials on a train. (R-07-4)

Require and verify that States and their communities that receive funds through the Hazardous Materials and Emergency Preparedness grant program conduct training exercises and drills with the joint participation of railroads and other transporters of hazardous materials operating within their jurisdictions as a means of evaluating State, regional, and local emergency hazardous materials response plans. (R-07-5)

To the Occupational Safety and Health Administration:

Require and verify that railroads transporting hazardous materials participate in joint training exercises and drills with the States, regions, or communities in which they operate as a means of evaluating the railroads' emergency hazardous materials response plans. (R-07-6)

To the CN:

Develop and implement a positive train control system that includes collision avoidance capabilities on main line tracks, establishing priority requirements for high-risk corridors such as those where passenger trains operate. (R-07-7)

To All Class I Railroads:

Ensure that alerters are installed on all your lead locomotives used to operate trains on tracks not equipped with a positive train control system. (R-07-8)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

Mark V. Rosenker
Chairman

Robert L. Sumwalt
Vice Chairman

Deborah A. P. Hersman
Member

Kathryn O'Leary Higgins
Member

Steven R. Chealander
Member

Adopted: March 20, 2007

Deborah A. P. Hersman, Member, filed the following concurring and dissenting statement on March 23, 2007.

While I supported adoption of this report, I do not support the issuance of Recommendations 5 and 6.

Recommendation 5 to the Pipeline and Hazardous Materials Safety Administration (PHMSA) recommends that the agency require and verify that States and their communities that receive funds through the Hazardous Materials and Emergency Preparedness (HMEP) grant program conduct training exercises and drills with the joint participation of railroads and other transporters of hazardous materials operating within

their jurisdictions. I do not believe the circumstances of this accident make the case for this recommendation for the following reasons:

- There is no information in this report that describes any HMEP grants to the State of Mississippi or the Bentonia Volunteer Fire Department.
- The community did conduct an exercise prior to the accident. On March 17, 2004, Yazoo County conducted a tabletop exercise with the CN and 20 different emergency response groups including the county's Emergency Incident Planning Committee.
- The emergency response in this accident was appropriate. The problem with the post-accident response in this accident was the railroad's failure to provide responders with an accurate consist. Despite this deficiency, the responders worked around the problem and prevented additional loss of life and damage to property. Their response was timely, effective and appropriate. The issue of providing accurate consists is appropriately addressed in Recommendation 2 to the Federal Railroad Administration and Recommendation 4 to PHMSA.

Additionally, I do not believe our recommendation is appropriate because the established purposes for expenditures of HMEP funds are not limited to conducting training exercises and drills. Grant recipients may find it more beneficial to use their allocation of funds to train emergency responders in hazmat awareness and recognition or for emergency circumstances other than rail accidents and tank car releases.

Similarly, I do not believe that Recommendation 6 to the Occupational Safety and Health Administration (OSHA) is justified. OSHA's mission and regulatory scheme are focused on protecting employees in their work place. While it is true that OSHA has a regulation (29 CFR 1910.120) requiring railroads to have an emergency response plan, OSHA does not require drills (joint or otherwise) and, according to this report, does not "oversee or review" any of the response plans. I believe it is unreasonable to expect that OSHA, which currently relies on employers to certify their own emergency response plans, will nevertheless require railroads to conduct joint response drills for the benefit of communities. Again, the community response to this accident was appropriate. The breakdown was in securing an accurate train consist from the railroad, an issue that is more effectively addressed by other recommendations in this report.

Kathryn O’Leary Higgins, Member, filed the following concurring and dissenting statement on March 28, 2007.

I concur with the findings, probable cause, and all but one recommendation in this report on our investigation of the tragic head-on collision between two CN freight trains in Anding, Mississippi. However, I believe the probable cause should have been more specific in one area, and I believe we should reiterate one recommendation to the Federal Railroad Administration (FRA).

Our findings and our probable cause list fatigue as a likely reason that the crew of the northbound CN train failed to heed the wayside signals that required them to stop at North Anding. That failure resulted in the head-on collision that killed four crew members from both trains. While we indicate fatigue as a likely factor in this accident the probable cause does not mention the reason the crew may have been fatigued. The report and staff presentation at the Board meeting implicate the schedule the crew worked as the likely reason for fatigue. I believe crew scheduling practices should have been identified as contributing to crew fatigue.

This crew worked 11-1/2 hour days, 6 days a week for 18 months prior to the accident. Their work “day” typically began at 10:30 p.m. when they were called and told to report for duty at midnight. They were on duty for the next 11 plus hours, often finishing just before noon. That almost 12 hour schedule did not take into account their travel time to and from the job. One crew member commuted an hour each way, adding to the length of his day.

There were positive features to this schedule. It was predictable and regular – the crew knew when they would be called. The schedule allowed them to be home every night and sleep in their own beds. They were used to this demanding routine and bid this schedule. This was an experienced crew. They were veterans with a good record. And while this is the schedule they bid, we don’t know what the alternatives were. This crew seemed to use their limited free time well. But the work schedule did not allow them enough time for restorative sleep. They typically slept five to five and a half hours a night.

Experts suggest that adults need a minimum of six to eight hours of uninterrupted sleep to be fully rested. CN’s scheduling practices are better than those of many other railroads and for that they should be commended. But just because CN work schedules are better than those of their competitors doesn’t mean they are good enough. Scheduling practices that allow crews to work up to 12 hours shifts, starting at midnight, for six days straight ignore the likely impact that schedule has on the crews and ultimately on public safety.

I recognize that the FRA does not currently have the authority to regulate work schedules. I am pleased that they are seeking this authority from Congress. I recognize that the crews voluntarily chose this schedule but question what choices they had. I recognize that changing crew scheduling practices has staffing implications and, therefore, cost implications for the railroads. The rules governing crew scheduling were formulated at the beginning of the 20th century, almost 100 years ago. This is the 21st century. Surely it’s time to modernize and update these practices. Surely it’s time to learn from the research that

has been done on the effects of fatigue on human performance. Just because the rules do not currently set limits on the hours that crews can work doesn't mean that limits shouldn't be voluntarily agreed to when it's in the best interest of the workers and public safety. I am convinced that railroads working with their unions, can still find a way to be profitable and implement 21st century scheduling practices. CN has taken important steps to regularize crew schedules. I hope they will consider going further and that other railroads will follow.

As a result of our investigation and report on the train accident in Macdona, Texas, on June 28, 2004, we determined that the probable cause of the collision was UP crew fatigue that resulted in the failure of the engineer and conductor to appropriately respond to wayside signals governing the movement of their train. Contributing to the crewmembers' fatigue was their failure to obtain sufficient restorative rest prior to reporting for duty because of their ineffective use of off-duty time and Union Pacific Railroad train crew scheduling practices, which inverted the crewmembers' work/rest periods. Three persons, including the conductor of the UP train and two local residents, died as a result of inhalation of chlorine gas that escaped from a punctured car and then engulfed the area. The UP train engineer, 23 civilians, and 6 emergency responders were treated for respiratory distress or other injuries related to the collision and derailment.

This serious accident prompted the Board to issue recommendation R-06-14 to FRA, which states: Require railroad to use scientifically based principles when assigning work schedules for train crewmembers, which consider factors that impact sleep needs, to reduce the effects of fatigue. That recommendation is every bit as important in addressing the schedule worked by the Anding crew that very likely led to their fatigue. For that reason, I asked the Board to reiterate this recommendation to the FRA. The Board declined to do so because it has been less than a year since this recommendation was issued and FRA seems to be taking affirmative steps to seek authority to address regulate work schedules. While I understand that is our traditional response, I disagree. Fatigue is on our Most Wanted list. It is a problem that plagues all modes of transportation, including the rail industry. I think it is important to use every opportunity to restate our concern and our recommendations to address that critical issue.

I also disagree with the Board's recommendation to the Occupational Safety and Health Administration (OSHA) to require and verify that railroads transporting hazardous materials participate in joint training exercises and drills with the communities through which they travel to evaluate emergency hazardous materials response plans. I fully concur with the goal of this recommendation, but do not support sending this recommendation to OSHA.

OSHA's principal job is to protect workers. The current regulatory requirement governing hazardous substances has to do with protecting workers whose jobs bring them in contact with such substances or who may be involved in clean up after a hazardous materials incident. Those plans to protect workers are to be shared by employers with the communities where they operate. While railroads, as employers, are covered by OSHA, they are not singled out or treated differently from any other employer when it comes to handling hazardous materials. Our recommendation asks OSHA to make a special rule for railroads regarding joint training exercises and drills with communities where the

railroads operate. I don't believe that is OSHA's job nor do I believe they can or will effectively implement this recommendation.

I do believe it is the job of the Department of Transportation, PHMSA, FRA, and the National Response Team to require that railroads work closely with states and communities to ensure adequate planning and preparation for hazardous materials events. That planning and preparation should include regular drills and exercises. In fact, the guidelines for states and communities authored by the National Response Team, recommends just such practices. All the agencies mentioned above participate as members of the National Response Team. The real question is who should be held accountable for making sure the plans are implemented and tested when it comes to railroads. I think that is the job of the National Response Team and the Department of Transportation, not the Department of Labor and OSHA.

Appendix A

Investigation

The National Transportation Safety Board was notified of the collision between two CN freight trains in Anding, Mississippi, about 8:00 a.m., eastern daylight time, on July 10, 2005. The investigator-in-charge and other investigative team members were launched from the Safety Board's Washington, D.C., Headquarters office and from the Los Angeles and Chicago regional offices. Member Deborah A. P. Hersman was the Board Member on scene. Investigative groups were formed to study operations, mechanical equipment, track, signals, survival factors, hazardous materials, event recorders, and human performance issues.

Parties to the investigation included the Federal Railroad Administration, the CN, the Brotherhood of Locomotive Engineers and Trainmen, and the United Transportation Union.

Appendix B

Time Line of Events for the Northbound Train's (IC 1013 North's) Accident Trip

Time	Event
12:30 a.m.	Northbound train crew reports for duty
3:38 a.m.	Northbound train departs Jackson
3:50 a.m.	Northbound train passes Cynthia at 57 mph ¹
3:58 a.m.	Northbound train passes Flora at 54 mph
4:00 a.m.	Witnesses hear northbound train's whistle north of Flora siding
4:10 a.m.	Northbound train passes detector: 41 mph in/46 mph out
4:14 a.m.	Northbound train passes Anding at 46 mph
4:14:35 a.m.	Northbound train trails through North Anding switch about 45 mph
4:15 a.m.	Collision with southbound train occurs

¹ Speeds at sidings are based on time distance averages between the south and north signals. Maximum authorized speed at these locations was 60 mph.

Appendix C

Emergency Response Events Time Line

Time²	Event
4:15 a.m.	Time of collision
4:24 a.m.	Yazoo City Emergency Services Dispatching Center receives report of accident and calls out Tri-Community Fire Department
4:32 a.m.	Bentonite Volunteer Fire Department (BVFD) receives call out
4:41 a.m.	BVFD arrives on scene, begins assessment, requests train consist through Yazoo County dispatch center
4:50 a.m.	BVFD begins evacuation of Anding
5:00 a.m.	Tank cars begin venting
5:25 a.m.	CN official arrives on scene
5:40 a.m.	CN official calls CN dispatcher on cell phone for consist information; northbound train consist information is received; however, cell phone service is interrupted before southbound train consist information is obtained
5:45 a.m.	Limited northbound train consist information is provided to BVFD based on call to CN dispatcher; BVFD requests train consist information from CN on-scene official
6:45 a.m.	Printed train consists arrive and are provided to BVFD; southbound train consist does not reflect cars set out or picked up at Greenwood
8:00 a.m.	Begin moving cars that did not derail away from the scene
8:25 a.m.	Fire suppression efforts commence using foam

² Many times listed are from handwritten logs or participants' recollections and should be considered approximate.

8:50 a.m.	Fire suppression efforts suspended because foam supply is exhausted
9:00 a.m.	Over course of several hours, access road is cut and accurate southbound train consist information is developed through site survey conducted on scene
1:40 p.m.	Entry assessment team reports that fire is fueled by diesel
4:40 p.m.	Last load of foam and foam application equipment arrive
6:00 p.m.	Fire suppression efforts resume
7:40 p.m.	Fire is declared extinguished
8:45 p.m.	Evacuation is lifted except for a few homes immediately adjacent to pileup; wreck clearing continues