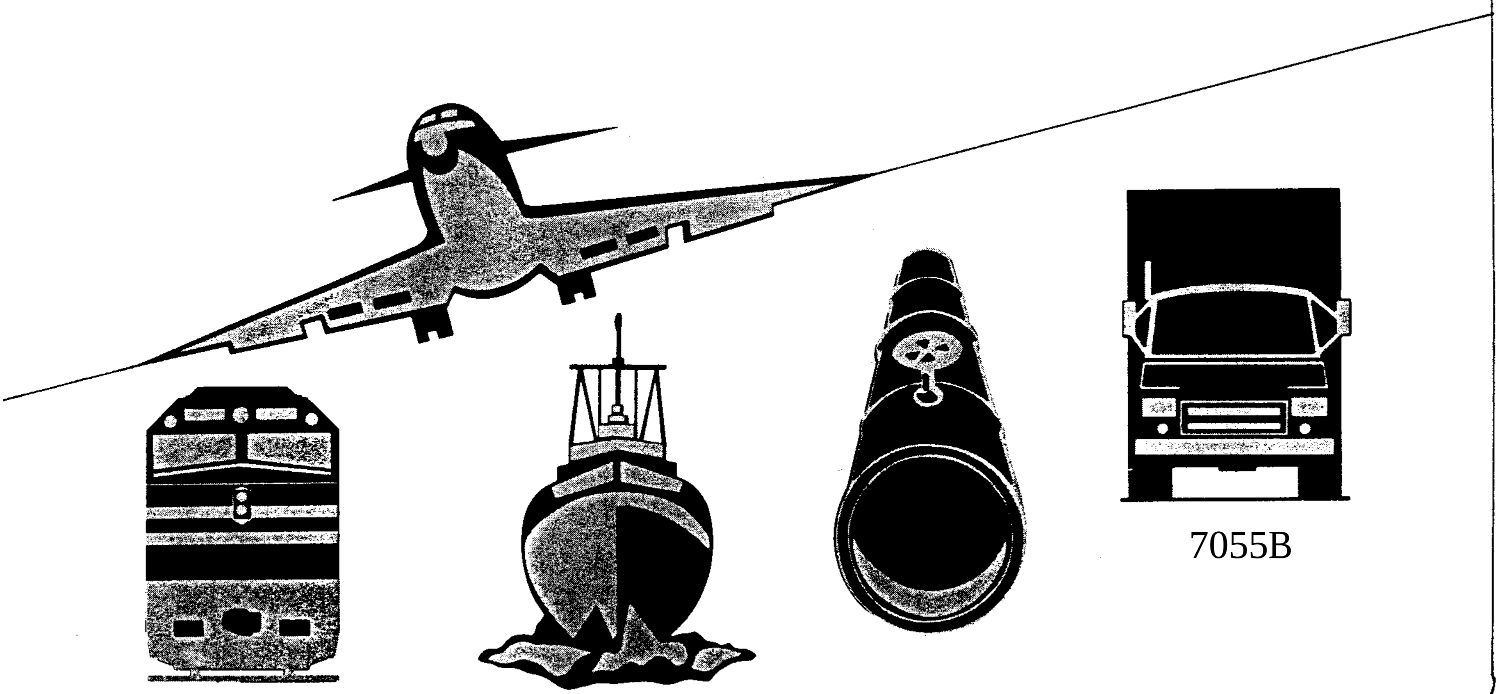
PB99-916303
NTSB/RAR-99/03

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

COLLISION OF NORTHERN INDIANA COMMUTER TRANSPORTATION DISTRICT TRAIN 102 WITH A TRACTOR-TRAILER PORTAGE, INDIANA JUNE 18, 1998



7055B

National Transportation Safety Board. 1999. ***Collision of Northern Indiana Commuter Transportation District Train 102 With a Tractor-Trailer, Portage, Indiana, June 18, 1998.*** **Railroad Accident Report NTSB/RAR-99/03. Washington, DC.**

Abstract: About 4:31 a.m. on June 18, 1998, a westbound Northern Indiana Commuter Transportation District two-car passenger train struck the second semitrailer of a long combination vehicle consisting of a tractor pulling two flatbed semitrailers loaded with steel coils at a highway-rail grade crossing near Portage, Indiana. When the vehicles collided, the second semitrailer broke away and was dragged by the train, while a chain securing a steel coil to the second semitrailer broke. The released coil entered the train's lead car through the front bulkhead and moved into the passenger compartment. Three fatalities and five minor injuries resulted.

The safety issues discussed in this report are safety at private grade crossings, the design of the National Steel Corporation's Midwest Steel grade crossing, the conspicuity of the long combination vehicle semitrailer, and the crashworthiness of the Northern Indiana Commuter Transportation District railcars.

As a result of its investigation, the National Transportation Safety Board issued recommendations to the U.S. Department of Transportation, the Federal Railroad Administration, the Federal Highway Administration, the Indiana Department of Transportation, the Northern Indiana Commuter Transportation District, the National Steel Corporation (Midwest Steel Division), and the Norfolk Southern Corporation. The Safety Board also reiterated one safety recommendation to the U.S. Department of Transportation.

The National Transportation Safety Board is an independent Federal agency dedicated to promoting aviation, raiload, highway, marine, pipeline, and hazardous materials safety. Established in 1967, the agency is mandated by Congress through the Independent Safety Board Act of 1974 to investigate transportation accidents, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The Safety Board makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

Recent publications are available in their entirety at **http://www.ntsb.gov/.** Other information about available publications may also be obtained from the Web site or by contacting:

National Transportation Safety Board
Public Inquiries Section, RE-51
490 L'Enfant Plaza, East, S.W.
Washington, D.C. 20594

Safety Board publications may be purchased, by individual copy or by subscription, from the National Technical Information Service. To purchase this publication, order report number **PB99-916303** from:

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161
(800) 553-6847 or (703) 605-6000

Railroad Accident Report

Collision of Northern Indiana Commuter Transportation District Train 102 With a Tractor-Trailer Portage, Indiana June 18, 1998

NTSB/RAR-99/03
PB99-916303
Notation 7055B
Adopted July 26, 1999

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

this page intentionally left blank

Contents

Executive Summary

About 4:31 a.m. central daylight time on June 18, 1998, a westbound Northern Indiana Commuter Transportation District two-car passenger train struck the second semitrailer of a long combination vehicle that consisted of a tractor pulling two flatbed semitrailers loaded with steel coils at a highway-rail grade crossing near Portage, Indiana. When the vehicles collided, the second semitrailer broke away from the first semitrailer and was dragged by the front of the train, while the single chain securing a steel coil to the second semitrailer broke. The released steel coil, weighing about 19 tons, entered the train through the front bulkhead of the lead car and moved into the passenger compartment. Three fatalities and five minor injuries resulted from the accident. Damages were estimated to total $886,000.

The National Transportation Safety Board determines that the probable cause of the collision between Northern Indiana Commuter Transportation District train 102 and a long combination vehicle (truck) at the National Steel Corporation's Midwest Steel grade crossing was ineffective action by Federal, State, and private agencies to permanently resolve safety problems at the Midwest Steel grade crossing, which they knew to be a hazardous crossing.

The major safety issues addressed in this report are

- Safety at private grade crossings,
- Design of the Midwest Steel grade crossing,
- Conspicuity of the long combination vehicle semitrailer, and
- Crashworthiness of the Northern Indiana Commuter Transportation District railcars.

As a result of this accident investigation, the Safety Board makes safety recommendations to the U.S. Department of Transportation, the Federal Railroad Administration, the Federal Highway Administration, the Indiana Department of Transportation, the Northern Indiana Commuter Transportation District, the National Steel Corporation (Midwest Steel Division), and the Norfolk Southern Corporation. The Safety Board also reiterates one safety recommendation to the U.S. Department of Transportation.

this page intentionally left blank

Factual Information

Accident Narrative

About 4:31 a.m. central daylight time[1] on Thursday, June 18, 1998, Northern Indiana Commuter Transportation District (NICTD) train 102, a two-car passenger train, collided with the right side of a long combination vehicle (LCV)[2] owned by Richard Pluta Trucking at the Midwest Division of the National Steel Corporation's (Midwest Steel's) grade crossing near Portage, Indiana.[3] (See figure 1 for a map of the region.) At this grade crossing, a private road leads north from U.S. Route 12 (US 12), intersects NICTD and Consolidated Rail Corporation (Conrail)[4] railroad tracks, and continues to the Midwest Steel facility and other businesses. The collision occurred on the westward NICTD track. (See figure 2 for a diagram of the various vehicles and the accident scene.)

Shortly before the collision, while the LCV was traversing the NICTD tracks, the approach of the westbound Conrail train 201 had activated the flashing light signals and automatic gates at the Conrail crossing. The truckdriver stopped the LCV before the Conrail crossing's south gate. The vehicle's second semitrailer was resting on the westward NICTD track. At this time, NICTD train 102, traveling westbound about 68 mph, was approaching the Midwest Steel grade crossing.

About 542 feet east of the crossing, the train 102 crew noticed the LCV's second semitrailer, which carried a steel coil (weighing about 19 tons) covered by a black tarp, on the crossing. The engineer said that he placed the train in emergency braking; then, followed by the conductor, he exited the control compartment and ran toward the rear of the passenger compartment. The crew alerted passengers in that area about the impending collision and told them to evacuate.

As the collision occurred, the LCV's second semitrailer broke away from the first semitrailer and was dragged by the front of the NICTD train, while the single chain securing a steel coil to the second semitrailer broke. The released steel coil entered the lead car of the train through the front bulkhead. The coil moved through the car until it came to rest about 34 feet into the passenger compartment. (See figures 3, 4, 5, and 6.) Three fatalities and five minor injuries among the passengers resulted.

[1] Unless otherwise noted, all times are in central daylight time.

[2] The LCV comprised a tractor and two semitrailers bearing three steel coils.

[3] All train movements and locations are within Indiana unless otherwise specified.

[4] At the time of the accident, Conrail operated the northern portion of the Midwest Steel crossing. As of June 1, 1999, the Conrail operation in this area was taken over by the Norfolk Southern Corporation. To avoid confusion, this report will continue to refer to the "Conrail" tracks for the remainder of the report.

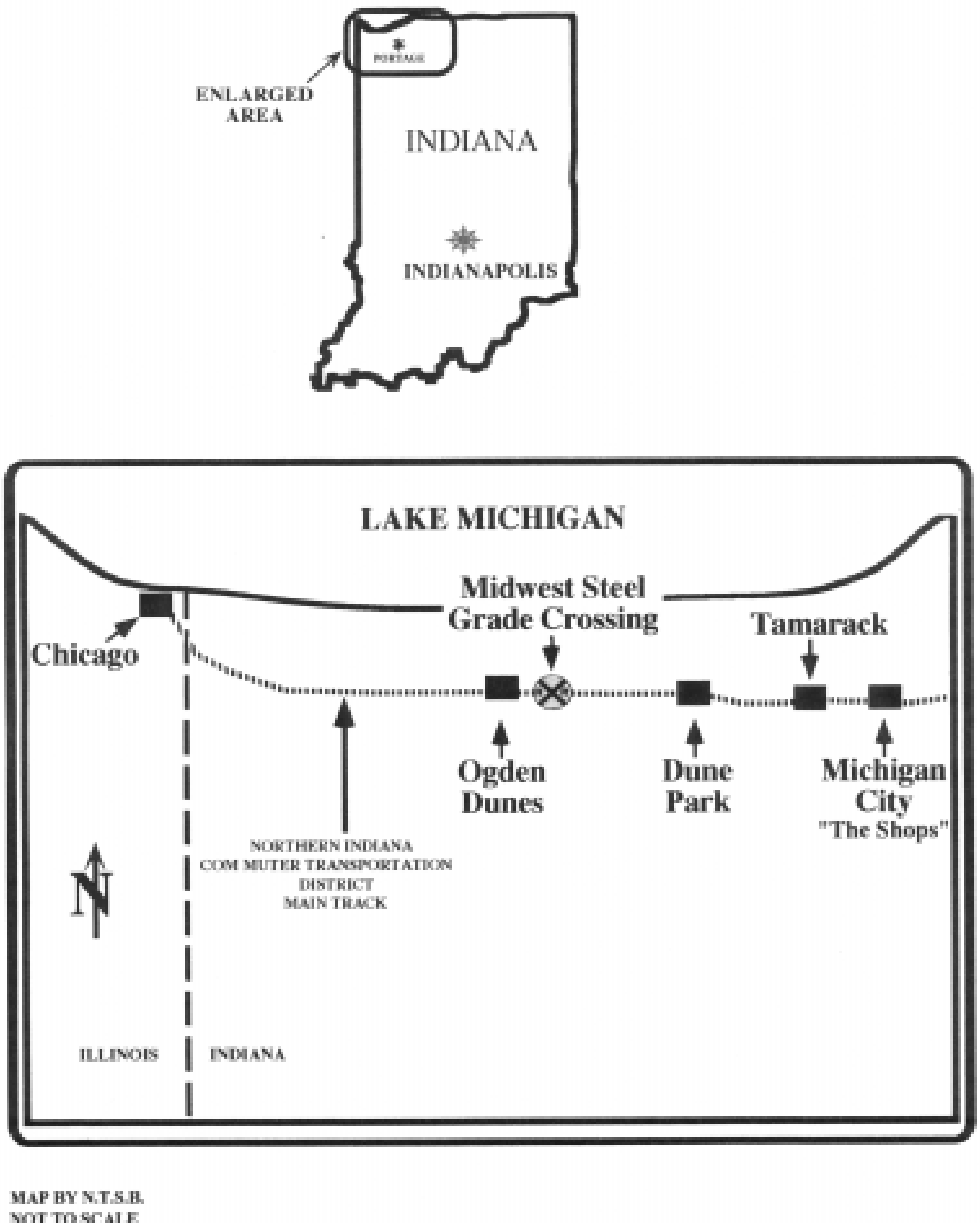


Figure 1. Map of accident area

Long Combination Vehicle

The LCV had been traveling from Detroit, Michigan, to Portage, Indiana, with a load of three coils of steel. The truckdriver arrived at the Midwest Steel grade crossing about 4:29 a.m., after traveling northbound on State Route 249 and turning eastbound on US 12. The driver stated that he drove in the rightmost of the two left turn lanes. He said he stopped and waited for the traffic signal to turn green (with an arrow); when it did, he began to turn northward toward the Midwest Steel facility. The driver's destination was PreCoat Metals, a company located next to the National Steel Corporation's Midwest Division facility.

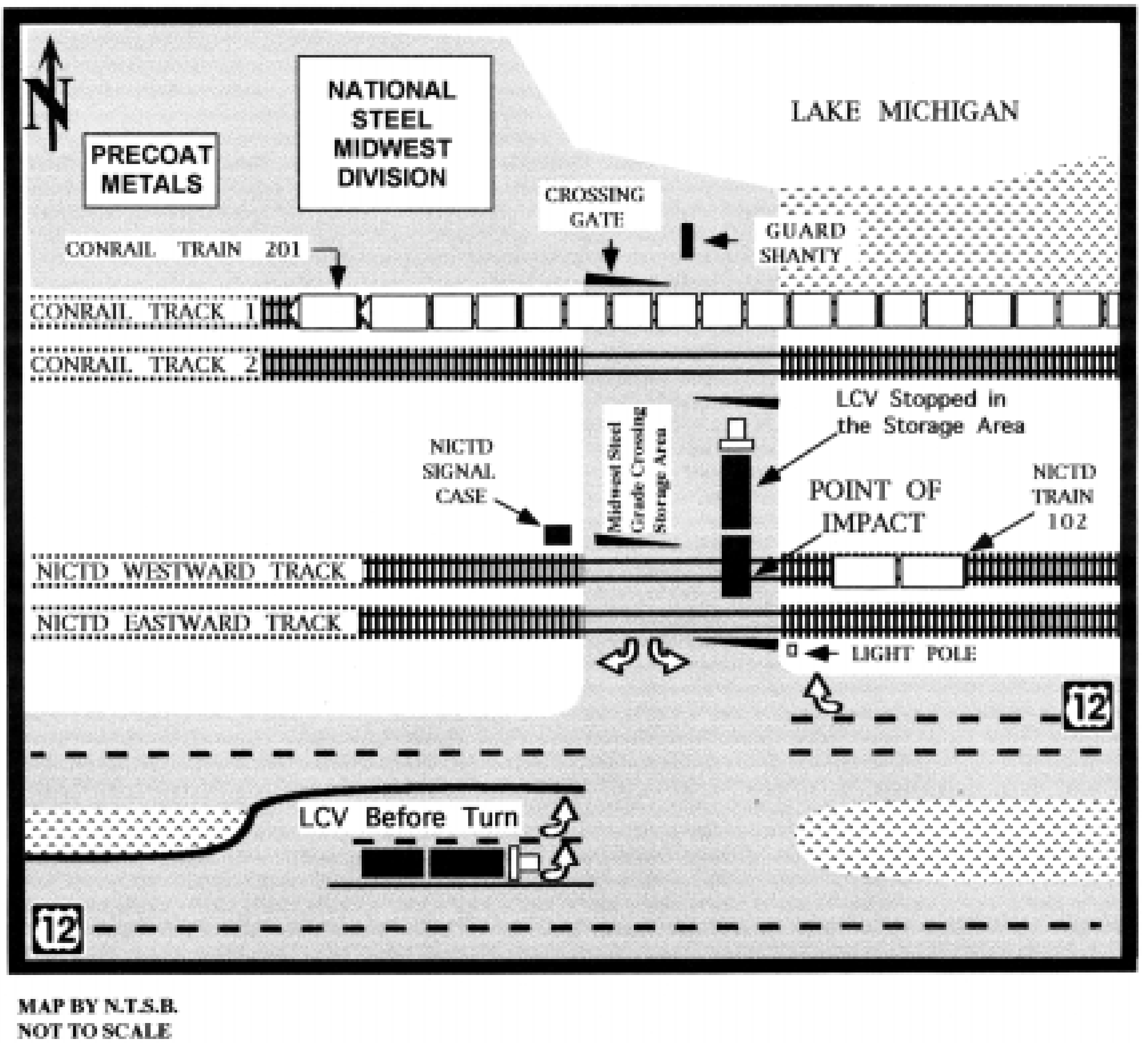


Figure 2. Scene of collision at Midwest Steel grade crossing

The truckdriver said that while he was making the turn into the Midwest Steel crossing, he did not see any approaching trains and the crossing gates and lights were not activated. According to the truckdriver, as he entered the area between the two sets of tracks (NICTD and Conrail), the Conrail gates and lights activated, and he stopped the LCV short of the descending inner gate. The second semitrailer of the 82-foot-long LCV remained on the NICTD westward track, clear of the descending southern outer NICTD gate. The northern inner NICTD gate remained in the "up" position.

As Conrail train 201 passed through the crossing, the truckdriver looked out his left door-mounted rearview mirror and saw the northern inner NICTD gate descending and the lights flashing. He said this indicated to him that a train was approaching on the NICTD tracks. According to the driver, he attempted to turn his vehicle to the left to pull the semitrailer off the tracks, but he did not have enough room or time. The commuter

Figure 3. East (undamaged) end of NICTD car 11

Figure 4. West (damaged) end of NICTD car 11

Figure 5. Steel coil inside NICTD car 11

Figure 6. Steel coil outside NICTD car 11

train struck the rear semitrailer, shearing off the kingpin and separating it from the first semitrailer of the LCV.

The truckdriver was not injured in the collision, and he remained with his vehicle until emergency response personnel arrived.

NICTD Train 102

The two-person crew (a conductor and an engineer) on NICTD train 102 had reported for duty at 3:57 a.m. in Michigan City, Indiana. Train 102 was a regularly scheduled westbound passenger train traveling from Michigan City to Chicago, Illinois, and consisting of two multiple-unit (MU) cars. The crew made the required predeparture inspections and reviewed the general orders. Finding no anomalies, the crew began the trip at 4:02 a.m.

After making a scheduled stop at the Michigan City Station, train 102 departed at 4:07 a.m. and proceeded on its route, making stops at the Tamarack and Dune Park Stations. Train 102 departed Dune Park at 4:22 a.m., heading toward its next scheduled stop at the Ogden Dunes Station. The conductor joined the engineer in the control compartment of the first car.

The train 102 engineer said that between milepost (MP) 48.0 and 50.0, he attempted to accelerate to the authorized speed of 79 mph. According to event recorder information, the train reached 78 mph for about 20 seconds before the engineer changed the throttle to a coasting position for the reduced speed limit at MP 50.0. As train 102 approached the Midwest Steel grade crossing (MP 49.77), the engineer observed a white tractor at the crossing. The engineer said that as train 102 neared the Midwest Steel grade crossing, conditions were dark with a light fog and it was difficult to see, so he asked the conductor to help him determine what was at the crossing. Both crewmembers believed that the tractor became visible about six pole lengths[5] (1,020 feet) from the crossing. The engineer said that when train 102 was about five pole lengths (850 feet) east of the crossing, he saw a semitrailer on the crossing and put the braking control into the emergency position. The conductor and engineer then left the control compartment and ran toward the rear of the car to warn the passengers of the impending collision.

One passenger, who was a NICTD employee, left his seat on the north side of the first car (near the control compartment) and followed behind the crewmembers. He did not reach a safe location before the steel coil moving through the railcar overtook him. The steel coil also overtook two passengers who were riding on the south side of the first car while they were at or near their seats. The railroad employee and the two other passengers received fatal injuries from the moving coil of steel. (See figure 7, passenger car diagram.) The cars remained coupled during the accident, and neither car derailed. No fire occurred in either car.

[5] The NICTD train crewmembers referred to distances in “pole lengths,” in reference to the distance between the catenary poles running along the track. The distance between the catenary poles east of the Midwest Steel grade crossing was 170 feet.

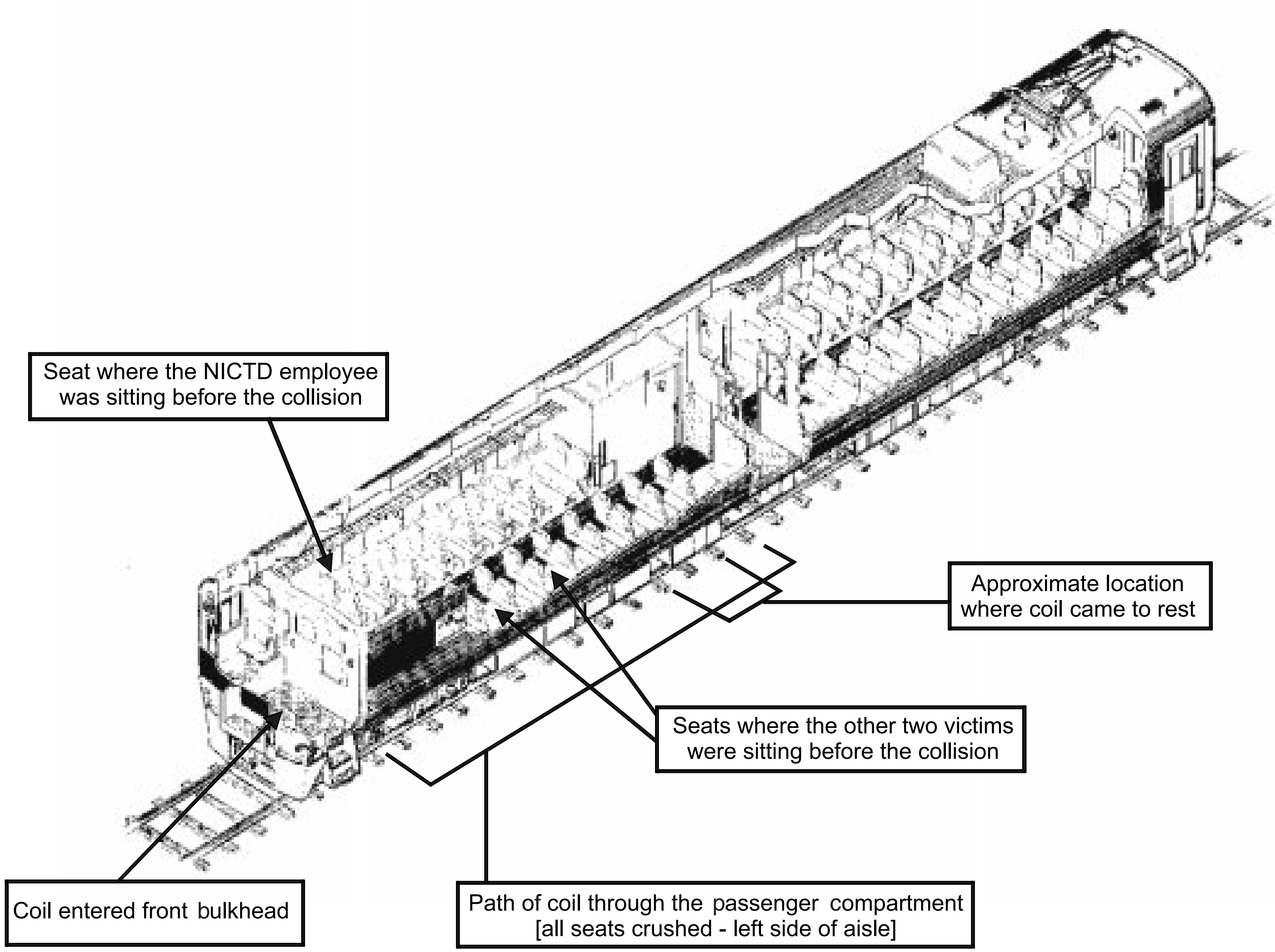


Figure 7. View of a typical NICTD Nippon Sharyo passenger railcar (Source: *NICTD Running Maintenance and Troubleshooting Manual, September 1982 edition, as modified by the Safety Board.*)

After the impact with the LCV, all the lights went off in train 102's first car, and the engineer observed that the front of the train was "just collapsed, like it was folding." Lights remained on in the second car. The engineer said he ran into the second car and remained there until the train came to a complete stop. He then moved to the operating cab in the rear of the second car and radioed the dispatcher to inform him that "we had hit a truck at the Midwest rail crossing and for him to get emergency personnel out as quickly as possible."

The engineer said he then returned to the first car to attempt to help the injured passengers. On the way, he met the conductor, who was going to the second car. The engineer took the conductor's flashlight and continued into the first car, where he saw the injured NICTD employee. The engineer said he shone his flashlight toward the front of the car, where he knew two passengers had been. He did not see anyone, and he did not hear anything. He went back to the second car and called the dispatcher again to let him know that the conductor was safe. He also advised the dispatcher that the coil had come into the car.

The 13 remaining passengers and the 2 members of the crew exited through the last door on the south side of the second car. By the time they had exited the train, emergency personnel (police) were arriving, and the engineer told them where to find the injured passengers. He said he tried to open the center door of the first car by using the emergency pull, but the door was jammed. The engineer then went to the north side of the first car and opened the emergency exit there.

Conrail Train 201

The crewmembers on Conrail train 201, which was a freight train, could not recall whether they had seen a truck at the Midwest Steel crossing. As Conrail train 201 passed the crossing, its conductor saw a "blue flash" in the rearview mirror on the left side of the locomotive cab. The conductor commented on the flash to the Conrail engineer, who also looked back.

They estimated that their train's speed was about 45 mph when passing the crossing. At the Midwest Steel crossing for Conrail trains, freight trains were allowed to travel 60 or 50 mph, depending on the type of train. The Conrail engineer said he was intentionally operating at a reduced speed because a train ahead of train 201 had to stop and switch cars.

Emergency Response

The accident site was under the incident command of the Portage Fire Department (PFD) of Porter County, Indiana. A Midwest Steel representative notified the Portage Police Department (PPD) dispatcher of the accident at 4:35 a.m. The PPD dispatcher dispatched Portage police, fire, and emergency medical services (EMS) personnel at 4:36 a.m. The PFD chief arrived on the scene at 4:44 a.m. and was advised that a steel coil was halfway into the first NICTD car and had pinned two people. At 4:49 a.m., the fire chief established incident and medical command and became the incident commander.

The fire chief requested that off-duty PFD and EMS personnel report to the station and called for mutual aid from the Ogden Dunes Volunteer Fire Department and the South Haven Fire Department, as well as an additional ambulance from the Porter Memorial Hospital EMS. At this time, the incident commander was advised that three people were inside the first NICTD car and that two were dead and one was alive but severely injured and pinned under the steel coil.

The PFD chief immediately requested a crane from Midwest Steel or the Port of Indiana to raise the coil. The assistant PFD chief asked the PPD dispatcher to request a University of Chicago Aeromedical Network helicopter and additional assistance. The assistant chief also contacted the Methodist Hospital, Northlake campus, to request a surgeon. While the additional help was being sought, a paramedic firefighter tried to communicate with, administer oxygen to, and monitor the cardiac status of the severely injured person pinned under the coil.

About 5:14 a.m., the incident commander was told that the injured person had lost all vital signs. The request for the helicopter was canceled, and all personnel left the NICTD train. The PFD chief released all units from the scene at 11:39 a.m.; he remained on the scene until the train was removed by NICTD.

Five people with minor injuries were transported or transported themselves to hospitals. All were treated and released the same day. A total of 22 emergency response personnel, 2 fire engines, and 2 ambulances responded from the PFD for this accident.

Injuries

Table 1. Injuries

Type*	Train Crew	Railroad Personnel	Truckdriver	Passengers	TOTAL
Fatal	0	1	0	2	3
Serious Injuries	0	0	0	0	0
Minor Injuries	0	0	0	5	5
No Injuries	2	0	1	8	11
Total	2	1	1	15	19

*Based on the injury criteria of 49 *Code of Federal Regulations* (CFR) 830.2 of the International Civil Aviation Organization, which the Safety Board uses in accident reports for all transportation modes.

Damage[6]

Truck semitrailers	$11,000
Train car 11	750,000
Train car 45	75,000
Signal	50,000
Total	$886,000

NICTD Train 102 Crew

NICTD records showed that each crewmember was qualified on the physical characteristics of the territory and the operating rules for trains over the NICTD system. The engineer and conductor typically worked together.

The engineer said that on the morning of the accident, he had awoken at 2:45 a.m. feeling rested. He had not worked on June 17 and had gone to bed that night at 9:30 p.m. and fell asleep about 10:30 p.m. On June 16, he had been woken up at 8:00 a.m. by a dispatcher who requested that he work that day (normally his day off). He departed for work at 9:45 a.m. and went off duty at 6:45 p.m.

The conductor said that on the morning of the accident, he had awoken at 2:45 a.m. feeling rested. He had had June 17 off and had gone to sleep at 8:15 p.m. that night. On June 16, which was normally his day off, he had worked with the engineer. That night, he went to bed at 10:30 p.m. and awoke about 7:00 a.m. on June 17.

On June 18, both the engineer and conductor had reported for duty at 3:57 a.m. Their train departed from the home terminal in Michigan City, Indiana, about 4:02 a.m. NICTD had scheduled them to finish work that day at 7:47 a.m. Both were compliant with the Federal Hours of Service Law.

Medical Factors

Both the engineer and conductor had received company physicals within the last 2 years and were in good health and qualified for service. Neither reported having taken any prescription or nonprescription medications on the day of the accident.

Training and Experience

The engineer, 33, had been working for NICTD as an engineer for about 9 years. He started with the railroad in May 1985 and had worked in the transportation department since January 1986. He had been working over the territory between Michigan City and Chicago since 1986, first as a collector and, since 1989, as an engineer.

[6] The truck semitrailer damage information was provided by Richard Pluta, the trailer owner. NICTD provided the rail damage information.

In accordance with Federal regulations covering the certification of locomotive engineers (49 CFR Part 240), NICTD records showed that the engineer's certification was current. The records included his motor vehicle driving record, as well as the findings of his physical exams, operational rules tests, and on-board performance checks.

The conductor, 41, had worked for NICTD for almost 20 years. He was hired on August 21, 1978, and became a conductor on August 23, 1980. He had operated between Michigan City and Chicago for about 20 years.

Truckdriver

Training and Experience

The truckdriver, 39, had been working as a truckdriver since 1985. He held a valid Michigan Class A commercial driver's license (CDL) with an endorsement for double and triple semitrailers. His license had no restrictions. He had a valid medical card, and his most recent medical examination had been on January 8, 1998. The driver said he was in good health and not under a doctor's care.

The truckdriver's driving history showed the following incidents:

3/09/92	Improper class/endorsement on CDL
5/21/92	Speeding
10/08/93	Speeding
9/11/95	Traffic collision, no injury (property damage only)
1/23/98	Speeding

At the time of the collision, the truckdriver was driving a vehicle owned by Richard Pluta Trucking. The vehicle and driver were on a long-term lease to Eastern Express, Inc., of Griffith, Indiana. The lease included a provision that allowed the driver to trip lease[7] with other carriers when Eastern Express did not have work for him.

Eastern Express officials said that the truckdriver had been working for them since January 1995. He had undergone pre-employment drug and alcohol testing, as well as three random drug and alcohol tests while employed by Eastern Express, and the results had all been negative. (The last random drug test had taken place on February 3, 1998.) The driver had also passed a company background check.

Company officials said they were satisfied with the driver's work, but they had not heard from him since May 20, 1998. If a driver did not report for 30 days, company policy was to terminate that driver's employment. Eastern Express said it had been preparing to terminate this driver's employment but had not yet done so when the accident occurred.

[7] A short-term lease under which a driver and vehicle are contracted to haul goods for a single trip (usually one way). Trip leases are commonly used by carriers needing additional drivers and vehicles.

The truckdriver had used the Midwest Steel grade crossing regularly between 1985 and 1993. He estimated that he traveled over the crossing twice a week during this period. Nearly all these crossings were made in vehicles with double semitrailer configurations. Since 1995, when he began working for Eastern Express, up to and including the accident trip, he estimated that he had used the Midwest Steel crossing two or three times.

Accident Trip

On June 15, 1998, the truckdriver entered into a trip-lease agreement with Top Line Express of Lima, Ohio. He was to pick up steel coils from Bethlehem Steel in Burns Harbor, Indiana, and deliver them to Flat Rock Metals in Flat Rock, Michigan, and Michigan Steel Processing in New Boston, Michigan. According to the driver's logbook, he picked up the load at Bethlehem Steel about 4:00 p.m. on June 15 and began to drive about 7:45 p.m. The truck had a mechanical failure en route, so he stopped at a truck stop in New Buffalo, Michigan, disconnected the semitrailers, and went home to nearby Niles, Michigan. He went to bed about 2:15 a.m.

On June 16, he woke at noon and drove the tractor to Be-Right Truck Repair in Gary, Indiana. (Be-Right Truck Repair is co-owned by the accident truck owner.) He spent the day at a restaurant and the repair shop. The vehicle was repaired about 4:00 p.m., and the driver drove the tractor home. He ate dinner, watched television, and went to bed about 9:00 p.m. He woke about 12:30 a.m. on June 17 and began his delivery trip about 1:30 a.m.

The truckdriver's log indicates that he made his first delivery to Flat Rock Metals about 5:30 a.m. and departed about 7:45 a.m. Security logs at Flat Rock Metals showed that he arrived at 5:50 a.m. and departed at 8:40 a.m. His log indicates that he then drove to Michigan Steel Processing, about 7 miles away.

The truckdriver contacted Top Line Express's agent about 2:15 p.m. to ask whether the agent had a return load for him. He was told to go to Thyssen Steel in Detroit and pick up three steel coils for delivery to PreCoat Metals, Inc., in Burns Harbor, Indiana. He did not obtain a signed copy of the trip lease or the required weight permit for Indiana.

The truckdriver arrived at Thyssen Steel between 3:00 and 3:30 p.m. According to the bill of lading, loading was completed at 4:19 p.m. The driver went to a truck stop in Detroit, where he rested in the truck's sleeper berth from 5:00 p.m. to about 11:00 p.m. He said he got up feeling rested. He then drove to Burns Harbor to make the delivery, arriving about 4:29 a.m. Table 2 lists the reported activities of the truckdriver during the 3 days preceding the accident in chart form. (Some times provided in table 2 are estimated.)

Table 2. Truckdriver's activities between June 15 and June 18, 1998

Date and Time		Driver's Actions
June 15	12:00 a.m. to 9:00 a.m.	Slept.
	9:00 a.m. to 10:00 a.m.	Woke up and ate.
	0:00 a.m. to 3:00 p.m.	Worked around house.
	3:00 p.m. to 4:00 p.m.	Called Top Line Express.
	4:00 p.m. to 8:00 p.m.	Picked up steel at Bethlehem Steel, Burns Harbor, Indiana.
	8:00 p.m. to 9:00 p.m.	Drove to New Buffalo, Michigan. Truck broke down.
	9:00 p.m. to 12:00 a.m.	Logged off duty. Watched TV and ate.
June 16	12:00 a.m. to 2:15 a.m.	Logged off duty. Watched TV and ate.
	2:15 a.m. to 1:00 p.m.	Slept, woke about 12:00 p.m. Dressed.
	1:00 p.m. to 2:00 p.m.	Drove to Gary, Indiana, to have tractor repaired.
	2:00 p.m. to 4:00 p.m.	Waited for repair.
	4:00 p.m. to 5:00 p.m.	Drove to New Buffalo, Michigan.
	5:00 p.m. to 9:00 p.m.	Watched TV and ate.
	9:00 p.m. to 12:30 a.m.	Slept.
June 17	12:30 a.m. to 1:30 a.m.	Woke up. Prepared for trip.
	1:30 a.m. to 6:00 a.m.	Drove to Flat Rock Metals in Flat Rock, Michigan.
	6:00 a.m. to 9:00 a.m.	Delivered steel to Flat Rock Metals, drove to Michigan Steel Products.
	9:00 a.m. to 11:00 a.m.	Off-loaded steel at Michigan Steel Products.
	11:00 a.m. to 2:15 p.m.	Ate lunch (no log entries).
	2:15 p.m. to 3:00 p.m.	Called Top Line Express agent and drove to Thyssen Steel in Detroit, Michigan.
	3:00 p.m. to 5:00 p.m.	Was at Thyssen Steel.
	5:00 p.m. to 11:00 p.m.	Ate dinner and rested in sleeper berth.
	11:00 p.m. to 12:00 a.m.	Departed for PreCoat Metals.
June 18	12:00 a.m. to 4:29 a.m.	Drove to Midwest Steel crossing.
	4:31 a.m.	Collision at Midwest Steel crossing.

Train

Mechanical

The Safety Board reviewed the inspection records for NICTD train 102. The records indicated the train had been mechanically inspected at 11:00 p.m., June 17, 1998. No defects were reported.

Train Consist

The MU lightweight stainless steel passenger railcars that NICTD operates in revenue service are self-propelled electric cars. Each 85-foot-long, 118,000-pound car operates on 1,500 volts DC supplied by overhead catenary wire. The operator controls are in control compartments at both ends of each car, allowing individual unit operation. NICTD operates its trains in consists of up to eight cars. Each car generally has a 93-passenger seating capacity and is fitted with bench seats that accommodate 2 passengers each.

NICTD car 11 (the lead car) was built in 1982. It was designed to generate 640 hp and was equipped with schedule 26B1 brake equipment. NICTD records show that car 11 passed an annual inspection on May 11, 1998. It could seat 93 passengers.

NICTD car 45 (the trailing car) was built in 1992. It was also designed to generate 640 hp and was equipped with schedule 26B1 brake equipment. NICTD records show that car 45 passed an annual inspection on June 15, 1998. It could seat 110 passengers. Both cars on NICTD train 102 were equipped with model 1260 event recorders from Peerless Instrument Company, Inc. Event recorder data indicated the train had been traveling at 68 mph when the emergency brakes were applied.

NICTD Operations

NICTD was established in 1977 by an act of the Indiana General Assembly and is an agency of the State of Indiana. NICTD provides passenger service between the Michiana Regional Airport in South Bend, Indiana, and Randolph Street Station in Chicago, Illinois. The line is about 90 miles long.

The rules for the NICTD railroad are set forth in an operating rulebook[8] and are supplemented and modified by timetable. Daily bulletins are used to show changes to the rules. If necessary, train orders are issued to immediately implement an operating rule or modify an existing rule. The permanent track speeds for NICTD trains are designated in the timetable, and temporary speed restrictions are issued by track bulletin.

NICTD uses wayside block signals. This automatic block signal system is primarily activated by conditions in the field, such as the presence of other railroad equipment

[8] The rulebook is the *Chicago South Shore and South Bend Railroad and Northern Indiana Commuter Transportation District, Rules and Regulations for the Government of the Operating Department*. It became effective September 1, 1986, and contains revisions added in April 1990.

or disruptions in the electrical circuit running through the rail from one block signal to the next. The majority of the signals cannot be controlled by a train dispatcher.

NICTD train 102 is a scheduled passenger train and, according to NICTD officials, carries about 200 passengers daily.

The NICTD railroad uses an efficiency testing program under which a supervisor had observed both the engineer and conductor performing their duties. In 1997, the engineer had been observed 28 times and the conductor 36 times. No exceptions were reported. Some of these observations occurred without the employees' knowledge. Results indicated that both employees routinely performed appropriately at grade crossings.

Truck

The LCV was a conventional truck tractor in combination with two heavy semitrailers; such a unit is commonly referred to as a "Michigan Train."[9] (See figures 8 and 9 for a photo of a Michigan Train as well as a diagram of the Michigan Train involved in this accident.) The vehicle was 82 feet long, and it had a gross vehicle weight (GVW) of 153,115 pounds.[10]

The truck tractor was a 1996 white GMC, model WIA64TES, three-axle conventional tractor with a sleeper cab. It was equipped with a model 3406E six-cylinder Caterpillar diesel engine, an Eaton-Fuller model RTX-16709B nine-speed transmission, and two Eaton model DS402 (3:90 ratio) rear-drive axles. The tractor was equipped with S-cam airbrakes.

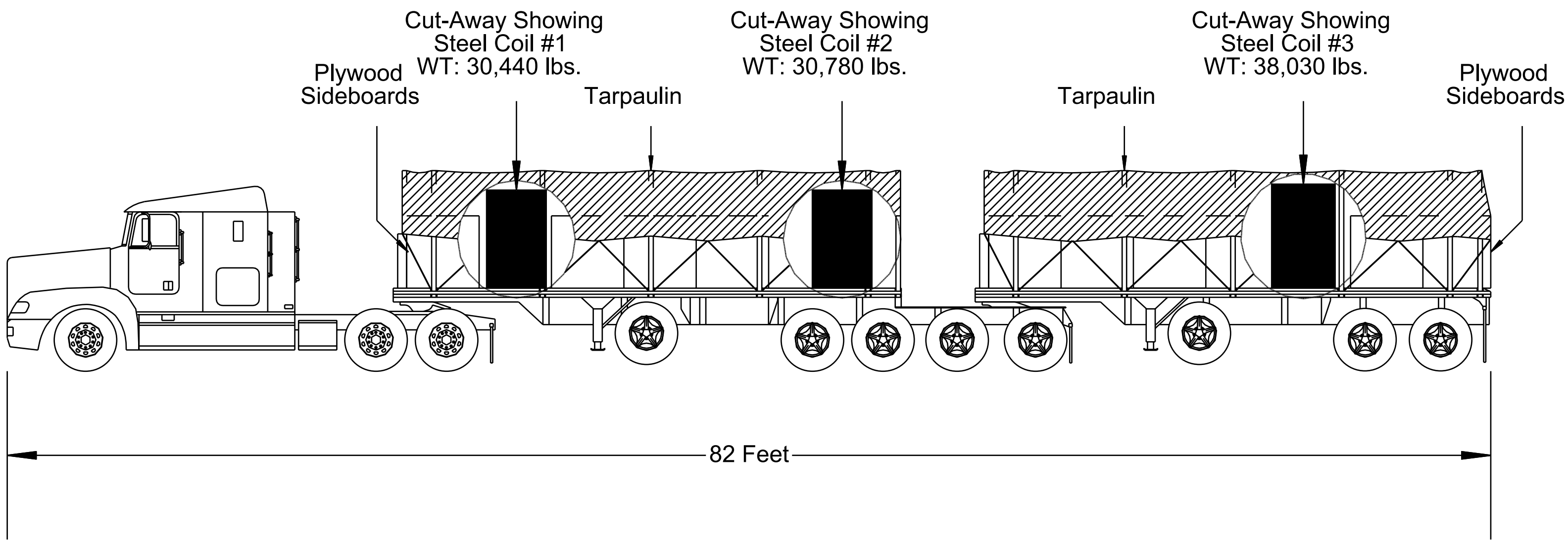
The first semitrailer was a 1973 ASM five-axle flatbed trailer with a fifth wheel hitch. The semitrailer was equipped with type 30 S-cam airbrakes on all five axles. The trailer bed was 28 feet long. The total semitrailer length to the rear of the frame, which extended about 10 feet beyond the trailer bed, was 38 feet.

The second semitrailer was a 1969 Fruehauf three-axle flatbed trailer. The semitrailer was equipped with type 30 S-cam airbrakes on all three axles and was 28 feet, 6 inches, long.

[9] A *Michigan Train* is a three-axle truck tractor in combination with a five-axle primary trailer equipped with a fifth wheel and trailed by a three-axle semitrailer. Michigan Trains generally have a total of 11 axles. Although these combination units are normally prohibited in Indiana, by using special designated routes and weight permits, they may transport goods, often steel, from Michigan to industrial locations in northern Indiana.

[10] The maximum GVW permitted in Indiana is 80,000 pounds. With a special weight permit, Michigan Trains may haul up to 134,000 pounds in Indiana over specified routes.

Figure 8. A Michigan Train at the Midwest Steel grade crossing



(Note: This is a non-scale version of the truck involved in this accident, to include the placement of the steel coils.)

Figure 9. Diagram of the Michigan Train involved in this accident (Safety Board)

Truck Position and Roadway Evidence

Police reported that when they arrived at the scene soon after the accident, the front of the tractor was about 6 feet south of the southernmost Conrail gate, and the rear of the first semitrailer was about 7.5 feet north of the northernmost NICTD rail.

Tiremarks from the second semitrailer's three axles were found. The tiremark from the first axle was about 53 feet long, running east to west and generally parallel to the north edge of the northernmost NICTD rail. The tiremark from the second axle was about 1 foot long and lay between the NICTD double tracks, about 3 feet from the southernmost rail for the westward mainline. The tiremark from the third axle was about 13 feet long. It lay between the NICTD double tracks and began about 8 feet from the southernmost rail for the westward mainline. All three tiremarks began about 15 to 20 feet from the east edge of the crossing pavement.

Load and Load Securement

The truckdriver had picked up the load of three steel coils at Thyssen Steel Group in Detroit, Michigan. According to the bill of lading, the motor carrier was Top Line Express, and the coils were to be delivered to PreCoat Metals, Inc., in Portage, Indiana. The (gross) weight of the three coils was listed as 1) 38,030 pounds, 2) 30,137 pounds, and 3) 30,468 pounds. The coils were loaded in reverse order, with the first coil placed on the rear semitrailer and the second and third coils on the lead semitrailer. The coil placed on the rear semitrailer was 72 inches in outside diameter, 41 inches wide, and had an open center ("eye").

After the accident, an Indiana State trooper found the two coils secured to the lead semitrailer by a chain over each coil. "Bump chains"[11] were also found. All the chains were 3/8-inch grade 7 chains with 6,600-pound working load limits (WLLs).

The truckdriver told the Safety Board that the coil on the rear semitrailer had been held by three chains. The driver said that to fix the position of the coil he had used one bump chain, one "over-the-top" chain, and one chain to keep the coil from moving backwards. During postaccident inspection of the semitrailers and NICTD car 11, investigators found one broken chain; it was also a 3/8-inch grade 7 chain. Title 49 CFR 393.102 (b), "Securement Systems," states that "the aggregate WLL of the tiedown assemblies used to secure an article against movement in any direction must be at least 1/2 times the weight of the article." The 38,030-pound steel coil would have required three 3/8-inch grade 7 chains with a cumulative WLL of 19,800 pounds, or 52 percent of the weight of the coil, to secure it according to regulation. Neither the bump chain nor the one used to keep the coil from moving rearward can be used in calculating the number of chains needed to secure the load. The three chains required by the securement regulation have to go "over the top" of the coil or "through the eye."[12]

[11] A *bump chain* is fastened over a wood block and in front of the steel coil. The bump chain keeps the steel coil from moving forward during a forceful brake application.

[12] 49 CFR 393.100 (iii) (a) (1), (2), and (3).

The executive director of the National Association of Chain Manufacturers told the Safety Board that too many variables exist to effectively calculate how many chains would have been needed to keep the coil secured to the rear semitrailer after the impact with the train, but three chains would probably not have kept the coil from breaking loose from the semitrailer. The Safety Board analyzed the load securement configuration as specified by Federal regulations (using three chains) for steel coil transport. The Board's computations showed that the rigging of three chains would have failed by a factor of about eight in this accident.

Vehicle Conspicuity

The second semitrailer had three amber lens lights, each about 2.5 inches in diameter, installed on both sides at a frame rail height of about 50 inches. The rear of the semitrailer had two tail lights and two combination brake and turn signal lights. The front corners of the semitrailer had one amber light each. Additionally, the semitrailer had round lens-style reflectors on the front corners, sides, and rear. Postaccident examination of the bulbs and electrical testing of the second semitrailer revealed that the lights had been on at the time of the accident.

Neither semitrailer was equipped with retroreflective tape. The Federal Conspicuity Systems law (49 CFR 571.108) mandates that all trailers manufactured after December 1, 1993, with a GVW rating in excess of 10,000 pounds and a width of at least 80 inches have retroreflective sheeting tape along both sides and the rear. Both semitrailers had been manufactured before December 1, 1993.

Track

NICTD

NICTD owns, inspects, and maintains its track structures. As Federal Railroad Administration (FRA) class 4 track, both the NICTD eastward and westward main tracks (from south to north) have a maximum allowable operating speed of 79 mph for passenger trains and 35 mph for freight trains.

An electrically energized catenary wire is situated over the approximate centerline of each NICTD track. The wire is supported by a series of wayside catenary support poles situated outboard of the track roadbed along the right of way.

Investigators found no abnormalities during the postaccident inspection of the track. A visual inspection of the rail did not reveal any fractures that may have interrupted signal circuitry. In addition to inspecting the track physically, the Safety Board reviewed NICTD track inspection records from May 19, 1998, to June 18, 1998. The inspection frequency for both main tracks met FRA requirements, and remedial corrective actions were taken when track defects were noted. No deficiencies were noted at the Midwest Steel grade crossing. All NICTD track inspections were conducted by designated individuals qualified under 49 CFR 213.7.

NICTD had conducted the most recent internal rail inspection in the area of the Midwest Steel grade crossing on November 6, 1997. During a visual inspection, investigators found no fractures that could have interrupted signal circuitry within the Midwest Steel grade-crossing area.

Conrail

The Conrail track consists of main track No. 2 and main track No. 1 (from south to north), which are tangent and about level in this vicinity. All train operations were remotely controlled by the Conrail train dispatchers in Dearborn, Michigan, and a traffic control signal system.[13] Besides Conrail trains, CP Rail System, Indiana Harbor Belt, CSX Transportation, and Amtrak trains operate over the Conrail tracks at the Midwest Steel grade crossing.

Grade Crossing

The FRA considers the intersections of the Midwest Steel private road with the Conrail and NICTD tracks to be two separate grade crossings. The FRA considers both intersections to be private crossings.

Location, Configuration, and Traffic

Location and Configuration. The highway portion of the Midwest Steel grade crossing is about 60 feet wide, accommodates two lanes of traffic in each direction, and intersects the railroad tracks at a right angle. The crossing is used primarily by the Midwest Division of the National Steel Corporation, including its employees, suppliers, visitors, and others having business at the plant. PreCoat Metals and other adjacent businesses also use the crossing.

In this area of Porter County, the Conrail and NICTD tracks parallel each other. Traveling from east to west, the tracks begin to parallel each other at the Burns Harbor Yard near Conrail MP 486 and NICTD MP 48.5. At the time of the accident, this stretch of track contained five grade crossings. All five crossings, with the exception of the five-track Conrail crossing at Old Wilson Road, were protected by gates, lights, and bells. (The Conrail crossing at Old Wilson Road had only flashing lights.) From east to west, the following crossings were in this area of parallel tracks:

Common Name	Conrail MP	NICTD MP	Primary Use	Ownership
Old Wilson Road	MP 486.71	MP 49.2	Commercial (now closed)	private
Midwest Steel	MP 487.29	MP 49.77	Commercial	private
Continental Can	MP 488	MP 50.51	Inactive	private
Hillcrest Road	MP 488.3	MP 50.8	Residential	public
County Line Road	MP 490.1	MP 52.6	Residential/Recreation	public

[13] The tracks are signaled in both directions. Signal indication provides the authority for a train to operate in either direction on the same track.

Traffic. Based on a postaccident traffic count by Midwest Steel, vehicles go through the crossing about 4,300 times per day. Of these crossings, about 2,500 are made by light vehicles (cars, pickup trucks, and so forth) and 1,800 by heavy trucks. These figures represent the traffic in both directions, so about 2,150 vehicles use the crossing daily. The Midwest Steel crossing serves as the primary entrance and exit to the area.

An average of about 132 trains use the Midwest Steel crossing daily. A Conrail dispatcher in Dearborn, Michigan, conducted an inventory and found that an average of 100 trains from various railroads, including about 14 Amtrak passenger trains, pass over the Conrail portion of the Midwest crossing daily. Most of these trains (about 86), are freight trains. On the NICTD side of the crossing, about 26 NICTD passenger trains use the crossing daily, as do an average of 6 freight trains.

Crossing Geometry

The Conrail and NICTD sections of the crossing are separated by 86 feet and 9 3/4 inches of paved asphalt from the southernmost Conrail rail to the northernmost NICTD rail. The NICTD north gate and the Conrail south gate are 58 feet apart. (See figure 10 for representations of these distances at the crossing.)

Grade-Crossing Obligations

History. According to NICTD officials, around 1908, an ice company owned a tract of land north of the tracks near the present-day Midwest Steel property. At the time, the ice company purchased a right of way to this property from the Chicago Lake Shore Railroad. The ice company retained the right to a private grade crossing and access to its property until the National Steel Corporation purchased the property.

NICTD officials told the Safety Board that, in July 1959, the National Steel Corporation requested the establishment of what eventually became the NICTD portion of the crossing. Gates and flashers were put in service in August 1959.

Responsibility. Four organizations have direct involvement with the Midwest Steel grade crossing—Midwest Steel (that is, the National Steel Corporation), NICTD, Conrail, and the Indiana Department of Transportation (INDOT). Several other businesses and agencies have less significant involvement with the crossing.

The engineering firm Cole Associates, Inc., conducted a property survey at the Midwest Steel grade crossing in 1997. Based on this survey, NICTD owns 120.58 feet of land between a monument located near US 12 and a north point near the crossing gate arm at the Conrail No. 2 main track. From the northern NICTD property line, Conrail owns 100.07 feet of property to its northern boundary line.

NICTD's agreement with the National Steel Corporation, dated August 1, 1968, for the construction, maintenance, and use of the private road crossing[14] requires that the National Steel Corporation, at its own expense, construct and maintain the Midwest Steel crossing in compliance with statutory regulations. All work must meet the approval of NICTD's chief engineer or his authorized agent. The agreement stipulates that the

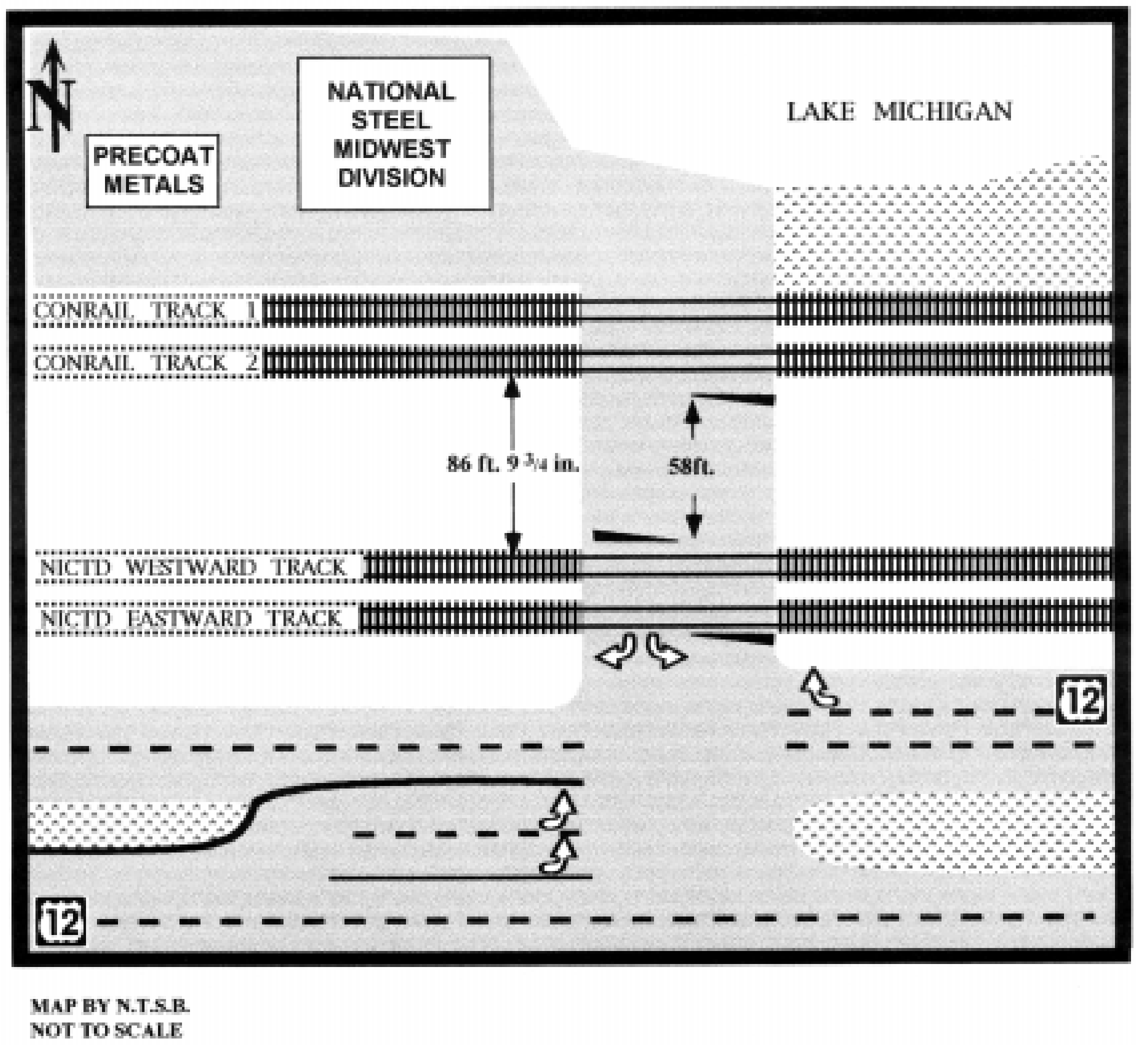


Figure 10. Distances at the crossing

crossing is to be protected at all times by automatic gates and flashing lights and such safety devices as may be required by NICTD. The agreement also stipulates that the crossing is to be used only by “Midwest Steel’s agents and servants and by persons having business with Midwest Steel.” In addition to the agreement, the railroads and the National Steel Corporation have issued permission to Sequa Coating Corporation (PreCoat Metals) and Portside Energy Corporation to use, under defined terms, the crossing.[15]

Conrail has a similar agreement with the National Steel Corporation, dated April 1995. Like the agreement with NICTD, Conrail’s agreement states that the crossing shall be protected with flashing lights and gates. These warning devices must be installed and maintained by Conrail at the National Steel Corporation’s expense.

[14] The contract was first made with the Chicago SouthShore and South Bend Railroad; it now applies to NICTD.

US 12 runs parallel to and about 45 feet south of the NICTD right of way. US 12 is maintained and operated by INDOT. INDOT does not exercise jurisdiction over the Midwest Steel crossing. INDOT is responsible for maintaining the highway traffic signals for the crossing and for managing traffic access to and from US 12 at the intersection adjacent to the crossing.

According to the NICTD general manager, INDOT has safety and crossing oversight responsibilities with respect to NICTD to the same extent as it has for other railroads within Indiana. According to the chief of the INDOT division of Intermodal Transportation, INDOT has a regulatory role over public grade crossings as defined in State statute, and no jurisdiction over private grade crossings. This official also stated that INDOT has oversight obligations arising from NICTD's enabling legislation such that INDOT provides funds to offset NICTD operating and capital costs, including the local matching funds associated with Federal grants.

According to testimony provided by INDOT representatives during depositions conducted by the Safety Board on October 28 and 29, 1998, in Merrillville, Indiana, INDOT has neither performed nor knows of any risk assessments performed on grade-crossing limitations regarding storage area lengths in this geographic region. During these proceedings, Federal Highway Administration (FHWA) and INDOT representatives also stated that neither the FHWA nor INDOT has the responsibility or authority to fund or otherwise oversee improvements at private crossings.

Highway-Rail Signals

NICTD Grade-Crossing Warning System. The NICTD grade-crossing warning system uses two signal masts, each equipped with a gate and located so that they will come down across each direction of highway traffic. The system uses 12 round 8-inch-diameter flashing lights and a bell, all mounted on the signal masts to provide warning for all directions of highway traffic. Track circuits monitor trains approaching the crossing from both directions. The amount of warning time provided is determined by the length of the approach track circuit and the speed of the approaching train.

The westbound track has both a west and an east approach track circuit. The west approach track circuit extends about 934 feet from the crossing. Trains approaching the crossing from the west are restricted to 20 mph. This configuration results in a minimum warning time of 31.8 seconds; slower trains receive a longer warning time. The east approach track circuit extends about 3,087 feet from the crossing. The maximum

[15] NICTD and PreCoat Metals had a formal agreement as to the latter's responsibilities for the Midwest Steel grade crossing. Under this agreement, PreCoat Metals agreed to meet all obligations (fiduciary in nature) that the National Steel Corporation had for this crossing should the National Steel Corporation not meet its obligations. Also, under this agreement, PreCoat Metals will incur all "reasonable costs," defined as those costs necessary and appropriate to the safe and prudent use and maintenance of the crossings as determined by mutual agreement or per industry, statutory, or regulatory standards, "as promulgated by the Association of American Railroads, the American Railway Engineering Association, State or Federal agencies, or the District's Chief Operation officer or his designee."

authorized speed for trains approaching the crossing from the east is 79 mph.[16] This configuration results in a minimum warning time of 26 seconds.

The eastbound track also has west and east approach track circuits. The west approach track circuit extends about 3,480 feet from the crossing. The maximum authorized speed for trains approaching the crossing from the west is 79 mph; this results in a minimum warning time of 33 seconds. The east approach track circuit extends about 3,087 feet from the crossing. Trains approaching the crossing from the east are restricted to 20 mph; this results in a minimum warning time of 105 seconds. Slower trains approaching the crossing from either direction receive a longer warning time.

Conrail Grade-Crossing Warning System. The Conrail grade-crossing warning system uses two signal masts, each equipped with a gate and located so that they will come down across each direction of highway traffic. The warning system uses eight round 8-inch-diameter flashing lights and a bell, all mounted on the signal masts to provide warning for all directions of highway traffic. The west approach for track No. 1 and track No. 2 are configured similarly; the east approach for track Nos. 1 and 2 are the same.

The west approach circuit extends about 4,980 feet from the crossing. A grade-crossing microprocessor monitors the approach circuit and calculates the speed of an approaching train and the time the train will take to arrive at the crossing. The microprocessor then activates the warning devices at a predetermined warning time. The microprocessor provides a relatively uniform warning time, but the time will fluctuate somewhat due to changing ballast and track conditions. The maximum authorized speed for trains approaching the crossing from the west is 79 mph. This configuration results in a minimum warning time of 43 seconds for all train speeds up to 79 mph.

The east approach consists of two circuits that extend a total of about 5,480 feet. The maximum authorized speed for trains approaching the crossing from the east is 79 mph. This configuration results in a minimum warning time of 46 seconds; slower trains receive a longer warning time. The east approach circuits also check the wayside railroad signal. If the wayside signal is red, the crossing will not be activated. This prevents the crossing warning devices from activating and blocking highway traffic while a train approaching the crossing from the east is stopped on the east approach circuit waiting for a permissive wayside signal.

INDOT Highway Traffic Signal System. The highway signal system is programmed to monitor traffic in four directions: (1) eastbound traffic on US 12, (2) westbound traffic on US 12, (3) eastbound US 12 traffic turning left onto the Midwest Steel entrance road, and (4) southbound traffic exiting the Midwest Steel facilities. The intersection is equipped with solid-state monitoring equipment and a video detection

[16] The signals on the NICTD signal system are arranged on the two tracks for movement with the current of traffic; trains traveling west are routed on the westbound track, while the eastbound track handles trains traveling east. Trains traveling east on the westward track are moving against the current of traffic and are restricted to 20 mph. Trains traveling west on the eastward track are moving against the current of traffic and are restricted to 20 mph.

system, which is used as a motion detector to notify the monitoring equipment of traffic waiting for a green light. The traffic signals are standard round 12-inch-diameter traffic lights and operate on a commercial power supply.

Highway-Rail Signal Interaction. The Midwest Steel entrance road is a north-south, two-way, double-lane roadway, intersected by four railroad tracks (two Conrail tracks on the north end and two NICTD tracks on the south end). Because of the proximity of the two railroad crossings, the Conrail and NICTD crossing warning devices are interconnected such that operation of the warning devices from one railroad activates the warning devices on the other railroad.

The two crossing warning devices are also interconnected with the highway traffic signals. Activation of either railroad crossing warning system causes the highway traffic signals to begin a railroad "preemption"[17] sequence. The signal preempt sequence is designed to provide a green signal for southbound traffic leaving the Midwest Steel facility. (See tables 3 and 4.)

Grade-Crossing Oversight

The FHWA. The FHWA does not have jurisdiction over private grade crossings. The funds it provides are not available for use at private crossings, including the accident crossing.

The FHWA regulates aspects of public grade crossings that affect highway safety. FHWA publications provide guidelines and standards for the correct design of grade crossings, the assessment of safety at grade crossings, and the appropriate placement of traffic control devices at and on the approaches to grade crossings. The FHWA also administers several Federal funding sources available to States for improving grade crossings. Title 23 *United States Code* section 130 designates specific funds for grade-crossing safety. Fifty percent of the section 130 funds must be spent on improving signs and pavement markings. Funds for hazard elimination (not specific to grade crossings) are designated in 23 *United States Code* section 152. According to the FHWA, "hazard elimination funds may also be used for highway-rail grade-crossing safety if the State has identified it on the priority list"[18] as a hazardous crossing. There is also an optional category of funds, a portion of which may be used either for grade-crossing improvements or for more general hazard elimination. In fiscal year 1997, Indiana received $4.96 million in section 130 funds, $3.84 million in hazard elimination funds, and $7.88 million in optional safety funds, for a total of $16.68 million. That year, Indiana obligated $6.21 million of Federal funds for specific grade-crossing projects.

---

[17] *Preemption* is the transfer of normal operation of traffic signals to a special control mode. It may involve using unique phase combinations, shortening interval times, or extinguishing certain indications and using visibility-limited signal indications.

[18] Transcript of 1998 deposition proceedings for FHWA Office of Motor Carriers representative Fred Small, p. 116.

Table 3. Order of events when a westbound Conrail train approaches crossing

	NICTD		CONRAIL		INDOT
Event/Time	**Gates**	**Flashing Lights**	**Gates**	**Flashing Lights**	**Highway Traffic Signals**
Conrail train detected on approach circuit.		Flashing lights on the south crossing signal activate.		Both north and south crossing signal lights activate.	Railroad preempt sequence begins.
3 seconds after activation.	South gate begins to descend.		Both gates begin to descend.		
*9 seconds after activation.					US 12 traffic signals move to red. Southbound traffic receives green interval.
15 seconds later.					Southbound traffic signals move to red.
5 seconds later.					East/west US 12 traffic receives green interval; interval stays green until crossing deactivates.

* This is the maximum time required to move the signals to red. Time may be less, depdending on which traffic phase the lights are in when preemption occurs.

The FRA. The FRA defines a private crossing as "a highway-rail crossing which is not a public crossing." It defines a public crossing as "the location where railroad tracks intersect a roadway which is under the jurisdiction of and maintained by a public authority and open to public travel."[19]

The FRA regulates the aspects of grade-crossing safety pertaining to railroads, including track safety, active signals, and train safety and conspicuity. For example, the agency's regulations specify the type of lighting to be placed on a locomotive (49 CFR 229.125); the audibility of the train horns (49 CFR 229.129); and the inspection, testing, and maintenance standards for grade-crossing signal system safety (49 CFR Part 234). The FRA also conducts research on safety at grade crossings.

In addition to grade-crossing oversight, the FRA is responsible for three specific areas of railroad operational oversight, as codified in 49 CFR Parts 217, 219, and 240. Part 217 requires railroads to file operating rules with the FRA and to test their employees on

[19] Federal Railroad Administration, *National Highway-Rail Crossing Inventory Instructions and Procedures Manual* (Washington: U.S. Department of Transportation, 1996), pp. 1-7.

Table 4. Order of events when a westbound NICTD train approaches crossing

	NICTD		CONRAIL		INDOT
Event/Time	**Gates**	**Flashing Lights**	**Gates**	**Flashing Lights**	**Highway Traffic Signals**
Conrail train detected on approach circuit.		Both north and south crossing signal flashing lights activate.		North crossing signal lights activate.	Railroad preempt sequence begins.
3 seconds after activation.	Both gates begin to descend.		North gate begins to descend.		
*9 seconds after activation.					US 12 traffic signals move to red. Southbound traffic receives green interval.
15 seconds later.					Southbound traffic signals move to red.
5 seconds later.					East/west US 12 traffic receives green interval; interval stays green until crossing deactivates.

* This is the maximum time required to move the signals to red. Time may be less, depdending on which traffic phase the lights are in when preemption occurs.

those rules "to determine the extent of compliance." Part 219 regulates the circumstances, conditions, and requirements concerning drug and alcohol testing. Part 240 describes the locomotive engineer certification process. (NICTD's records showed that the engineer involved in this accident had been properly certified.)

The FRA has eight geographic regions in which it places its regional field offices, and each of these regions is assigned a grade-crossing safety manager. Portage is in Region 4, which is headquartered in Chicago, Illinois. Before the accident, the FRA Region 4 crossing manager, having received a December 2, 1997, letter from NICTD regarding the potential hazard posed by the use of Michigan Train LCVs at the Midwest Steel crossing, had called for meetings between the railroads using the crossing, Midwest Steel, INDOT, the Port of Indiana, and the FRA. Representatives of these organizations and several other interested agencies met in January 1998. In spring 1998, the parties agreed to retain American Consulting Engineers, Inc., to provide alternative improvement options.

American Consulting Engineers, Inc., completed its study on October 7, 1998. The study offered six "grade separation"[20] alternatives, all involving the construction of new bridges or additions to the Port of Indiana bridge. They ranged in cost between $5 million and $10 million. The firm recommended an option costing $5.1 million, indicating that this proposal was the most economical, had the simplest geometrics, and eliminated intermixing with Port of Indiana traffic. In November 1998, National Steel Corporation representatives presented the study to INDOT, the Indiana Department of Commerce, and the Governor of Indiana.

In August 1998, the FRA crossing manager arranged for a safety alert to be posted on the Internet for American Trucking Associations truckdrivers. This safety alert briefly described the Portage accident, provided some grade-crossing accident statistics, and listed “lifesaving tips for the professional driver” concerning locations where roadways cross railroad tracks.

State of Indiana. The State of Indiana, through INDOT, is also involved with the safety of grade crossings. INDOT declares its mission to be providing “customers the best transportation system that enhances mobility, stimulates economic growth, and integrates safety, efficiency, and environmental sensitivity.”[21] In addition, one of INDOT’s strategic goals is to “create, promote, and maintain a safe transportation system and a safe work environment” through reducing the number and severity of accidents.[22] As a part of its effort to fulfill its mission and meet its strategic goal, INDOT maintains an inventory of Indiana’s public grade crossings, assesses the relative risk at each one, and allocates Federal and other funds to improve those it considers most dangerous. However, the State of Indiana does not have jurisdiction over, and does not inventory or upgrade, private crossings.

Under the Indiana State Code, INDOT adopted rules for the operation of LCVs on heavy duty highways. The code specifies the routes to be used by the heavy duty vehicles. (See appendix B for selections from the Indiana State Code.) Under Chapter 5, section 4, the Code lists the highways designated as “extra heavy duty highways,” noting that “Highway 12, from one-fourth (1/4) mile west of the Midwest Steel entrance to Highway 249” is such a highway. Chapter 5, section 6 of the Code states that

> [INDOT] shall implement procedures that, in cooperation with the State police department and local police departments, enhance the safety of citizens along and near extra heavy duty highways listed in section 4 of this chapter.

INDOT does not have authority over permitted vehicles once they leave State highways.

Private Crossings. In June 1994, the FRA, in conjunction with the FHWA, the National Highway Traffic Safety Administration, and the Federal Transit Administration,

---

[20] *Grade separation* occurs when a bridge or tunnel is built to vertically separate roadways from railroads at a crossing site.

[21] INDOT strategic plan detailed at http://www.state.in.us/dot/sp. Viewed on May 25, 1999.

[22] INDOT strategic plan.

published a report entitled *Rail-Highway Crossing Safety Action Plan Support Proposals*. The report describes an action plan, consisting of numerous projects within six initiative areas, intended to reduce the number of grade-crossing accidents and casualties without adversely affecting the economic potential of the rail and highway infrastructures. One of the six initiatives was safety at private crossings; the report concluded that responsibilities and standards for private crossings should be developed and defined. The report also stated

> The Department proposes to develop and provide national, minimum safety standards for private crossings and to eliminate the potential impediment to high speed rail operations posed by private crossings.

In July 1998, the Safety Board published a study on safety at passive grade crossings, based on investigations of 60 passive grade-crossing accidents.[23] At that time, no action had been taken on the U.S. Department of Transportation's (DOT's) proposals concerning responsibility at private grade crossings. In this study, the Safety Board made the following safety recommendation to the DOT:

> <u>H-98-32</u>
>
> Determine within 2 years, in conjunction with the States, governmental oversight responsibility for safety at private highway-rail grade crossings and ensure that traffic control on these crossings meets the standards within the *Manual on Uniform Traffic Control Devices*.

In a letter dated December 23, 1998, the DOT stated

> In 1993, the FRA circulated 'Preliminary Guidelines: Safety of Private Highway-Rail crossings.' Our intent was to work with state and industry officials to develop final guidelines. In the 1994 action plan, the department made a commitment to develop and define responsibilities and minimum safety standards (Guidelines) for private crossings. That commitment still stands; however, severe staff resource limitations in [the] FRA's safety and legal offices have precluded the aggressive pursuit of this goal. Our review in the 1993/1994 time frame indicated that federal legislation might be necessary in order to resolve some of the issues and controversies. The Department appreciates the increased emphasis this recommendation provides and commits to initiating action on this issue within 2 years, following completion of the statutory mandated whistle ban proceedings.

In a letter dated February 8, 1999, the Safety Board stated

> The Safety Board notes in your response that the DOT remains committed to initiating action on this issue within the next 2 years, following completion of the FRA statutorily mandated whistle ban proceedings. [Safety Recommendation] H-98-32 has been classified 'Open-Acceptable

[23] National Transportation Safety Board, *Safety at Passive Grade Crossings, Volume I: Analysis*, Safety Study NTSB/SS-98/02 (Washington: National Transportation Safety Board, 1998).

> Response' pending completion by the DOT of the minimum safety standards and clarification of governmental oversight responsibility for private grade crossings.

The Safety Board also issued parallel Safety Recommendation H-98-35 to the States. It stated:

> H-98-35
>
> Determine within 2 years, in conjunction with the U.S. Department of Transportation, governmental oversight responsibility for safety at private highway-rail grade crossings and ensure that traffic control on these crossings meets the standards within the *Manual on Uniform Traffic Control Devices*.

To date, nine States (Maryland, New Mexico, North Carolina, Utah, Hawaii, Connecticut, New York, Nebraska, and Montana) have responded to Safety Recommendation H-98-35.

Maryland's September 9, 1998, response stated that

> We agree that governmental agencies have an oversight responsibility for safety at private highway-rail grade crossings. Also, the State does periodically evaluate all of the public crossings in Maryland. Many of the passive crossings where a driver would have a problem detecting the approach of a train have already had active devices installed. The few that remain unsignalized are prioritized for improvement and active devices are being installed, as funding becomes available.

New Mexico's September 11, 1998, response stated that

> The Railroads and Utilities Section of the Department will communicate and work closely with the FRA regarding the need to take action on this issue. Any action taken will be predicated on what Federal law calls for and the level of funding available. New Mexico law does not currently provide for addressing safety issues at private grade crossings; such issues are exclusively dealt with between the railroad and private property owner.

North Carolina's September 11, 1998, response stated that

> The regulation of private crossings involves government in the private matters of individual property owners. Such regulation runs counter to the current push to make government less intrusive in private matters….

Utah's September 21, 1998, response stated that "UDOT would be willing to work with USDOT in making such a determination."

Hawaii's September 25, 1998, response stated that "the Hawaii Department of Transportation will comply with your Safety Recommendations H-98-34 through -37."

Connecticut's October 5, 1998, response stated that

> Under the authority of existing State statutes, in March of 1993 DOT implemented a private crossing safety initiative to establish uniform minimum standards for traffic control devices at private rail crossings. Every private crossing in Connecticut that did not have active warning devices was assigned a minimum traffic control device consisting of a private crossing sign or a private crossing sign and a stop sign. Some crossings were also assigned a painted stop bar. Enforcement of the maintenance of the signage has proven to be somewhat difficult due to lack of staff, but enforcement is currently sufficient.

New York's October 20, 1998, response stated that

> New York State Law affords the Commissioner of Transportation broad jurisdiction over private grade crossings along railroad routes where passenger trains operate. Currently this law applies to all intercity passenger routes.

Nebraska's March 8, 1999, response stated that

> The Nebraska Department of Roads' policy on private highway-rail grade crossings conforms in large part to the recommendation of H-98-35. The Nebraska Department of Roads, pursuant to LB 255 adopted in 1997 by the Nebraska Legislature, is in the process of undertaking a safety analysis of all 6,613 at-grade crossings in Nebraska, both public and private. Pursuant to § 4 of LB 255, Nebraska has a measure of jurisdiction over all crossings, regarding the construction, repair, and maintenance of such crossings. Whether the Nebraska Department of Roads has the power to direct the placement of traffic control devices at private crossings or at crossings not part of the State Highway System has not been determined. In any case, a determination of the power of the Department regarding such crossings by a court of law will not be made until the Department has rules and regulations in place and has attempted to force compliance of those rules.

Montana's March 19, 1999, response stated that "State or local authorities should not have any responsibility or oversight for private crossings. Private railroad crossings are an issue to be addressed by the private party and the respective railroad company."

Indiana has not responded to Safety Recommendation H-98-35. The Safety Board is sending a second notification of the recommendation to the State of Indiana.

Meteorological Information

At 4:50 a.m., on June 18, 1998, the weather station at Gary, Indiana, 9 miles west of Portage, reported the weather as mostly cloudy with 10-mile visibility, a temperature of 71.6° F, and 6-knot winds. The train 102 engineer described the weather at the time of the accident as "dark and a light fog" and said it was not raining.

Toxicological Information

After the accident, the operating crewmembers of NICTD train 102 submitted urine samples for postaccident drug testing and were given breath tests for the presence of alcohol. FRA regulations did not require that they take such tests. In this accident, exceptions to toxicological testing at 49 CFR 219.201 (b) applied:

> *Exceptions*. No test shall be required in the case of a collision between railroad rolling stock and a motor vehicle or other highway conveyance at a rail/highway grade crossing. No test shall be required in the case of an accident/incident the cause and severity of which are wholly attributable to natural cause (e.g., flood, tornado or other natural disaster) or to vandalism or trespasser(s), as determined on the basis of objective and documented facts by the railroad representative responding to the scene.

Breath tests were administered to the conductor and the engineer at 7:51 and 8:35 a.m., respectively. Urine samples were taken from the conductor and the engineer at 8:10 and 8:50 a.m., respectively, at LaPorte Hospital in LaPorte, Indiana. The urine samples were sent to the South Bend Medical Foundation, where they were analyzed. The results for both drug and alcohol testing for the NICTD train 102 crew were negative.

When the police arrived at the accident site, they did not observe any indication of impaired behavior on the part of the truckdriver. They requested that the driver submit to blood and urine tests, and he agreed. The Porter Memorial Hospital's Northern Indiana Occupational Medical Services clinic staff took blood and urine samples from the truckdriver at 7:30 a.m., about 3 hours after the accident. Samples were taken in accordance with the sampling procedures set out in DOT regulations at 49 CFR Part 382.

The clinic sent the samples to a contract lab, Quest Diagnostics, Inc., of Wood Dale, Illinois. The lab tested the samples using the DOT testing protocol. Under 49 CFR Part 382, blood is used for alcohol testing, and urine is tested for five families of illicit drugs.[24] The truckdriver's blood test results were negative for ethyl alcohol. The urine test results were positive for cannabinoids (marijuana). The testing specified does not distinguish between tetrahydrocannabinol (THC), the active substance in marijuana, and tetrahydrocannabinol carboxylic acid (THC-COOH), an inactive metabolite of marijuana. THC can impair behavior, depending on how much of the marijuana substance was used and how recently it was used. THC-COOH is a product of the metabolism of THC and does not measurably affect behavior. THC-COOH can remain in the body for several weeks or months after marijuana use.

About 3 milliliters of the blood sample taken from the driver remained after the lab had completed the alcohol testing. The Safety Board sought a portion of the remaining blood sample for additional testing. Quest Diagnostics agreed to retain the sample pending a subpoena. A subpoena was issued and forwarded to Quest Diagnostics, where it was received on Wednesday, July 15, 1998. The subpoena called for the lab to send the blood

[24] Marijuana, cocaine, opiates, phencyclidine, and amphetamines.

sample to the Civil Aeromedical Institute (CAMI) Toxicology and Accident Research Laboratory in Oklahoma City, Oklahoma, for further testing.

On Friday, July 17, Safety Board, CAMI, and Quest Diagnostics representatives conducted phone discussions about forwarding the sample. Shipment of the sample on that day would have resulted in a Saturday delivery to CAMI. Because CAMI did not have staff working on Saturday, the sample, which was to be shipped in a container with ice and kept cold, could warm over the weekend without care, potentially damaging it. They agreed that the shipment should be delayed until the following Monday, July 20.

On July 23, the Quest Diagnostics director of laboratory operations notified the Safety Board that the sample had not been forwarded but had been inadvertently disposed of during the weekend of July 18 and 19. He reported that Quest Diagnostics had tagged the sample to be kept, but it had apparently been stored with other samples for disposal and had been discarded. Efforts to locate the discarded sample were unsuccessful.

Survival Aspects

NICTD Carbody Structure

Train 102 consisted of two self-propelled railcars;[25] NICTD car 11 was in the lead at the time of the accident with NICTD car 45 in trail. The self-propelled MU electric passenger railway cars that NICTD operates in revenue service are of similar design and were manufactured by Nippon Sharyo Seizo Kaisha Ltd. of Toyokowa, Japan (Nippon Sharyo).[26] The body shells were constructed by Nippon Sharyo at its facility in Toyokowa and then shipped to the Cleveland, Ohio, facility of the General Electric Apparatus Service Division for final assembly. The leading car (car 11) of train 102 was a 1EBU51 model (as designated by Nippon Sharyo's internal order number), from a lot of 43 cars delivered in 1982 and 1983.

Crashworthiness

Collision posts fitted to MU passenger railcars are substantially constructed I-beam-shaped structural members, located within the vestibule door frame at the end bulkheads of each car. One collision post is installed on each side of the end bulkhead vestibule door frame, for a total of four collision posts per car. They are anchored to the carbody underframe and roof structure. By deforming on impact, they are intended to absorb kinetic energy in a "centerline-to-centerline" type of collision, reducing the tendency of car bodies to telescope (when one carbody intrudes longitudinally into another). This type of intrusion has historically been disastrous to occupants of passenger compartments.[27]

[25] Passenger-carrying railroad cars operated by NICTD, as described in this investigation, are technically defined as "MU locomotives," pursuant to the definition under the FRA locomotive safety standards in 49 CFR 229.5.

[26] Nippon Sharyo Seizo Kaisha Ltd. is now operating under the name Nippon Sharyo Ltd. Also, Sumitomo Corporation of America handled commercial arrangements for the transaction.

The construction drawings[28] for this car design showed that two collision posts, consisting of modified I-beam members, were fitted to the vestibule door frames at the end bulkheads of each car, as required by 49 CFR 229.141. The construction technical specification[29] for this car design indicated that each collision post was a welded assembly, made from steel plates and welded to the underframe end sill and roof structure.

According to 49 CFR 229.141 (a) (4), MU railcar main vertical members (referred to by the industry as "collision posts") "shall have an ultimate shear value of not less than 300,000 pounds at a point even with the top of the underframe member to which it is attached," among other technical requirements.

Postaccident Inspection

Upon their arrival at the accident site, investigators found two catenary support poles to the north side of the NICTD right of way dislodged and destroyed. The point of impact was about the intersection of the westbound NICTD track and the northbound lane of the grade crossing. The front of NICTD car 11 came to rest about 450 feet west of the point of impact. The flatbed truck trailer was distorted into a crescent shape, and the wreckage had wrapped and wedged around the front of car 11 during the collision. The kingpin of the struck trailer, which had connected it to the leading trailer, was sheared off. The leading flatbed trailer remained attached to the truck tractor at the grade crossing and retained its cargo.

The cargo of the struck trailer was a 72-inch-diameter by 41-inch-wide open-center coil of steel that reportedly weighed 38,030 pounds. It had reportedly been chained to the approximate center of the flatbed trailer deck and covered with a tarp. The coil had dislodged from the trailer on impact and penetrated the front bulkhead of NICTD car 11. Investigators found the tarp wrapped around the front end of NICTD car 11. They found the coil inside the forward passenger compartment area of car 11, it having traveled inward almost to the center vestibule area, a distance of about 34 feet. The coil was recovered from the car at the grade-crossing site with a heavy-lift crane that operated through a hole cut in the roof above the coil.

The NICTD signal controller box adjacent to and immediately west of the crossing on the north side of the track was off its foundation and demolished. The rails and track roadbed between the point of impact and where the equipment came to rest were

---

[27] National Transportation Safety Board, *Collision of Illinois Central Gulf Railroad Commuter Trains, Chicago, Illinois, October 30, 1972*, Railroad Accident Report NTSB/RAR-73/05 (Washington: National Transportation Safety Board, 1973), and John H. White, Jr., *The American Railroad Passenger Car: Vol. 1* (Baltimore: John Hopkins University Press, 1978), p. 148.

[28] Nippon Sharyo engineering drawing ref. B0631B13680, originally dated April 23, 1981, revision B, dated December 7, 1981, and related engineering drawings for this carbody series.

[29] *Specifications of Electric Multiple Unit Commuter Cars for Northern Indiana Commuter Transportation District (Chicago South Shore & South Bend Railroad) Spec. No. SP90034, 1983,* [prepared by] Nippon Sharyo Seizo Kaisha, Ltd., Japan.

undamaged. An overhead streetlight on the southeast corner of the NICTD tracks was not operational.

Safety Board investigators examined the train 102 control positions at the NICTD shop in Michigan City on June 19, 1998. Car 11's operating controls were positioned in the following manner: the reverser key was in the forward position; the master controller handle was popped up; the brake valve cut-out was in the operating position and locked; and the brake handle was in the extreme right quadrant in the emergency position.

Rail Equipment

NICTD Car 11. The front bulkhead had sustained major impact damage, resulting in a breach that opened into the front vestibule and passenger compartment and extended from about the floorline to the ceiling and from the extreme left front corner post to the left edge of the right collision post, contained within the front bulkhead. The damage severed the wiring and electrical conduits routed through the front bulkhead. Neither the interior emergency lights nor the public address system in the first car was operable following the accident. A battery back-up arrangement supported these systems, but these circuits were also rendered inoperable by the front bulkhead damage.

The front bulkhead panel assembly had been pressed inward in a crushing manner and destroyed. Several structural and sheathing elements, including parts of the left front sheathing panel and the door frame, had been displaced and bowed into a curved shape toward the left sidewall. The ceiling and roof structural elements above the front bulkhead and vestibule were pulled downward and inward. The inner partition wall of the front vestibule and the partition slider-door were also pressed inward with the elements compressed beneath and among the remains of the front bulkhead panel.

The left collision post had fractured into two pieces at a point about 39 inches above its bottom end. The connections at its upper and lower ends were not completely severed, and the top and bottom segments did not fully separate from their anchorage points. (See figure 11 for a diagram showing the collision posts within the car structure.) The front window in the operator's cab area was fractured, and several wall panels had been slightly displaced and distorted.

The forward passenger compartment (behind the front vestibule) revealed scuffing and gouges on the low ceiling area immediately aft of the vestibule slider door. The rows of seats on the left side of the aisle, from the extreme front to the rearmost seat (adjacent to the restroom door), had been crushed and pressed downward in an aft direction. The rows of seats on the right side of the aisle in the forward passenger compartment were intact and did not exhibit impact damage. Two lengths of heavy chain were on the floor, one length of which had a hook-eye attached.[30]

[30] Information on the chain appears in the "Laboratory Tests" section of the report.

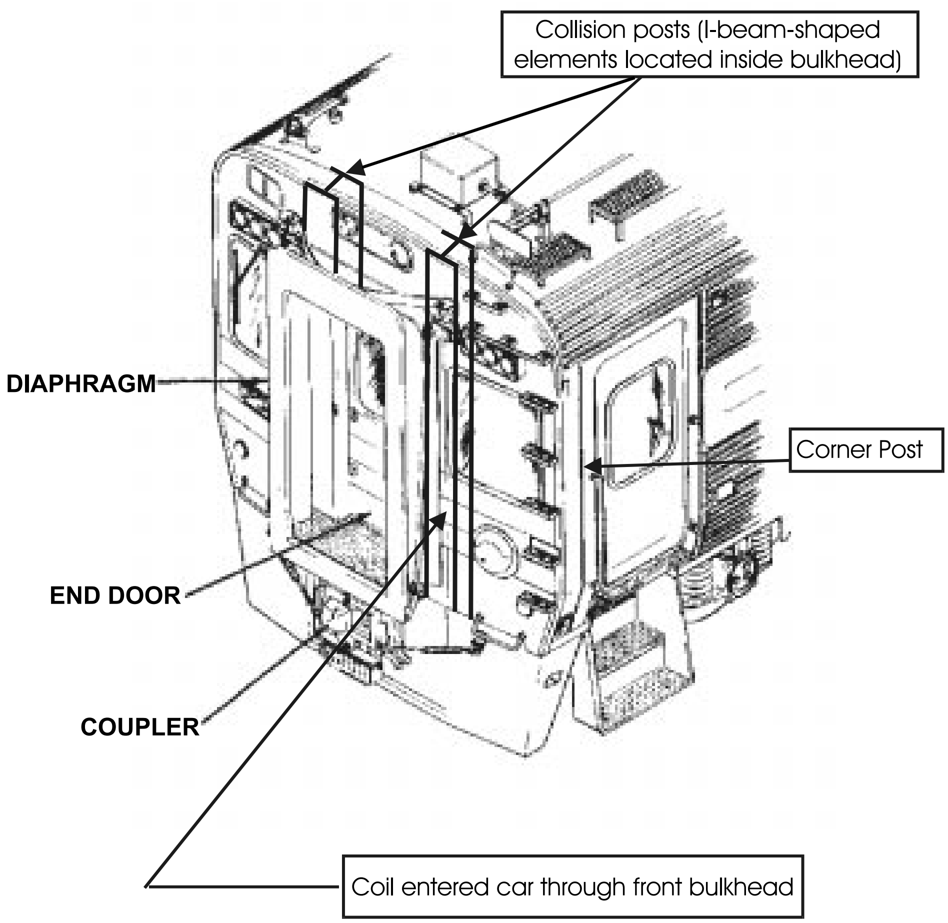


Figure 11. View of a typical NICTD Nippon Sharyo railcar, showing "collision post" locations within the car (Source: *NICTD Running Maintenance and Troubleshooting Manual,* September 1982 edition, as modified by the Safety Board.)

The floor area adjacent to the restroom, where the steel coil came to rest about 34 feet from the front of the train, had partially collapsed. The coil was oriented with its parallel side faces about parallel to the exterior sidewalls.

A pronounced crescent-shaped gouge was found on the exterior aisle wall of the restroom partition, aft of the leading corner of the restroom aisle wall partition, consistent with the coil having traveled to the restroom partition wall before moving back toward the front of the car, a distance of about 56 inches, to the point where it came to rest.

Examination of the center vestibule area indicated no damage. Examination of the aft passenger compartment, behind the center vestibule area, indicated that the seats were fully intact and undamaged. Numerous seat cushions were dislodged.

With the exception of the breach in the front bulkhead, the exterior of car 11 received little damage. Minor nonstructural impact damage was observed at the right rear step well.

NICTD Car 45. Investigators found no internal damage to the trailing car. Externally, it sustained minor penetration of its exterior shell due to electrical arcing from contact with the dislodged (but energized) overhead catenary wire. The pantographs and related electrical equipment on the roof were destroyed.

Truck

On June 20 and 22, 1998, the Safety Board and the Indiana State police conducted a joint inspection of the LCV. They found the following defects: 1) tire less than 2/32 inch on #8 axle, first semitrailer, 2) exhaust leak in tractor, 3) leaking outer wheel seal on #4 axle, 4) air leak at tractor secondary tank, 5) low air buzzer not functioning in tractor, 6) brake shoe partially missing at left #4 axle, 7) defective hose at main tank in first semitrailer, 8) combination vehicle overweight (153,115 pounds), and 9) brakes out of adjustment on axles #4, 5, 6, 7, and 8. The Indiana State police issued citations for the following out-of-service violations under the Commercial Vehicle Safety Alliance: logbook not kept current, eight brakes out of adjustment, improper load securement, and failure to retain previous 7 days of logbook pages.

Postaccident Testing

Visibility and Stopping

On June 20, 1998, Safety Board investigators conducted visibility and stopping tests with a two-car train similar to NICTD train 102 and a Michigan Train LCV similar to the accident vehicle, except that it was equipped with reflective tape. To approximate accident conditions, all tests were performed between 3:45 and 4:45 a.m. The weather was clear. Test results appear in table 5. (See appendix C for more detailed test results.)

Table 5. Visibility and stopping test results

Test	Action	Result
Visibility Test 1	Parked tractor-trailer on grade crossing and moved train eastward until tractor was out of sight.	Lost sight of tractor-trailer 3,279 feet from grade crossing.
Visibility Test 2	Same conditions as in test 1 except railcar interior lights were turned off.	Lost sight of tractor-trailer 3,279 feet from grade crossing.
Visibility Test 3	With tractor-trailer lights on and side marker lights and reflective tape covered, moved train westward until tractor came into view.	Tractor became visible 794 feet from the grade crossing.
Visibility Test 4	With tractor-trailer lights on and side marker lights and reflective tape covered, moved train westward until semitrailer came into view. Test conducted at 4:28 a.m.	Semitrailer became visible 542 feet from the grade crossing.
Stopping Test	With train moving westward at 68 mph, emergency braking was applied 542 feet east of grade crossing.	Train stopped 1,675 feet from brake application.

Crossing Signal Systems

Conrail signal and grade-crossing warning equipment did not sustain any damage in the accident. INDOT reported that its highway signal equipment was not damaged. NICTD signal equipment was damaged by a downed pole line. The catenary line was also affected. The crossing warning equipment case was destroyed.

NICTD Grade-Crossing Warning System. NICTD signal equipment was destroyed during the collision and so was not available for testing. The underground cables used to interconnect the NICTD signal case with the Conrail signal case and the highway traffic signal case were identified, and their insulation resistance was tested. Test results showed them to be clear of grounds and short circuits. The monthly record indicated that the crossing was in compliance, and the record noted no exceptions.

Highway Traffic Signal System. Safety Board staff reviewed the maintenance log for the traffic equipment. It showed that an annual inspection and relamp (replacement of bulbs) was performed on September 16, 1997. On March 2, 1998, the timing and preemption operation was verified. The most recent log entry, for March 19, 1998, listed no equipment exceptions.

INDOT personnel stated that, in 1995, INDOT began a program to check the functionality of all traffic signals subject to railroad preemption. The Midwest Steel crossing preemption was inspected, and changes were made to the interconnection circuits. Before December 1995, the preemption circuit used a normally open contact to monitor activation of the warning devices. This was changed to a normally closed contact, which provided a "fail-safe"[31] circuit.

Conrail and NICTD Interconnection. Safety Board investigators tested the interconnection between the two railroads after the equipment for each crossing had been individually tested. Investigators measured the delay between activation of the warning devices from one railroad and the appropriate devices from the other railroad. The delay was negligible.

Railroad and Highway Interconnection. INDOT provided the Safety Board with timing charts for the Midwest Steel traffic light preemption sequences. Investigators conducted tests to verify that the equipment was working as designed.

When east and west highway traffic lights on US 12 signaled green, activation of the crossing warning devices from either railroad on either main track caused the east and west traffic lights to move to red in an average of 6 seconds. Southbound traffic lights then displayed a green light (for track clearance) for an average of 14 seconds. After the southbound traffic lights moved to red, east and west traffic lights displayed a green light. They remained green until the railroad crossing preemption terminated. Left turn arrows for east US 12 traffic remained red while the railroad crossing devices activated.

[31] Term used to designate a railway signaling design principle, the object of which is to minimize the hazardous effects of a component or system failure. Under a *fail-safe* system, if a break or failure occurs, the signal activates to prevent traffic from entering the intersection.

When the left turn arrows for east US 12 traffic turning left onto Midwest Steel Road displayed green, activation of the crossing warning devices from either railroad on either main track caused the left turn arrows to move to red in an average of 4 seconds. The southbound traffic lights then displayed a green light (for track clearance) for an average of 13 seconds. East and west US 12 traffic lights also displayed green lights. The lights remained green until the railroad crossing preemption terminated. Left turn arrows remained red while the railroad crossing devices activated.

Testing determined the traffic light preemption sequences to be in accordance with the timing charts provided by INDOT.

Railroad Signal Event Recorders. Postaccident data were downloaded from the Diagnostic Log at the Conrail Computer Assisted Train Dispatching Facility in Dearborn, Michigan. They indicated the following:

Time[32]	Event
05:16:48	Westbound signal is cleared by Conrail dispatcher for westbound Conrail train 201, track No. 1.
05:29:26	Crossing warning devices are activated for Conrail train 201 at the Midwest Steel crossing.
05:30:22	Crossing warning devices are activated for NICTD train 102 at the Midwest Steel crossing.
05:32:55	Crossing warning devices at the Midwest Steel crossing are deactivated for Conrail train 201.

Laboratory Tests

The chain that was used to secure the coil of steel to the second semitrailer was sent to the Safety Board Materials Laboratory for analysis. The chain was in two pieces, one of which had a hook-eye attached to the end. It was considerably worn near the hook-eye. Hardness and cross-sectional area measurements were made on the links in the worn and unworn areas. Theoretical calculations of the load-carrying capability of the chain, based on these measurements, indicated that the unworn section would break at a load of about 29,000 pounds. The worn section, which had a much smaller cross-sectional area, would have broken at about 15,000 pounds. The chain had fractured in an unworn region.

The left collision post from the front of train car 11 was examined both on site and in the laboratory. Examination revealed that the collision post had fractured in overstress where its reinforcement ended, about 39 inches from the bottom. The collision post had also partially separated from its attachment to the frame structure at the top and bottom. The fracture at the top, where the collision post attached to the ceiling structure, was an overstress separation. The fracture at the bottom, where the collision post was welded to the end sill assembly under the floor of the car, occurred immediately adjacent to a weld.

[32] Because the dispatcher was in Michigan, times were provided in eastern daylight time.

Investigators learned that NICTD car 11 had not been involved in any collision event prior to the Portage accident that might have compromised the strength of the collision post. Design documentation indicated that the collision post had met FRA design requirement safety standards as specified in 49 CFR 229.141 (a) (4).

Investigators found two welds in the collision post attachment that were identified for further examination. The first was the vertical inboard rear weld, which had been specified[33] as a fillet weld. The weld was not readily visible due to the presence of a 6.7-inch-long threaded fastener at the joint. The fastener was 5/16-inch in diameter, rusted on the surface, and it did not have a head. It appeared welded and/or wedged in place. (See figure 12.) According to NICTD (Mechanical Department management), this fastener is not a normal component of the collision post. Comments were offered that it could have functioned as a shim or filler material during welding, although a positive determination could not be made.[34]

Figure 12. Arrow indicates threaded fastener at the joint welded and/or wedged in place

The second weld that was further examined was the vertical inboard front weld. This weld was specified[35] as a single-bevel groove weld and was required to have 100-percent penetration by the NICTD specification.[36] The front of the collision post had separated from the sill at this joint, with nearly all of the weld filler material remaining on the end sill side of the fracture.

[33] Nippon Sharyo drawing B0631B13680, revision B, “Arrangement of Collision Post and Corner Post,” dated April 23, 1981.

[34] When asked, Nippon Sharyo did not provide an explanation of the purpose of this element.

[35] Nippon Sharyo drawing B0631B13680.

Six metallographic sections were taken through the end sill side of the joint, such as the one shown in the lower portion of figure 13. Only one of the six sections showed 100-percent penetration, with the amount of penetration varying in the other five sections. All six sections showed areas of lack of fusion between the weld and the collision post material, as evidenced by the joint failing not through the weld or the collision post material, but at the interface between the two.

The incomplete penetration, the lack of fusion, and the presence of the fastener indicated a failure on the part of Nippon Sharyo to employ adequate welding quality assurance when manufacturing the car. The Safety Board contacted Nippon Sharyo to determine whether any documentation existed regarding inspection or testing of the welds in question. Nippon Sharyo responded that neither the NICTD contract, industry practice and standards, nor the quality control and assurance program at the manufacturer's assembly plant required the preparation of written reports confirming weld inspection. No such inspection documentation was prepared or existed. Nippon Sharyo further indicated that its quality control and assurance procedures were approved by NICTD and NICTD's expert consultant on railroad car design and that Nippon Sharyo used its experience in preparing manufacturing drawings in accordance with the production contract specifications.

Nippon Sharyo indicated that it used only "certified" welders in the construction of the cars and that its certified welders performed "self-inspections" of each weld. The car manufacturer also indicated that NICTD and its expert consultant had the right and opportunity to inspect the welds to ensure that proper welding procedures and practices were followed and that the welds met specifications. Nippon Sharyo reported that NICTD and its representatives performed such inspections, and that Nippon Sharyo performed its own inspections, each company adhering to its respective quality assurance procedures.

Other Information

State Truck Size and Weight Regulations

The Midwest Steel highway-railroad grade crossing was built in the 1950s, when trucks were typically much shorter in length than those on today's highways. As the need for larger commercial vehicles grew, manufacturers began to build larger single vehicles, and carriers increased the use of combination vehicles (tractors, semitrailers, and trailers).

Traffic regulation is under the jurisdiction of the individual States. Each State has truck size and weight regulations consistent with the design of its local roads. As interstate truck traffic increased, the differences between the various States' truck size and weight regulations impeded interstate movement of goods. Whenever a truck crossed the State line from a less restrictive to a more restrictive State, the truckdriver would be required to

[36] *Specification of Electric Multiple Unit Commuter Cars for Northern Indiana Commuter Transportation District*, Specification number SP90034, section S3.03(c), which states that "End underframe shall be assembled by arc welding in accordance with S12.10, using 100-percent penetration welds."

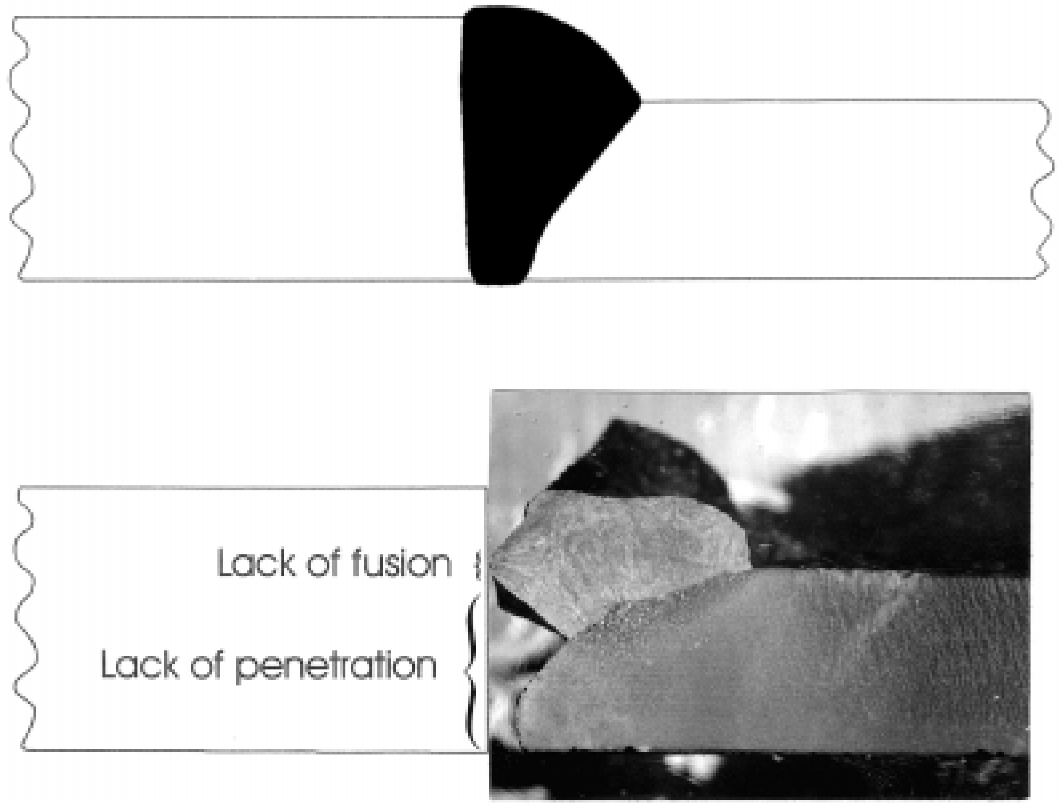


Figure 13. Top graphic shows an illustration of a full penetration weld between two pieces of metal; bottom graphic shows a photograph of the weld found at the base of the collision post, where less than full penetration is indicated by the gaps on the left side and at the bottom

reduce his vehicle's length or be subject to citation or prohibition from travel (or both) in that State.

The trucking industry petitioned the U.S. Congress to enact legislation to standardize size and weight regulations among the States. In 1982, Congress passed the Surface Transportation Assistance Act. It contains a provision that essentially permits unlimited overall truck lengths on designated routes, which include the National System of Interstate and Defense Highways; on the Federal-aid primary system of highways qualified by the Secretary of Transportation; and on routes designated by local (State) authorities.

Thus two sets of vehicle length regulations apply in each State. The State's own regulations restrict the length of combination commercial vehicles operating on highways other than designated routes, and the Federal law allows combination commercial vehicles of unlimited lengths (with minor restrictions) to operate on designated highways. The minor restrictions are

> (1) The length of the semitrailer in exclusive combination with a truck tractor does not exceed 48 feet. A semitrailer not more than 53 feet in length shall satisfy this requirement when configured with two or more rear axles, the rearmost of which is located 40 feet or less from the kingpin or when configured with a single axle which is located 38 feet or less from the kingpin. For purposes of this paragraph, a motortruck used in combination with a semitrailer, when that combination of vehicles is engaged solely in the transportation of motor vehicles or boats, is considered to be a truck tractor. (2) Neither the length of the semitrailer nor the length of the trailer when simultaneously in combination with a truck tractor exceeds 28 feet, 6 inches.[37]

The Portage accident vehicle was 82 feet long overall, and the two semitrailers measured 28 feet and 28 feet, 6 inches, respectively. In Michigan, if this vehicle had been operated on nondesignated highways, the maximum permissible overall length of the tractor and two semitrailers would have been 59 feet. In Indiana, if this vehicle had been operated on nondesignated routes, the maximum permissible overall length would have been 65 feet. Because this vehicle was operated on designated routes in both Michigan and Indiana, its 82-foot length was lawful under the Federal unlimited vehicle length exemption.

The Surface Transportation Assistance Act did not address the issue of truck weight. State legislatures continue to enact weight restrictions consistent with their State's roadway and bridge designs. The maximum GVW for a commercial vehicle is 80,000 pounds in all but 10 States. Twenty-seven States have some provision for heavier vehicle weight limits when specific combinations of vehicles are used. All States have programs in place under which the State may, via a permit purchased by the carrier, allow specified vehicles using specified routes to carry specified (up to unlimited) weights. Such loads are known as "permit loads."

In Michigan, the maximum vehicle weight is 80,000 pounds when the vehicle is equipped with 5 axles. A vehicle may legally weigh up to 161,000 (plus) pounds when equipped with up to 11 axles. In Indiana, the maximum vehicle weight is normally 80,000 pounds, but a maximum weight of 134,000 pounds is allowed when the vehicle has a permit. Indiana also restricts these permitted loads to specific routes.

The accident vehicle had a GVW[38] of about 153,115 pounds. The truckdriver did not obtain an overweight permit for the State of Indiana nor would a permit have been issued for a vehicle with a GVW greater than the 134,000-pound limit. According to the

---

[37] *California Vehicle Code*: Division 15, "Size, Weight, and Load," and Chapter 4, "Length," Section 35401.5.

[38] The weight was determined by the Indiana State police by weighing the vehicle, minus the rear trailer and load, and then adding the weight of the coil and the unladen weight of the semitrailer.

driver's account of the routes he traveled from Detroit, Michigan, to Burns Harbor, Indiana, he used routes specified for heavier vehicles.

The LCV was not inspected at the Indiana-Michigan border. Neither Indiana nor Michigan has a "port-of-entry"[39] system for monitoring commercial vehicle traffic entering its State. Enforcement of the size and weight regulations is a function of the State and local law agencies and is conducted at fixed facilities and by mobile enforcement units.

Postaccident Actions

NICTD. After the accident, NICTD officials met with FRA representatives and instituted a slow-speed restriction at the Midwest Steel crossing. NICTD also reduced its operating speeds for passenger trains to 50 mph on this crossing. Since the Portage accident, NICTD has given two Operation Lifesaver education programs at the Midwest Steel grade crossing, during which NICTD representatives provided truckers with Operation Lifesaver materials about the dangers of highway-rail grade crossings.

National Steel Corporation's Midwest Division. According to Midwest Steel officials, they have instituted a number of changes since the accident. They have

- Installed new signs[40] that describe the relationship between the two sets of tracks and the safe distance between them.
- Conducted communications campaigns involving carriers, vendors, and drivers making deliveries to their plant.
- Participated with the FRA in two safety blitzes during which plant personnel spoke to drivers about the crossing and its dangers.
- Improved visibility at the crossing, at the recommendation of the FRA, by installing a 75-foot light tower with 12,000 watts of lighting.
- Completely repaved the crossing.
- Developed procedures to keep trucks from waiting along the highway.
- Issued frequent-delivering carriers pre-scale tickets to avoid unnecessary stops at gate 1, roughly 100 feet north of the crossing.
- Issued carriers blank pre-scale tickets.
- Posted a traffic controller at the crossing.

---

[39] A *port-of-entry* system requires the establishment of truck inspection terminals on the major highway routes entering a State. Commercial vehicles entering the State are examined for weight, registration, fuel tax, and other documentation necessary to operate in the State. States not having a port of entry system rely on road enforcement or a series of inspection sites in the State for commercial vehicle enforcement, or both.

[40] Three signs were posted, in July 1998, in a cluster, providing information as follows: (1) *DANGER: Trucks, Do Not Stop On or Between Tracks* (white background, black lettering with red around the word "DANGER"), (2) a 30- by 30-inch (approximate) yellow sign with black lettering showing two sets of railroad tracks and arrows indicating the distance between the tracks as 55 feet, and (3) a 30- by 30-inch (approximate) circular sign with a white background showing a truck between the tracks with the truck's trailer fouling them. The sign has a red circle with a slash, indicating that such positioning is prohibited.

Incidents Since the Portage Accident. On July 16, 1998, at 6:34 a.m., the engineer of the eastbound Conrail train MAIL8M, traveling at 60 mph on the Conrail No. 2 (inside) track, put the train into emergency braking because he was concerned that a southbound flatbed trailer was extending onto the No. 2 track. According to the engineer, he could not tell whether the trailer was on the track or simply in close proximity. The engineer said that he was about an "engine length" away when the truck moved forward and a collision was avoided.

About 3:00 p.m., on August 19, 1998, the engineer of the eastbound Amtrak train 352, the Lake Cities, put the train into emergency braking because he saw a truck on or near the Conrail tracks.

On January 21, 1999, an eastbound Conrail train went into emergency braking at 11:02 a.m. because of a truck extending onto the tracks.

All three incidents involved tractors with single semitrailers exiting the Midwest Steel plant area during daylight hours. The Safety Board has learned of other incidents since June 18, 1998, at the Midwest Steel crossing involving trucks striking the gates in attempts to avoid oncoming trains. One incident was witnessed by a Conrail police officer, another by an independent truckdriver (who notified the Safety Board), and a third by a Safety Board investigator. Additional gate contact incidents have been reported to NICTD.

FRA Safety Standards. On May 12, 1999, the FRA issued comprehensive Federal safety standards for railroad passenger equipment,[41] entitled "Passenger Equipment Safety Standards; Final Rule," to become effective July 12, 1999. Included in the standards are new strength requirements for collision post structures of MU locomotives and cab car equipment, which are cited under 49 CFR 238.211. Strength requirements for collision post structures of MU locomotives and cab car equipment were previously cited under 49 CFR 229.141, which applies to the NICTD equipment in this investigation.

[41] *Federal Register*, Vol. 64, No. 91, May 12, 1999, "Rules and Regulations," pp. 25539-25705.

Analysis

Exclusions

The weather was dry with a light fog at the time of the accident. The weather, including the fog, did not significantly impair visibility or the stopping capabilities of any of the vehicles involved.

The NICTD track approaching the accident site is straight and provides an unimpeded view of the Midwest Steel grade crossing. No obstructions were found to impair sight of the crossing for westbound trains.

A review of track inspection records and an inspection of the track and its geometry revealed no anomalies, and the NICTD train 102 engineer took no exception to the track.

A review of the maintenance records and inspections both before and after the accident revealed that neither of the two NICTD passenger cars had any mechanical problems.

Investigators found that the LCV had numerous mechanical violations that, if they had been discovered during a roadside inspection, would have caused it to have been placed out of service. However, the truckdriver did not indicate that he had any difficulty (mechanical or otherwise) with the operation of his vehicle, and none of the violations appear to have had any effect on this accident.

Investigators considered the current railroad operational instructions and rules, the supervision of the operational personnel, the overall operation of the trains, and the performance of the employees involved with the accident. Regarding these factors, the Safety Board investigators discovered no deficiencies during the NICTD operations investigation.

Based on the foregoing information, the Safety Board concludes that neither the weather, the track, the mechanical condition of the train, the mechanical condition of the LCV, nor railroad operations caused or contributed to the collision.

The train 102 engineer was experienced in operating the commuter passenger train over the territory and had been observing the appropriate rules and procedures, in accordance with NICTD practices, while operating the train. His past efficiency and safety audits showed that he routinely complied with NICTD rules. Similarly, the conductor was experienced and was compliant with NICTD rules.

The night before the accident, both the engineer and conductor had less sleep than the amount typically needed to achieve adequate rest, about 8 hours of uninterrupted sleep. People who receive less than adequate sleep are subject to fatigue-impaired performance. Nevertheless, the Safety Board found no performance deficiencies on the part of the crewmembers in their efforts to stop the train, avoid the collision with the tractor-trailer, or respond to the accident.

No evidence indicates that either crewmember had been taking prescription or nonprescription medications or illicit drugs that could have affected their performance. No evidence indicates they were under the influence of alcohol. Both men were in good health and had normal vision (or were wearing corrective lenses) and hearing.

The Safety Board concludes that the train engineer and conductor were qualified to perform their duties and showed no evidence of impairment from drugs, alcohol, or fatigue.

The emergency response personnel arrived at the accident site within about 10 minutes and, despite the problems posed by the size of the steel coil, tried to free the injured person trapped under it. Although he succumbed to his injuries, their efforts were appropriate under the circumstances and involved a number of agencies that might reasonably have been expected to provide suitable assistance. Therefore, the Safety Board concludes that the emergency response was timely and effective.

The remainder of the analysis is divided into four main sections. In the first, the Safety Board reviews the accident. In the second section, the Board considers the behavior of the train 102 engineer and the LCV truckdriver. The third section of the analysis considers the major safety issues identified in this investigation: the safety at private grade crossings and the design of the Midwest Steel grade crossing. Finally, the Safety Board considers the other safety issues that emerged during this investigation, including the conspicuity of the LCV semitrailer and the crashworthiness of the NICTD railcars.

Accident

About 4:31 a.m. on Thursday, June 18, 1998, NICTD train 102 collided with the right side of an LCV at the Midwest Steel grade crossing near Portage, Indiana. At this grade crossing, a private road leads north from US 12, intersects the NICTD and Conrail railroad tracks, and continues to the Midwest Steel facility and other businesses.

Shortly before the collision, while the LCV was traversing the NICTD tracks, the approach of the westbound Conrail train 201 had activated the flashing light signals and automatic gates at the Conrail crossing. The truckdriver had stopped the LCV before reaching the Conrail crossing's south gate with the vehicle's second semitrailer resting on the westward NICTD track. At this time, NICTD train 102, traveling westbound about 68 mph, was approaching the Midwest Steel grade crossing.

About 542 feet east of the crossing, the train 102 crew noticed the LCV's second semitrailer, which carried a steel coil covered by a black tarp, on the crossing. The engineer said that he placed the train in emergency braking; then, followed by the conductor, he exited the control compartment and ran toward the rear of the passenger compartment.

The crew alerted passengers in that area about the impending collision and told them to evacuate.

As the collision occurred, the LCV's second semitrailer broke away from the first semitrailer and was dragged by the front of the NICTD train; at the same time, the single chain securing the steel coil to the second semitrailer broke. The released steel coil entered the first train car through the front bulkhead. The coil moved through the car until it came to rest about 34 feet into the passenger compartment. Three fatalities and five minor injuries resulted.

Operator Actions

Train 102 Engineer

The train 102 engineer estimated that he first saw the tractor when the train was about 6 pole lengths (1,020 feet) from the crossing and then detected the semitrailer and made the brake application when the train was about five pole lengths (850 feet) from the crossing. According to the Board's accident reconstruction, the engineer could have seen the truck tractor when train 102 was about 794 feet from the crossing, and the semitrailer (blocking the crossing) when the train was about 542 feet from the crossing.[42] The train 102 engineer would have needed very little time (about 1 second) to recognize the danger and put the train into emergency braking.

Safety Board stopping tests showed that at a speed of 68 mph, train 102 required about 1,675 feet in which to stop. Visibility test results showed that the engineer could not have seen any part of the truck until the train was about 800 feet from the crossing, roughly half the distance necessary to stop the train. Therefore, the Safety Board concludes that, if the train 102 engineer had detected the truck as soon as it became visible and immediately put the train into emergency braking, train 102 could still not have been stopped in time to avoid the collision.

Truckdriver

Actions Preceding the Accident Period. The Safety Board found numerous indications of inadequate performance on the part of the truckdriver before he reached the Midwest Steel grade crossing. Postaccident examination of the vehicle indicated, for example, that the driver had not adequately maintained his logbook and that his vehicle had been overweight for travel in Indiana. The securement of the coil to the trailer, for which the truckdriver was responsible, was also not adequately performed.

According to the truckdriver, the 38,030-pound steel coil on the LCV's second semitrailer was secured by three chains. Two of the three chains kept the coil from moving

[42] Although the Safety Board tried to replicate visibility and other conditions during the accident reconstruction, at the time of the accident, the visibility of the LCV would have been additionally diminished by the presence of Conrail train 201, which blocked the artificial light coming from the Midwest Steel and PreCoat Metals facilities from reaching the LCV.

forward or rearward. Only one 3/8-inch grade 7 chain, which was very worn in areas and had a 6,600-pound WLL, went over top of the coil to secure it to the trailer bed.

Federal regulations require that such a steel coil be secured to a semitrailer by a minimum of three 3/8-inch grade 7 tiedown assemblies (chains). The regulations also require that the chains used to keep the coil from moving forward or rearward not be included when calculating the number of chains needed to secure the load. In other words, use of three "over the top" or "through the eye" chains would have been necessary to meet Federal requirements for securing the coil to the trailer bed, and the truckdriver used only one such chain.

While the truckdriver did not correctly apply Federal regulations regarding load securement, the impact with train 102 brought tremendous force to bear on the semitrailer and placed enormous stress upon the chain that secured the coil. All available evidence indicates that, given the force of the accident and the weight of the coil that broke loose from the second semitrailer, the coil still would have broken loose from the semitrailer even had it been secured according to Federal regulations.

Actions at the Midwest Steel Crossing. When the truckdriver arrived at the Midwest Steel grade crossing, no trains were visible, and no warning devices were active. As he crossed the NICTD tracks, the lights and gates activated for the approaching Conrail train 201. In response to these signals, the truckdriver stopped the LCV about 6 feet before it reached the gate separating it from the Conrail tracks. When he stopped for the Conrail gate, the truckdriver knew that the second semitrailer of his LCV was blocking a portion of the NICTD tracks.

The truckdriver had three primary options by which he could have actively addressed the situation. He could have tried to 1) back the LCV completely out of the crossing and onto the highway, 2) turn the LCV so it would fit safely between the NICTD and Conrail tracks, or 3) move the LCV forward and closer to the lowered Conrail gate. All these options had drawbacks. In backing the LCV off the crossing, the truckdriver would have been backing a large, multi-segment vehicle onto a highway, where traffic might be present. Because the vehicle was so long and the space between the tracks was limited, maneuvering it to fit safely between the tracks would have required the truck-driver to first back up the LCV and then to make minute and indeterminate positioning adjustments within a confined space. Moving the 82-foot LCV forward the 6 feet remaining between it and the lowered Conrail crossing gate would still have left a portion of the second trailer overhanging the NICTD track.

Absent the imminent danger of an approaching train on the NICTD tracks, the driver may have felt no special urgency to take any of these options, all of which were, for different reasons, unsatisfactory. Once the driver saw, however, that the crossing warning devices for the opposite lane of traffic had been activated, he knew that a train was approaching on the NICTD tracks, which was an imminent danger. At this point, the truckdriver should have known that some action on his part was necessary to avoid a collision. Given that the NICTD signal activated some 26 seconds before NICTD train 102 would arrive at the crossing, the driver had less than 26 seconds in which to act.

After the accident, investigators found that the truck's wheels had been turned to the left, consistent with the driver's statement that he had begun to turn the LCV to position it between the two sets of tracks. Based on the truckdriver's statement that he had tried to reposition the LCV between the tracks but lacked sufficient room and time, and the position of the LCV's wheels after the accident, it appears the truckdriver began but did not successfully complete the maneuver before the NICTD train reached the crossing. (Because the truck was not equipped with an event recorder, the Safety Board cannot be sure of the truckdriver's actions and must rely on physical evidence and testimony.)

The Safety Board considers that, although the truckdriver could have taken more effective action earlier to prevent the accident, the prompting of the traffic and rail signals introduced him into a situation in which his vehicle created a grade-crossing hazard.

The Safety Board conducted a study, published in 1995, entitled *Factors That Affect Fatigue in Heavy Truck Accidents*.[43] The study identified critical measures that predict fatigue-related accidents. The duration of the most recent sleep period and the amount of sleep in the past 24 hours are the leading critical measures.

By examining the driver's (incomplete) logbook and conducting postaccident interviews, investigators learned the truckdriver slept only about 6 hours in his truck sleeper berth (between 5:00 and 11:00 p.m. on June 17) in his most recent sleep period and that this was the total amount of his sleep for the 27 hours preceding the accident. This quantity of sleep is 2 hours less than the 8 hours the average person needs to function normally. In addition, this driver worked a somewhat irregular schedule; he was awake at the time of the accident (4:30 a.m.) the day before, but slept during that time 2 days earlier. Irregular schedule was another predictor examined in the fatigue study.

Consequently, the potential existed for the truckdriver to have been fatigued. As previously stated, however, the Board found that the driver's actions at the Midwest Steel grade crossing were generally consistent with reasonable driver behavior under the given circumstances.

To determine whether drugs and alcohol caused or contributed to this accident, the truckdriver's postaccident toxicological samples were taken and tested in a timely manner. The results of the blood alcohol test were negative. The results of the urine drug test were positive for the presence of marijuana or marijuana metabolites, raising the possibility that the driver might have been impaired by marijuana. To resolve the issue, the Safety Board sought to conduct further blood tests that would distinguish between THC (the active substance in marijuana) and THC-COOH (the inactive metabolite of marijuana). Unfortunately, the testing lab discarded the blood sample before further tests could be conducted.

The Safety Board had to consider other evidence to determine whether the truckdriver might have been impaired by drug use at the time of the accident. For instance, in their postaccident observations, the police did not detect any signs of behavior impairment

[43] National Transportation Safety Board, *Factors that Affect Fatigue in Heavy Truck Accidents*, Safety Study NTSB/SS-95/02 (Washington: National Transportation Safety Board, 1995).

on the part of the truckdriver. Also, as noted above, the truckdriver's conduct at the crossing represented reasonable driver behavior, and his responses were essentially those that would have been expected of an unimpaired driver.

Therefore, based on the foregoing evidence concerning the truckdriver's actions, decision-making, and behavior both before and during the accident, the Safety Board concludes that, despite vehicle overloading, logbook discrepancies, inadequate load securement, and the potential for impairment due to fatigue and marijuana use, these factors concerning the truckdriver's actions did not contribute to the collision.

Grade Crossing

Crossing Geometry and Storage Area

The crossing area of the Midwest Steel compound grade crossing consisted of two sets of double tracks, one set owned by Conrail and one by NICTD, separated by 86 feet and 9 3/4 inches of paved asphalt (from the southernmost Conrail rail to the northernmost NICTD rail). A 58-foot space lay between the southernmost Conrail gate and the northernmost NICTD gate. Thus, the maximum storage area for the grade crossing was about 58 feet.

The accident LCV was 82 feet long, 24 feet longer than the 58-foot storage distance. Nevertheless, nothing in law or practice prevented the 82-foot-long LCV from using this crossing. Therefore, the Safety Board concludes that, as currently configured, the Midwest Steel grade-crossing storage area cannot safely accommodate all vehicles that are allowed to use it.

Since the Portage accident in late June 1998, several additional incidents and near-misses have taken place at the Midwest Steel grade crossing. The Safety Board understands that, even before this accident occurred, the National Steel Corporation, NICTD, INDOT, the Port of Indiana, and the FRA had agreed that the safety issues raised by the crossing should be addressed. The Safety Board has long advocated total grade separation as the best means of ensuring grade-crossing safety.[44] Because of the continuing danger posed by this crossing, the Safety Board believes that the FRA, the FHWA, INDOT, the National Steel Corporation, Norfolk Southern Corporation,[45] and NICTD should work together to make, within 2 years, permanent engineering changes to the Midwest Steel highway-rail grade crossing that will minimize or eliminate safety hazards at this crossing.

Signals

Conrail Traffic Control Signal System. Postaccident examination showed that the traffic control signals were displaying the proper signal sequence for Conrail train

[44] *Safety at Passive Grade Crossings, Volume I: Analysis*, Safety Study NTSB/SS-98/02, p. 64.

[45] On June 1, 1999, the Conrail operation through this crossing became part of Norfolk Southern Corporation.

movements on both tracks. Signal inspection records indicated no deficiencies that would have prevented proper operation of the system.

NICTD Automatic Block Signal System. Similarly, postaccident signal examination and inspection records did not show any deficiencies that would have prevented proper operation of the automatic block signal system. The train crew said that NICTD train 102 was operating on a clear signal indication and that the visibility of the wayside signals was adequate for proper train handling.

Conrail/Midwest Steel Grade-Crossing Warning System. Statements from the LCV truckdriver indicated that the crossing warning devices were clearly visible, which allowed the truckdriver to stop his vehicle when the Conrail train activated the gates and flashing lights. With the Conrail signal correctly lined, the overlay circuit on the westbound approach would activate the crossing as soon as a train was detected[46] on the circuit. In this instance, the interconnection between the Conrail and NICTD systems activated the proper lights and gates for both railroads without observable delay.

NICTD/Midwest Steel Grade-Crossing Warning System. Because the signal case was destroyed during the collision, no grade-crossing signal equipment was available for testing. A routine maintenance inspection of the grade-crossing warning equipment performed the day before the accident showed no deficiencies that would have prevented the warning devices from operating properly. The inspection report listed no anomalies in the functionality of the warning devices.

Furthermore, the LCV truckdriver said that he saw the NICTD north gate and flashing light units for southbound traffic activate shortly before the accident occurred. The NICTD preemption circuit that sent the signal to the highway traffic controller was functioning properly and, along with the railroad interconnect circuit, would preempt the highway traffic signals whenever either railroad warning device was activated.

The LCV truckdriver stated that he saw the Conrail warning system activate and he stopped his vehicle. The Conrail warning system was designed to provide a minimum of 45 seconds warning before an approaching train occupied the crossing. Conrail train 201 was not traveling at the maximum authorized speed so the actual time provided was 56 seconds (according to event recorder data). The LCV truckdriver also stated that while he was stopped, he saw the NICTD north flashing lights and gate activate. The NICTD warning system was designed to provide a minimum of 26 seconds of warning before an approaching train occupied the crossing. NICTD train 102 was traveling close to the maximum authorized speed but went into emergency braking about 542 feet from the crossing. Therefore, it appears that about 82 seconds elapsed between the time the Conrail train entered the circuit and the collision.

US 12/Midwest Steel Traffic Signal System. The investigation determined that the preemption circuit between the highway traffic controller and the NICTD signal case was functioning as designed. Activation of the grade-crossing warning system from either

[46] The equipment takes 2 to 3 seconds to recognize a shunt on the track circuit.

railroad would have triggered the highway traffic signals to begin their railroad preemption sequence.

The preemption sequence was designed to run through the traffic signal phases to provide southbound traffic with a green interval adequate to clear any vehicles that might be on, or close to, the track in an area exposed to railroad traffic. The preemption was also designed to prevent traffic on US 12 from receiving a green left turn arrow interval after the NICTD south gate and flashing light units were activated and while the traffic signal controller was in the railroad preemption sequence. The traffic preemption sequence was not designed to affect northbound highway traffic coming from the east or west and moving into the Midwest Steel facility.

By design, therefore, eastbound US 12 traffic turning left could receive a green turn arrow and start across the railroad tracks but be unable to clear both sets of tracks before being stopped by the activation of the Conrail railroad crossing warning devices. On the basis of the preceding information, the Safety Board concludes that the signal systems operating at the Midwest Steel grade crossing functioned as designed, and no signal operation failures caused or contributed to the accident.

Interconnected Signals. Under the current signal configuration, the interconnected railroad crossing warning devices "simultaneously preempt"[47] the highway traffic signals. Because of this design, the left turn arrow that signaled the LCV truckdriver was green and did not move to red until after the railroad crossing warning devices activated. If the highway traffic signal preemption had been designed to account for both directions of traffic on the Midwest Steel Road, the highway traffic signals would have flushed out any traffic stopped on the crossings exiting the Midwest Steel facility and would not have displayed a green light for traffic approaching the facility. This design feature would have prevented traffic from beginning to cross the two sets of tracks and then being stopped before safely clearing them.

The railroad warning system is currently designed to simultaneously activate the gates and lights of the occupied track and the single set of outside gates and lights for the opposite set of tracks. This activation makes the exit gate and signals for the opposite set of tracks inactive, permitting traffic to exit the storage area. In this accident, when the Conrail train entered the approach circuit, both Conrail gates and the outside NICTD gate (for northbound traffic entering the plant) activated simultaneously. The inside NICTD gate (for southbound traffic exiting the plant) did not activate until the NICTD train entered the east approach circuit. The Safety Board therefore concludes that the Midwest Steel grade-crossing signal system did not prevent vehicles from being trapped in the storage area between the NICTD and Conrail tracks.

Cognizant that the signal system at the Midwest Steel grade crossing was not keeping vehicles from becoming trapped within the storage area, on August 12, 1998, the Safety Board issued four urgent Safety Recommendations (R-98-44 through -47) that

[47] *Simultaneous preemption* occurs when the "notification of an approaching train is forwarded to the highway traffic controller unit or assembly and railroad active warning devices at the same time."

asked the FRA, the FHWA, INDOT, and the National Steel Corporation to institute immediate measures to ensure safe passage for traffic across the Midwest Steel grade crossing until a more permanent solution could be implemented. The recommendations called for the organizations to work together to

> Take immediate steps to provide traffic controllers to supervise and coordinate the safe movement of highway and railroad traffic at the Midwest Steel and Wilson Road grade crossings.[48] Ensure that the traffic controllers are able to communicate directly with highway and railroad traffic, and keep the controllers assigned to this duty until permanent engineering changes to these grade crossings can be identified and implemented. [Footnote added.]

The Safety Board received responses from the FRA, the FHWA, INDOT, and the National Steel Corporation. The responses indicated that a traffic controller has been posted to coordinate the safe movement of traffic through the Midwest Steel grade crossing until a more permanent solution, such as grade separation, can be developed. The Safety Board classified Safety Recommendations R-98-44 through -47 “Open—Acceptable Response.” The Safety Board urges the recipients to continue to work to improve safety at the Midwest Steel grade crossing.

Grade Crossing Safety

Oversight and Jurisdiction. The various entities involved at the Midwest Steel grade crossing were aware that the crossing posed unusual hazards. The relatively high rate of vehicle and train traffic, as well as the number of LCVs using the crossing, were hazard factors noted by NICTD and the other organizations connected with the crossing. Despite their consciousness of the dangers posed by the crossing, they took no effective permanent corrective action to ensure its safety. This lack of action in the face of known safety hazards raises serious concerns about the distribution of responsibilities for ensuring safety at a private grade crossing, such as the Midwest Steel grade crossing.

The primary difference between public and private grade crossings is roadway ownership, which affects the obligations and indemnification of the parties involved in the crossing activity. At a private crossing, roadway design and maintenance are usually the responsibility of the private entity that owns the roadway. The private entity may enter into a contractual agreement with the railroad(s) regarding the liability for any casualty incurred at the crossing due to any lack of specified maintenance.[49]

In the case of the Midwest Steel grade crossing, the National Steel Corporation had contractual agreements with NICTD and Conrail specifying the National Steel Corporation’s

[48] The Wilson Road grade crossing was closed on December 29, 1998. This crossing is now opened only when the Port of Indiana advises that a cargo vehicle cannot use the Port of Indiana overpass because of size or weight restrictions. At such times, Port of Indiana supervisory personnel direct and control the rail and vehicle traffic.

[49] Not all private crossings are covered by contractual agreements. In many cases, the owner of the private roadway is unknown.

responsibility[50] to maintain the crossing signal lights, the gates, and the road surface. This agreement is fiduciary in nature, calling for the National Steel Corporation to furnish the funding for the maintenance of the roadway surface and any crossing signal lights and gates as specified by the respective railroad's division engineer. Should deficiencies in any of these identified areas cause an accident, the National Steel Corporation would be liable. But the contracts do not state that the National Steel Corporation is responsible for the overall safety of the crossing. Contracts governing private crossings often do not specify responsibility for all factors that could affect crossing safety. Because of the distribution of safety responsibilities for private crossings, some important safety factors are not addressed by any agency.

The FRA is responsible for railroad track, train, and signals safety at all grade crossings, whether private or public. The FRA's jurisdiction applies to rail operations only. The FRA oversees the gates, crossing lights, and track gauges for both public and private crossings, ensuring that they meet Federal standards. On the other hand, the FHWA and INDOT have far fewer responsibilities for private crossings than for public crossings. Because it is a private crossing, neither the FHWA nor INDOT has jurisdiction over the highway component of the Midwest Steel crossing.

Consequently, key factors affecting the crossing's safety, such as what types of vehicles may use the crossing, the appropriate configuration of the storage area, and necessary signal timing considerations, are not overseen by any agency. Not only are significant safety elements not addressed by any private or government entity, but the complex interactions between rail and highway operations are not adequately coordinated.

To summarize, no single entity—not the crossing owner, or a railroad, or a Federal or State regulatory agency—was responsible for the safety of the entire Midwest Steel private grade crossing. (See appendix D for a table detailing the responsibilities of the entities involved in this situation.) Therefore, the safety-related developments that affected the Midwest Steel crossing over time, such as changes in vehicles using the crossing and in train and vehicle traffic levels, were not reviewed by a single entity, and effective steps were not taken to resolve these recognized safety problems. Several organizations involved in the crossing, including Midwest Steel, NICTD, and the FRA, were aware that safety was being compromised at the Midwest Steel crossing, but no entity had or assumed the responsibility to act to solve the problems. Therefore, the Safety Board concludes that the lack of clear delineation of oversight responsibility for the safety of the Midwest Steel private grade crossing undermined its safety.

The private classification of a crossing can affect still other important factors concerning its safety. For instance, funds distributed to the States by the FHWA for making crossing improvements will not, in most States, be available to improve safety at a private crossing. In addition, individual State policy establishes whether existing guidelines and standards for safe crossing design must be applied to both public and private crossings. As

[50] Depending on the contractual situation, PreCoat Metals, rather than the National Steel Corporation, could be responsible.

noted, the State of Indiana does not have jurisdiction over private crossings; hence, INDOT does not have clear authority to require the same level of design safety at both public and private crossings.

In Indiana and other States, Federal guidelines for the appropriate design and placement of warning devices at grade crossings, as codified in the *Manual on Uniform Traffic Control Devices* (MUTCD), are required to be applied at public crossings.[51] Because of many States' (including Indiana) lack of jurisdiction, however, adherence to the MUTCD guidelines cannot be required at private crossings. Consequently, private crossings in Indiana are not required to meet any standards for signage, pavement markings, or other elements of traffic safety and control.

Following the 1995 Fox River Grove accident,[52] in which a school bus stopped at a grade crossing extended into the path of a train, the Safety Board made the following safety recommendation to the FHWA:

> <u>H-96-40</u>
>
> Develop guidelines and amend the MUTCD to provide methods to delineate the area (zone) that a train, or its cargo, or both, may occupy on the track or tracks of a railroad grade crossing so motorists have visual reference points that enable them to ascertain whether their vehicle is encroaching on the travel path of the train, or its cargo, or both.
>
> In a letter dated March 13, 1997, the FHWA stated
>
> The Federal Highway Administration has begun developing delineation and signing guidelines for the recommended zone at railroad grade crossings. The FHWA has worked with the Illinois Department of Transportation (IDOT) in determining a signing and delineation method which will comply with the requirements of the MUTCD. The IDOT will begin using the method in early 1997. The FHWA has assigned a number and title to a[n] IDOT request for a change to the MUTCD for inclusion of the proposed delineation and signing method; Request VIII-43 C—Roadway Rail Pavement Marking and Signing Plan. The FHWA will consider the IDOT method and other submitted methods and will request public comments through the publication of a Notice of Proposed Amendments to the MUTCD regarding recommended guidance which may be included in the MUTCD as discussed in the above safety recommendation.
>
> In a letter dated May 21, 1997, the Safety Board stated

---

[51] The MUTCD provides guidelines for sign, signal, and pavement marking design, as well as for appropriate placement. MUTCD guidelines become State law when each State adopts them; all States are required to adopt the MUTCD or a State manual that conforms to the MUTCD.

[52] National Transportation Safety Board, *Collision of Northeast Illinois Regional Commuter Railroad Corporation (METRA) Train and Transportation Joint Agreement School District 47/155 School Bus at Railroad/Highway Grade Crossing in Fox River Grove, Illinois, on October 25, 1995*, Highway/Railroad Accident Report NTSB/HAR-96/02 (Washington: National Transportation Safety Board, 1996).

> The Safety Board understands that the FHWA has begun developing delineation and signing guidelines for such zones at railroad grade crossings. The FHWA has worked and will continue to work with the Illinois Department of Transportation in determining a signing and delineation method that will comply with the design requirements of the MUTCD. Pending amendment of the MUTCD to meet the intent of this recommendation, Safety Recommendation H-96-40 will be classified 'Open—Acceptable Response.'

Recent contact with the FHWA indicates that a Notice of Proposed Rulemaking will be issued in December 1999 to amend the MUTCD to address this recommendation.

Signage of the type specified in Safety Recommendation H-96-40 might have warned the driver of an LCV of the special hazard the Midwest Steel crossing posed. Therefore, the Safety Board concludes that the use of the MUTCD at private as well as public crossings may help ensure that certain hazardous situations at private grade crossings receive appropriate attention before an accident occurs.

Public Use of Private Crossings. Throughout the United States, roadway ownership establishes whether a grade crossing is classified as public or private. The classification does not take into account the impact each privately owned crossing may have on the safety of the members of the general public who also use it.

The Midwest Steel grade crossing involves more public presence than its designation as a private crossing would imply. About 4,300 public highway vehicles and 132 trains traverse the Midwest Steel grade crossing on an average day. Of the 132 trains, about 14 are Amtrak and 26 are NICTD passenger trains, all carrying members of the public. In addition, during this investigation, the Safety Board found that the Midwest Steel grade-crossing storage area is owned by NICTD (a public agency) and that the collision occurred on publicly owned land.

The Midwest Steel crossing is not the only private grade crossing in the United States with significant public involvement. Many private crossings provide access to public facilities, such as parks or municipal dumps. In addition, many crossings throughout the Nation are traversed by the public riding on passenger trains. The members of the public using these private crossings are entitled to the same level of safety as is required on public grade crossings. Nevertheless, because of differentiations in how private and public crossings are overseen, funded, and regulated, a lower level of safety may be tolerated on private crossings than on public crossings. The Safety Board concludes that the current method of classifying grade crossings based solely on whether the roadway involved is publicly or privately owned does not provide a uniform level of safety at all grade crossings. Therefore, to ensure that public and private crossings are provided a uniform level of safety, the Safety Board believes the DOT should eliminate any differentiations between private and public highway-rail grade crossings with regard to providing funding for, or requiring the implementation of, safety improvements.

One Level of Safety. While roadway ownership determines whether a crossing is classified as private or public, the public rightly expects safe transport over all U.S. grade crossings, whether private or public. The Safety Board considers that the Nation's motorists and rail passengers are entitled to the same high level of safety at both public and private grade crossings. This "one-level-of-safety" objective means that public and private crossings throughout the United States should be equally safe for use and should meet the same safety requirements.

The Safety Board's investigation of the Portage grade-crossing accident has shown that some of the differences between public and private grade crossings have a negative effect on the safety of some private grade crossings. Private grade crossings lack coordinated safety oversight, funding to make safety improvements, and established safety guidelines and standards. Public grade crossings, however, have all of these benefits.

The Safety Board considers that this situation causes disparity between the safety levels required at public and private grade crossings. In effect, public grade crossings are by their public nature provided greater potential to achieve and maintain a higher level of safety than private grade crossings. But many private grade crossings involve the public, either as railroad passengers or highway vehicle occupants. Therefore, the Safety Board concludes that the current disparity in treatment between private and public grade crossings can place members of the public traveling on private grade crossings at increased risk.

Public safety demands that all grade crossings throughout the United States be required to meet one level of safety. In its 1998 passive grade-crossing safety study, the Safety Board found that a serious impediment to achieving one level of safety at all grade crossings was public agencies' lack of jurisdiction at private crossings. Accordingly, the Safety Board made the following safety recommendations to the DOT and the States (respectively):

> <u>H-98-32 and -35</u>
>
> Determine [in conjunction with each other] within 2 years, governmental oversight responsibility for safety at private highway-rail grade crossings and ensure that traffic control on these crossings meets the standards within the MUTCD.[53]

The DOT has stated that it intends to act on this issue within the proposed time frame, and the recommendation is in "Open—Acceptable Response" status. The responses from the States, however, have been limited (nine States have responded to date) and not generally favorable. Only three States (Utah, Maryland, and Hawaii) appear to fully accept this recommendation. Indiana has not yet replied to the recommendation.

Grade-Crossing Hazard Formula. At public grade crossings in Indiana, INDOT uses a formula developed by the DOT to determine the relative likelihood of accidents occurring at the grade crossing. Those public crossings found to be hazardous under this

[53] *Safety at Passive Grade Crossings, Volume I: Analysis*, Safety Study NTSB/SS-98/02, p. 87.

formula are listed and addressed, in priority order, as crossings requiring safety improvements.

INDOT does not use this hazard index formula to evaluate private crossings, so INDOT never applied the formula to the Midwest Steel grade crossing. However, even if INDOT had evaluated private grade crossings, the hazard index formula used would not have included data on the special characteristics that make the Midwest Steel crossing particularly hazardous.

The DOT-based index employed by INDOT basically considers the volume of vehicular traffic using the crossing, the number of trains traversing the crossing, the types of warning devices at the crossing, and the number of accidents that have taken place at that location. The formula would not take into account the fact that about 30 percent of the trains traversing the Midwest Steel grade crossing are passenger trains. (Systemwide, NICTD reportedly carries 11,000 to 12,000 commuters each weekday.) Nor would the formula consider that, of the 4,300 motor vehicle crossings that take place daily, about 1,800 are made by heavy trucks. Despite the obvious safety problems identified during the Portage investigation, under the limited INDOT hazard criteria, the Midwest Steel crossing would not have been classified as a particularly dangerous crossing, largely because it had experienced only one accident in the past 5 years. The Safety Board therefore concludes that an accurate evaluation of the accident risk at the Midwest Steel grade crossing could not be made using the current hazard index formula because the formula does not reflect the presence of passenger trains and the prevalence of tractor-semitrailers using the crossing.

In its 1998 passive grade crossing safety study, the Safety Board issued the following safety recommendation to the DOT.

<u>H-98-33</u>

> Develop a standardized hazard index or a safety prediction formula that will include all variables proven by research or experience to be useful in evaluating highway-rail grade crossings, and require the States to use it.

In the same letter of December 23, 1998, in which the DOT responded to Safety Recommendation H-98-32, the DOT failed to respond to Safety Recommendation H-98-33. Therefore, in a letter dated February 8, 1999, the Safety Board stated

> [Safety Recommendation] H-98-33 asked the DOT to develop a standardized hazard index or a safety prediction formula that will include all variables proven by research or experience to be useful in evaluating highway-rail grade crossings, and require the States to use it. Because no response was provided for [Safety Recommendation] H-98-33, the Board has classified this recommendation 'Open--Await Response.'

Therefore, to ensure that the hazard formula used to establish the relative danger posed by a grade crossing is as accurate as possible, the Safety Board reiterates Safety Recommendation H-98-33 to the DOT.

Crossing Closure. The Safety Board has long held that the ultimate level of safety for grade crossings is achieved by grade-crossing elimination through grade separation or closure. The FRA has made reducing the number of crossings throughout the Nation an agency objective. In 1990, the FRA's grade crossing inventory files recorded 292,839 public and private grade crossings. The FRA's goal, announced in 1991, is a 25-percent reduction in the number of crossings (about 73,000 crossings) by the year 2001.[54] As of May 31, 1999, the FRA recorded an inventory of 259,266 public and private grade crossings, representing a reduction of about 11.5 percent (33,573 crossings) in the number of crossings.

In recent years (1994 through 1998), more than 4,000 accidents, on average, have occurred annually at U.S. grade crossings. This means about 11 accidents occur daily on these crossings. In 1998, a total of 431 deaths resulted from grade-crossing accidents, or more than 1 death per day.[55]

Grade-crossing elimination would improve safety for members of the public traveling in both trains and motor vehicles. Although the FRA is working to reduce the number of U.S. grade crossings, the agency's stated goals are not being met. In fact, 8 years into its 10-year plan, the FRA has achieved less than half of its goal. The Safety Board therefore concludes that had the FRA grade-crossing closure program been more successful in eliminating grade crossings, fewer grade-crossing accidents might have occurred.

Long Combination Vehicle Conspicuity

Two days after the accident, the Safety Board conducted sight and stopping distance testing with a train similar to NICTD train 102 and an LCV Michigan Train similar to the one involved in the accident. Unlike the accident semitrailer, the test semitrailer was marked with retroreflective tape. During the test, retroreflective tape on the test semitrailer was visible to the test engineer at a distance of 3,279 feet.

Had the LCV on the tracks on the morning of June 18 been marked with retroreflective tape like that on the test semitrailer, the engineer of train 102 would quite likely have seen the LCV while the train was still more than 3,000 feet from the crossing. Because the engineer required only about 1,675 feet in which to stop the train, he might have been able to stop the train well before the crossing, thus avoiding the collision. Therefore, the Safety Board concludes that the train 102 engineer might have seen the LCV sooner and been able to stop the train in time to avoid the collision if the semitrailer involved had been equipped with retroreflective tape.

The Conspicuity Systems law that became effective December 1, 1993, did not apply to trailers manufactured before that date. However, DOT rulemaking that would

[54] Gilbert E. Carmichael, *Highway–Rail Grade Crossings: The Unfinished Safety Agenda. In: The Job's Not Done: Proceedings, 1991 National Conference On Highway–Rail Safety, 1991 July 7–10* (Philadelphia, PA. College Station, TX: TransCo, 1991), pp. 5–9.

[55] *Safety at Passive Grade Crossings, Volume I: Analysis*, Safety Study NTSB/SS-98/02, p. vii.

require all trailers manufactured before December 1, 1993, to be retrofitted with retroreflective tape went into effect on June 1, 1999.[56] Motor carriers have 2 years to complete the retrofitting.

Train Car Crashworthiness

Collision Post

According to 49 CFR 229.141 (a) (4), a collision post "shall have an ultimate shear value of not less than 300,000 pounds at a point even with the top of the underframe member to which it is attached." The kinetic energy released by the impact of the coil upon its collision with the front bulkhead of car 11 was approximately 2.36 million foot pounds.

The collision post in car 11 was not designed to absorb the force of an object (such as the coil) weighing 38,030 pounds at the speed at which the collision occurred. Therefore, the Safety Board concludes that the structural elements of the NICTD railcar 11 collision post that failed were overwhelmed by the force of the collision, and the post could not have prevented penetration of the steel coil, given the train speed and the weight of the coil.

Nevertheless, the Safety Board is concerned about the lack of weld penetration and fusion and the unexplained fastener found in the collision post welds of this railcar. Although intrusion of the coil into the railcar was probably unavoidable in this accident, collision posts should always be installed to ensure optimum strength and effectiveness. The purpose of the collision posts provided within passenger cars is to prevent intrusion into the car body. Passengers and crew depend on the collision posts to provide protection in the event of an accident. The Safety Board therefore finds the existence of defective welds in the area of the collision posts disturbing. Although the weld quality did not affect the outcome of the Portage accident, the presence of defective welds can only serve to weaken the structure of the car. If adjacent welds had demonstrated the same deficiencies as those found by investigators, the strength of the collision post structure could have been significantly compromised.

The lack of joint penetration and lack of fusion found on the vertical inboard front weld would have resulted in a weld that was weaker than the 100-percent penetration (and fused) weld that was required. Because of the loading speed and the point of application in this accident, the load path did not go through either the front or rear vertical inboard welds. However, many other possible accident scenarios exist in which the strength of the vertical inboard collision post welds would have been relied upon to prevent intrusion into the car. The Safety Board concludes that, under some circumstances, the full strength of the vertical inboard collision post welds may be necessary to protect passengers and crew.

Railroad passenger and transit cars are purchased through contracts that cite detailed technical specifications. The technical specifications typically dictate require-

[56] FHWA final rule docket No. MC-94-1 (*Federal Register*, Vol. 64, No. 61, March 31, 1999, pp. 15587-15606).

ments intended to ensure the quality and performance of the vehicle, including workmanship standards. The NICTD specification is clear that "The contractor shall be responsible for the quality of the welding and brazing done by himself and his subcontractors."[57] Nippon Sharyo indicated that it performed inspections in addition to those performed by NICTD and its representatives, but the welding defects noted in the vertical inboard collision post welds were apparently not found during these inspections. No records of the Nippon Sharyo weld inspections could be reviewed by the Safety Board, but based on the presence of these weld defects, the Safety Board concludes that Nippon Sharyo did not employ sufficient quality assurance procedures during the welding of the collision post structures.

The Safety Board considers that, because of Nippon Sharyo's insufficient welding quality assurance procedures, deficiencies such as the lack of joint penetration, the lack of fusion, and the unexplained components found in the collision post welds of this car might also be found in other Nippon Sharyo railcars in the NICTD fleet. Therefore, the Safety Board believes that NICTD should inspect the collision post welds of all Nippon Sharyo railcars in its fleet and repair any welds that are deficient.

The Safety Board is aware of another fleet of cars, virtually identical in design to the NICTD cars, that was also manufactured by Nippon Sharyo.[58] It is not known whether these cars contain weld defects in the collision posts, such as the lack of penetration and fusion noted here, or whether the same weld quality assurance procedures were used in both cases. The Safety Board therefore believes that the FRA should determine the extent of the weld quality assurance inadequacies demonstrated by Nippon Sharyo in its collision post welds, and implement corrective action as necessary to ensure the strength of the collision posts.

The Safety Board is aware of no Federal requirements for welding quality assurance in the attachment of collision posts. The FRA does require, however, that collision posts be constructed to a certain strength specification and that "the attachment of these members at bottom shall be sufficient to develop their full shear value."[59] Because of the vital safety role played by the collision posts, the Safety Board considers that the attachment welds should be carefully inspected to ensure that they are of a sufficient quality to fulfill the design requirements of the car. The Safety Board therefore believes that the FRA should require 100-percent nonvisual inspection of all collision post attachment welds made on MU locomotives and passenger cars during manufacture, and require that inspection records be retained for the life of the car.

[57] *Specification of Electric Multiple Unit Commuter Cars for Northern Indiana Commuter Transportation District*, Specification number SP90034, section S12.10(b), dated 1983.

[58] 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: National Transportation Safety Board, 1997).

[59] 49 CFR 229.141.

Emergency Lighting and Public Address Systems

Following the collision, the emergency electrical system on the first car of train 102 immediately lost all power because damage to the front end severed the wiring and electrical conduits routed through the front bulkhead of that car. Consequently, neither the interior emergency lights nor the public address system in car 11 was operable. Circuits for the backup battery were also made inoperable by the front bulkhead damage.

The failure of emergency electrical systems to provide power can be a serious problem in situations such as collisions and derailments and has been addressed by the Safety Board in other accident investigations.[60] In this case, to provide emergency care and extricate victims, the PFD furnished its own portable lighting. Passengers in the lead railcar used illumination from the second car and a flashlight provided by one of the crewmembers for their emergency lighting, so the electrical failure did not hinder their evacuation. Crewmember statements indicated that, because of the train's small size, they were able to communicate readily with the passengers despite the nonfunctioning public address system. Therefore, the Safety Board concludes that the failure of car 11's emergency electrical systems did not affect the evacuation and emergency response efforts following the Portage accident.

[60] 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: National Transportation Safety Board, 1997); *Amtrak Train 87 Derailment after Colliding with Intermodal Trailer from CSXT Train 176 Selma, North Carolina May 16, 1994*, Railroad Accident Report NTSB/RAR-95/02 (Washington: National Transportation Safety Board, 1995); and *Derailment of Amtrak Train No. 2 on the CSXT Big Bayou Canot Bridge near Mobile, Alabama, September 22, 1993*, Railroad-Marine Accident Report NTSB/RAR-94/01 (Washington: National Transportation Safety Board, 1994).

Conclusions

Findings

1. Neither the weather, the track, the mechanical condition of the train, the mechanical condition of the long combination vehicle, nor railroad operations caused or contributed to the collision.

2. The train engineer and conductor were qualified to perform their duties and showed no evidence of impairment from drugs, alcohol, or fatigue.

3. The emergency response was timely and effective.

4. If the train 102 engineer had detected the truck as soon as it became visible and immediately put the train into emergency braking, train 102 could still not have been stopped in time to avoid the collision.

5. Despite vehicle overloading, logbook discrepancies, inadequate load securement, and the potential for impairment due to fatigue and marijuana use, these factors concerning the truckdriver's actions did not contribute to the collision.

6. As currently configured, the Midwest Steel grade-crossing storage area cannot safely accommodate all vehicles that are allowed to use it.

7. The signal systems operating at the Midwest Steel grade crossing functioned as designed, and no signal operation failures caused or contributed to the accident.

8. The Midwest Steel grade-crossing signal system did not prevent vehicles from being trapped in the storage area between the Northern Indiana Commuter Transportation District and Consolidated Rail Corporation tracks.

9. The lack of clear delineation of oversight responsibility for the safety of the Midwest Steel private grade crossing undermined its safety.

10. The use of the *Manual on Uniform Traffic Control Devices* at private as well as public grade crossings may help ensure that certain hazardous conditions at private grade crossings receive appropriate attention before an accident occurs.

11. The current method of classifying grade crossings based solely on whether the roadway involved is publicly or privately owned does not provide a uniform level of safety at all grade crossings.

12. The current disparity in treatment between private and public grade crossings can place members of the public traveling on private grade crossings at increased risk.

13. An accurate evaluation of the accident risk at the Midwest Steel grade crossing could not be made using the current hazard index formula because the formula does not reflect the presence of passenger trains and the prevalence of tractor-semitrailers using the crossing.

14. Had the Federal Railroad Administration grade-crossing closure program been more successful in eliminating grade crossings, fewer grade-crossing accidents might have occurred.

15. The train 102 engineer might have seen the long combination vehicle sooner and been able to stop the train in time to avoid the collision if the semitrailer involved had been equipped with retroreflective tape.

16. The structural elements of the Northern Indiana Commuter Transportation District railcar 11 collision post that failed were overwhelmed by the force of the collision, and the post could not have prevented penetration of the steel coil, given the train speed and the weight of the coil.

17. Under some circumstances, the full strength of the vertical inboard collision post welds may be necessary to protect passengers and crew.

18. Nippon Sharyo Ltd. did not employ sufficient quality assurance procedures during the welding of the collision post structures.

19. The failure of car 11's emergency electrical systems did not affect the evacuation and emergency response efforts following the Portage accident.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the collision between Northern Indiana Commuter Transportation District train 102 and a long combination vehicle (truck) at the National Steel Corporation's Midwest Steel grade crossing was ineffective action by Federal, State, and private agencies to permanently resolve safety problems at the Midwest Steel grade crossing, which they knew to be a hazardous crossing.

Recommendations

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

to the U.S. Department of Transportation:

> Eliminate any differentiations between private and public highway-rail grade crossings with regard to providing funding for, or requiring the implementation of, safety improvements. (I-99-02)

to the Federal Railroad Administration:

> Work together with the Federal Highway Administration, the Indiana Department of Transportation, the National Steel Corporation, the Norfolk Southern Corporation, and the Northern Indiana Commuter Transportation District to make, within 2 years, permanent engineering changes to the Midwest Steel highway-rail grade crossing that will minimize or eliminate safety hazards at this crossing. (R-99-31)

> Determine the extent of the weld quality assurance inadequacies demonstrated by Nippon Sharyo Ltd. in its collision post welds, and implement corrective action as necessary to ensure the strength of the collision posts. (R-99-32)

> Require 100-percent nonvisual inspection of all collision post attachment welds made on multiple-unit locomotives and passenger cars during manufacture, and require that inspection records be retained for the life of the car. (R-99-33)

to the Federal Highway Administration:

> Work together with the Federal Railroad Administration, the Indiana Department of Transportation, the National Steel Corporation, the Norfolk Southern Corporation, and the Northern Indiana Commuter Transportation District to make, within 2 years, permanent engineering changes to the Midwest Steel highway-rail grade crossing that will minimize or eliminate safety hazards at this crossing. (H-99-27)

to the Indiana Department of Transportation:

> Work together with the Federal Railroad Administration, the Federal Highway Administration, the National Steel Corporation, the Norfolk

> Southern Corporation, and the Northern Indiana Commuter Transportation District to make, within 2 years, permanent engineering changes to the Midwest Steel highway-rail grade crossing that will minimize or eliminate safety hazards at this crossing. (H-99-28)

to the National Steel Corporation, Midwest Steel Division:

> Work together with the Federal Railroad Administration, the Federal Highway Administration, the Indiana Department of Transportation, the Norfolk Southern Corporation, and the Northern Indiana Commuter Transportation District to make, within 2 years, permanent engineering changes to the Midwest Steel highway-rail grade crossing that will minimize or eliminate safety hazards at this crossing. (H-99-29)

to the Norfolk Southern Corporation:

> Work together with the Federal Railroad Administration, the Federal Highway Administration, the Indiana Department of Transportation, the National Steel Corporation, and the Northern Indiana Commuter Transportation District to make, within 2 years, permanent engineering changes to the Midwest Steel highway-rail grade crossing that will minimize or eliminate safety hazards at this crossing. (R-99-34)

to the Northern Indiana Commuter Transportation District:

> Work together with the Federal Railroad Administration, the Federal Highway Administration, the Indiana Department of Transportation, the National Steel Corporation, and the Norfolk Southern Corporation to make, within 2 years, permanent engineering changes to the Midwest Steel highway-rail grade crossing that will minimize or eliminate safety hazards at this crossing. (R-99-35)

> Inspect the collision post welds of all Nippon Sharyo Ltd. railcars in your fleet and repair any welds that are deficient. (R-99-36)

Also as a result of its investigation, the National Transportation Safety Board reiterates the following safety recommendation:

to the U.S. Department of Transportation:

> Develop a standardized hazard index or a safety prediction formula that will include all variables proven by research or experience to be useful in evaluating highway-rail grade crossings, and require the States to use it. (H-98-33)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

JAMES E. HALL
Chairman

ROBERT T. FRANCIS II
Vice Chairman

JOHN A. HAMMERSCHMIDT
Member

JOHN J. GOGLIA
Member

GEORGE W. BLACK, JR.
Member

Adopted: July 26, 1999

Appendix A
Investigation

The National Transportation Safety Board was notified about 8:00 a.m., eastern daylight time, on June 18, 1998, that a Northern Indiana Commuter Transportation District (NICTD) commuter train had collided with a tractor-trailer near Portage, Indiana. The investigator-in-charge and other members of the Safety Board investigative team were dispatched from the Washington, D.C., headquarters office and the Los Angeles, California, Denver, Colorado, and Chicago, Illinois, regional offices. The investigative groups studied rail operations, track and signals, mechanical and survival factors, human performance, and highway operations and vehicles.

The Federal Railroad Administration, the Federal Highway Administration, NICTD, the United Transportation Union, the National Steel Corporation's Midwest Division, the Portage Fire Department, the Porter County Sheriff's Office, the Indiana State Police, and the Indiana Department of Transportation assisted in the Safety Board investigation.

Safety Board staff conducted a deposition proceeding as part of its investigation on October 28 and 29, 1998, in Merrillville, Indiana, during which 10 witnesses testified.

Appendix B
Selections from the Indiana State Code

IC 9-20-5, Chapter 5. Heavy Duty Highways and Extra Heavy Duty Highways:

IC 9-20-5-1:

Sec. 1. (a) The Indiana department of transportation may adopt rules under IC 4-22-2 to do the following:

(1) Establish and designate a highway as a heavy duty highway.

(2) Remove the designation of a highway or part of a highway as a heavy duty highway.

(b) The Indiana department of transportation shall periodically publish a map showing all highways designated by the department at the time as heavy duty highways.

As added by P.L. 2-1991, SEC. 8.

IC 9-20-5-2:

Sec. 2. Whenever the Indiana department of transportation designates a heavy duty highway, the department shall also fix the maximum weights of vehicles that may be transported on the highway. The maximum weights may not exceed the following limitations:

(1) A vehicle may not have a maximum wheel weight, unladen or with load, in excess of eight hundred (800) pounds per inch width of tire, measured between the flanges of the rim, or an axle weight in excess of twenty-two thousand four hundred (22,400) pounds.

(2) The total weight concentrated on the roadway surface from any tandem axle group may not exceed eighteen thousand (18,000) pounds for each axle of the assembly.

(3) The total gross weight, with load, in pounds of a vehicle or combination of vehicles may not exceed eighty thousand (80,000) pounds.

As added by P.L. 2-1991, SEC. 8.

IC 9-20-5-3:

Sec. 3. The Indiana department of transportation may not designate an Indiana highway as a heavy duty highway unless the department finds that the highway is:

(1) so constructed and can be so maintained; or

(2) in such condition; that the use of the highway as a heavy duty highway will not materially decrease or contribute materially to the decrease of the ordinary useful life of the highway.

As added by P.L. 2-1991, SEC. 8.

IC 9-20-5-4:

Sec. 4. In addition to the highways established and designated as heavy duty highways under section 1 of this chapter, the following highways are designated as extra heavy duty highways:

(1) Highway 41, from 129th Street in Hammond to Highway 312.

(2) Highway 312, from Highway 41 to Highway 12.

(3) Highway 912, from Michigan Avenue in East Chicago to Highway 12.

(4) Highway 12, from Highway 912 to Clark Road in Gary.

(5) Highway 20, from Clark Road in Gary to Highway 39.

(6) Highway 12, from one-fourth (1/4) mile west of the Midwest Steel entrance to Highway 249.

(7) Highway 249, from Highway 12 to Highway 20.

(8) Highway 12, from one and one-half (1 1/2) miles east of the Bethlehem Steel entrance to Highway 149. [Emphasis added.]

(9) Highway 149, from Highway 12 to a point thirty-six one-hundredths (.36) of a mile south of Highway 20.

(10) Highway 39, from Highway 20 to the Michigan state line.

(11) Highway 20, from Highway 39 to Highway 2.

(12) Highway 2, from Highway 20 to Highway 31.

(13) Highway 31, from the Michigan state line to Highway 23.

(14) Highway 23, from Highway 31 to Olive Street in South Bend.

As added by P.L. 2-1991, SEC. 8. Amended by P.L. 12-1991, SEC. 4; P.L. 123-1993, SEC. 1; P.L. 124-1993, SEC. 1; P.L. 119-1995, SEC. 2.

IC 9-20-5-5:

Sec. 5. The maximum size and weight limits for vehicles operated with a special weight permit on an extra heavy duty highway are as follows:

(1) A vehicle may not have a maximum wheel weight, unladen or with load, in excess of eight hundred (800) pounds per inch width of tire, measured between the flanges of the rim.

(2) A single axle weight may not exceed eighteen thousand (18,000) pounds.

(3) An axle in an axle combination may not exceed thirteen thousand (13,000) pounds per axle, with the exception of one (1) tandem group that may weigh sixteen thousand (16,000) pounds per axle or a total of thirty-two thousand (32,000) pounds.

(4) The total gross weight, with load, of any vehicle or combination of vehicles may not exceed one hundred thirty-four thousand (134,000) pounds.

(5) Axle spacings may not be less than three (3) feet, six (6) inches, between each axle in an axle combination.

(6) Axle spacings may not be less than eight (8) feet between each axle or axle combination.

As added by P.L. 2-1991, SEC. 8.

IC 9-20-5-6:

Sec. 6. The Indiana department of transportation shall implement procedures that, in cooperation with the state police department and local police departments, enhance the safety of citizens along and near extra heavy duty highways listed in section 4 of this chapter. [Emphasis added.]

As added by P.L. 2-1991, SEC. 8.

IC 9-20-5-7:

Sec. 7. A vehicle or combination of vehicles having a total gross weight in excess of eighty thousand (80,000) pounds but less than one hundred thirty-four thousand (134,000) pounds must obtain a special weight permit to travel on an extra heavy duty highway.

As added by P.L. 2-1991, SEC. 8. Amended by P.L. 122-1993, SEC. 2.

IC 9-20-5-8:

Sec. 8. The Indiana department of transportation may not issue a permit under this chapter for the operation of a vehicle if any of the following conditions apply:

(1) The owner or operator of the vehicle has not complied with IC 8-2.1-24.

(2) The owner or operator of the vehicle has not provided the Indiana department of transportation with the owner's or operator's Social Security number or federal identification number.

(3) The owner or operator of the vehicle has not registered the vehicle with the bureau, if the vehicle is required to be registered under IC 9-18.

As added by P.L. 122-1993, SEC. 3. Amended by P.L. 110-1995, SEC. 30.

Appendix C
Visibility and Stopping Tests

Safety Board investigators conducted visibility and stopping tests with a two-car train similar to NICTD train 102 on June 20, 1998. To approximate accident conditions, all tests were performed between 3:45 and 4:45 a.m. The weather was clear.

Visibility test 1.—A Michigan Train LCV similar to the accident vehicle, except that it was equipped with reflective tape, was parked with its semitrailer on the NICTD westward track at the crossing. The train, with headlights illuminated, was backed from the crossing until the tractor-trailer could not be seen. It could not be seen beyond 3,279 feet.

Visibility test 2.—Same conditions as test 1, but the interior lights on the train were extinguished. This factor made no discernible difference in the tractor-trailer's visibility. Results were identical to test 1.

Visibility test 3.—While the semitrailer's lights were on and its side marker lights and reflective tape were covered (making the test semitrailer indistinguishable from the accident semitrailer), the train was slowly brought toward the crossing until the white tractor of the LCV could be seen. The tractor could be seen when the train was 794 feet from the crossing.

Visibility test 4.—The train was moved further toward the crossing until the semitrailer could be seen. It was discernable 542 feet from the crossing. This test was performed at 4:28 a.m.

Stopping distance.—Two torpedoes (explosive caps fastened to the top of the rail and exploded by the pressure of a rolling wheel to give an audible indication of conditions on the track ahead) were placed on the rail 542 feet to the east of the crossing. The semitrailer was removed from the crossing. The train was moved eastward sufficiently to allow it to accelerate to 68 mph. As the test train approached the crossing at 68 mph and reached the spot 542 feet from the crossing, the torpedoes exploded, which gave the test engineer an audible stimulus to place the train into emergency braking, which he did. The train then slowed and stopped. With the train in emergency braking, it passed through the crossing at 43 mph, stopping 1,133 feet beyond the crossing. The total stopping distance was 1,675 feet.

Air brake test.—Investigators inspected the braking systems on cars 11 and 45 in the NICTD Michigan City, Indiana, shop on June 19, 1998. Both units were equipped with Sabe/Knise tread brake units. The braking system on each car functioned as intended during application and release, and the electronic monitoring system indicated the proper corresponding condition.

Appendix D
Highway-Rail Grade-Crossing Obligations

ORGANIZATION	RESPONSIBILITIES		
	General	For Public Crossings	For Private Crossings
FRA	Regulates the aspects of grade-crossing safety pertaining to railroads (track safety, active signals, and train safety and conspicuity).	Limited to operations on the railroad rights of way for railroad track, train, and signal safety. No responsibility for highway components.	Limited to operations on the railroad rights of way for railroad track, train, and signal safety. No responsibility for highway components.
FHWA	Regulates the aspects of grade-crossing safety pertaining to highway safety (crossing design, safety assessments, traffic control devices, and funding improvements). Regulates truck size on “designated” highways.	Regulates aspects of grade crossings that affect highway safety and funds improvements for public crossings, including MUTCD warning device standards	Has no authority to regulate passive crossings on private roads.
INDOT	Owns U.S. Route 12. Is responsible for maintaining the highway traffic signals that can be preempted and are interconnected with the railroad signals. Regulates truck weight on designated highways and truck size and weight on “nondesignated” highways.	Maintains the public roadways and highway signal systems next to private crossings. Maintains an inventory of public crossings, assesses the relative risk at each crossing, and allocates funds for improvements.	No jurisdiction. No inventory. No funding for improvements. No authority over private crossings or roads.
NICTD	Owns, maintains, and inspects the NICTD tracks. Maintains the railroad automatic block signal system and the preemption circuit between the highway traffic controller and the NICTD signal case. Maintains the interconnection between the two railroads.	No responsibility for the roadway or crossing.	Through contractual agreement, maintains the crossing signal lights and gates for private crossing owner (Midwest Steel). No responsibility for the roadway or crossing.
Conrail	Owns, maintains, and inspects the Conrail tracks. Conrail dispatchers control all trains on this track via a train control signal system.	Maintains the crossing signal lights and gates.	Through contractual agreement, maintains the crossing signal lights and gates for private crossing owner (Midwest Steel). No responsibility for the roadway or crossing.
National Steel Corporation’s Midwest Steel Division	Owns the roadway intersecting the railroad tracks and the storage area.	N/A	Through contractual agreements with NICTD and Conrail, constructs and maintains the crossing signal lights, gates, and roadway surface.

Acronyms and Abbreviations

CAMI	Civil Aeromedical Institute
CDL	commercial driver's license
CFR	*Code of Federal Regulations*
Conrail	Consolidated Rail Corporation
DOT	U.S. Department of Transportation
EMS	emergency medical services
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
GVW	gross vehicle weight
IDOT	Illinois Department of Transportation
INDOT	Indiana Department of Transportation
LCV	long combination vehicle
Midwest Steel	Midwest Division of the National Steel Corporation
MP	milepost
MU	multiple-unit
MUTCD	*Manual on Uniform Traffic Control Devices*
NICTD	Northern Indiana Commuter Transportation District
Nippon Sharyo	Nippon Sharyo Ltd.
PFD	Portage Fire Department
PPD	Portage Police Department
THC	tetrahydrocannabinol
THC-COOH	tetrahydrocannabinol carboxylic acid
US 12	U.S. Route 12
WLL	working load limit