National Transportation Safety Board
Washington, D.C. 20594

Railroad Accident Brief

Accident No.:	DCA-05-MR-013
Location:	Chicago, Illinois
Date:	September 17, 2005
Time:	8:35 a.m. central daylight time[1]
Railroad:	Northeast Illinois Regional Commuter Railroad Corporation (Metra)
Property Damage:	$6.35 million
Fatalities:	2
Injuries:	117
Type of Accident:	Derailment

The Accident

On Saturday, September 17, 2005, about 8:35 a.m., eastbound (inbound) Northeast Illinois Regional Commuter Railroad Corporation (Metra) train 504 derailed one locomotive and five cars at milepost (MP) 4.7 near West 47th and South Federal Street in Chicago, Illinois.[2] The train was being operated in the push mode from a cab control car at the lead end. The train had departed Joliet, Illinois, at 7:24 a.m. en route to the LaSalle Street station in downtown Chicago. The train crew consisted of an engineer in the cab control car and a conductor, an assistant conductor, and a collector in the passenger cars.

The train derailed as it traversed a crossover from track 2 to track 1 that had a prescribed maximum operating speed of 10 mph. (See figure 1.) The train was traveling 69 mph as it entered the crossover. The second through the fifth cars from the lead end of the train struck a steel girder that was part of a bridge that carried the tracks over 47th Street. Both turnouts of the crossover and one power switch machine were destroyed. Following the accident, Metra relocated the track to a new bridge adjacent to the original bridge.

[1] All times in this brief are central daylight times.

[2] Eastbound trains are inbound trains originating at Joliet, Illinois, destined for the LaSalle Street station in Chicago; conversely, westbound trains are outbound trains departing Chicago. MP numbering decreases in the eastbound, or inbound, direction of travel.

Figure 1. Train after derailment. (It was operating in push mode and traveling in the direction of the arrow.)

Metra reported that 185 passengers and 4 crewmembers were on the train. There were 109 passengers, 4 crewmembers, and 4 others injured. Additionally, two passengers were killed. The derailment occurred during daylight hours, in sunny, clear weather with a temperature of 65° F.

The Accident Sequence

The crew of the train had reported for duty on Saturday morning at Joliet, Illinois. According to the work records, all crewmembers were in compliance with the hours-of-service regulations. Before departing Joliet, the crew performed the required tests and inspections and held a job briefing that included a discussion of the placement of cars and locomotive for the train, the crew assignments, the cars that would be initially open to the public, and the track warrant[3] issued for their trip. The train departed Joliet on schedule, at 7:24 a.m.

[3] Track Warrant No. 109171 contained three track bulletins that affected the movement of trains on the Rock Island District: Bulletin A-101 was a Form A speed restriction, bulletin B-101 was a Form B for a track work zone on track 2, and bulletin D-101 was a Form D for a segment of track 1 that was to be out of service.

Train 504 traveled on the Rock Island District from Joliet, MP 40.2, to Gresham, MP 9.8, arriving at 8:28 a.m.,[4] or 3 minutes late. The engineer stated that the trip to Gresham was uneventful, the weather was clear, and the signal indications were clearly visible. The track warrant showed track work on an upcoming portion of the track, between MP 6.68 and MP 6.2. A Form B, restricting train movements to provide protection for maintenance workers, had been issued for track 2, the track train 504 was on; the restriction was in effect between 8:00 a.m. and 5:00 p.m. Metra procedures required train engineers to contact the employee in charge of the work crew for permission to enter the work limits at the speed specified by the employee in charge.

Metra designates the boundaries of a work zone by putting signs, referred to as "flags,"[5] next to the track. Red flags are placed at each end of a work zone, and yellow/red advance flags are placed 1 mile in advance of the red flag.

Operating rules state that the flags should not be installed before the time designated on the Form B. If the flags are not visible or installed by the designated time,[6] the train engineer must still contact the employee in charge before entering the work zone. If the engineer cannot reach the employee in charge, he is to stop the train and ask the dispatcher for instructions.

The yellow/red flag had not been installed 1 mile in advance of the work zone (MP 7.68) when train 504 passed that point at 70 mph about 8:30:58. a.m.[7] At 8:31:42 a.m., signal 068, MP 7.0, displayed a *clear* signal indication (green aspect)[8] as the train slowed to 42 mph in preparation for the 40-mph speed restriction between MP 6.9 and MP 6.6 for the Norfolk Southern Railroad grade crossing at Englewood (MP 6.7). (See figure 2.)

[4] Train movement times were established by coordinating times from the event recorder on the lead cab control car with the Metra Consolidated Control Facility clock time. Train speeds were recorded on the lead cab control car event recorder. Train 504 had 17 scheduled station stops before the Gresham station.

[5] The "flags" used by Metra are colored metal boards, red and yellow/red, affixed to metal posts driven into the ground at prescribed locations. If the flags are not placed, it is noted on a form.

[6] Travel conditions and time schedule constraints can interfere with flags being installed at the exact prescribed times. Vandalism can result in flags being damaged or removed.

[7] Signal information and train speeds were coordinated from the event recorder on the train and the wayside electronic and diagnostic signal logs.

[8] A *clear* indication, either a green or green over red aspect, tells train engineers that they can proceed at the maximum speed authorized for their train.

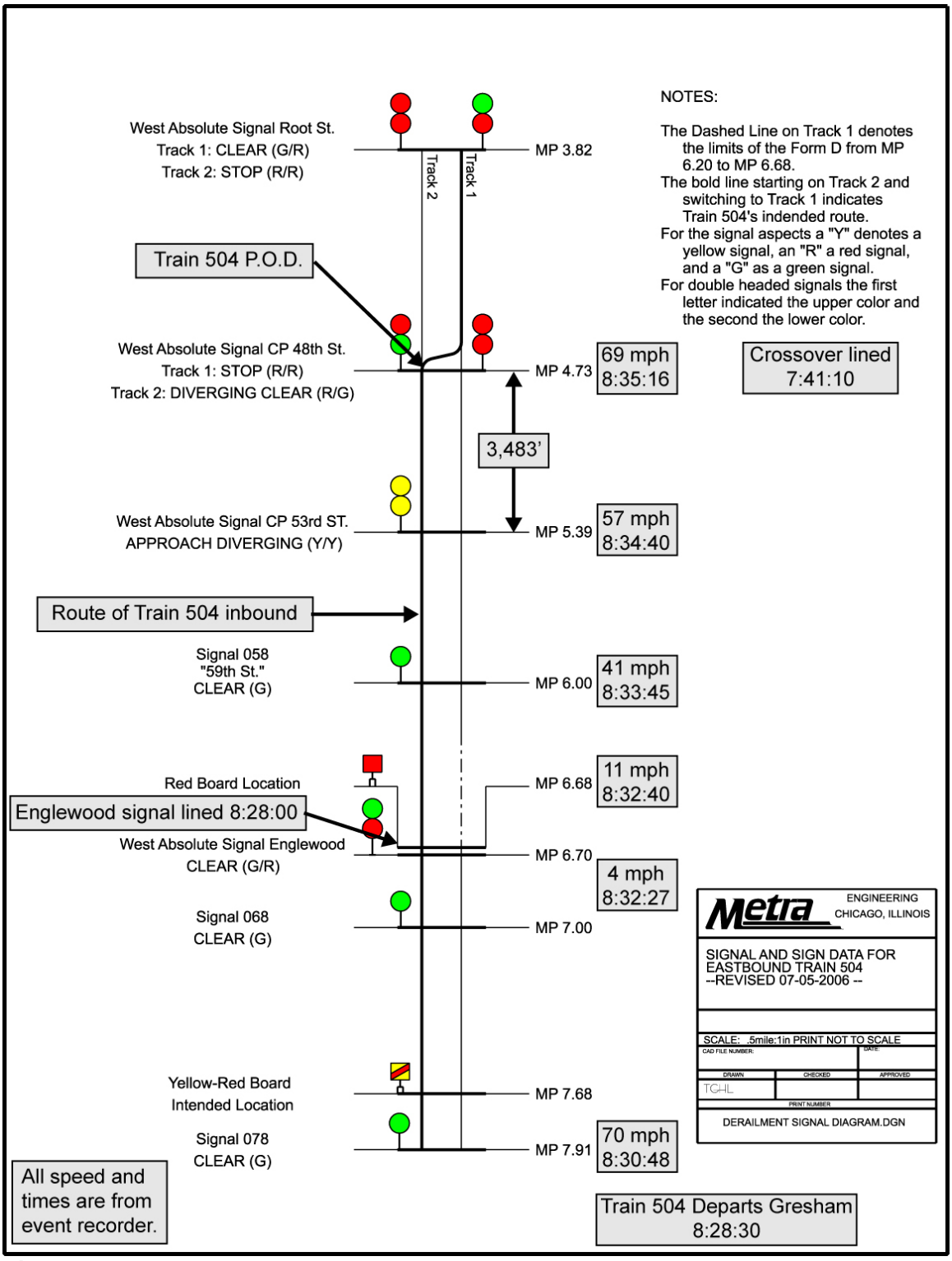
NOTES:
The Dashed Line on Track 1 denotes the limits of the Form D from MP 6.20 to MP 6.68.
The bold line starting on Track 2 and switching to Track 1 indicates Train 504's indended route.
For the signal aspects a "Y" denotes a yellow signal, an "R" a red signal, and a "G" as a green signal.
For double headed signals the first letter indicated the upper color and the second the lower color.
West Absolute Signal Root St.
Track 1: CLEAR (G/R)
Track 2: STOP (R/R)
MP 3.82
Track 2
Track 1
Train 504 P.O.D.
West Absolute Signal CP 48th St.
Track 1: STOP (R/R)
Track 2: DIVERGING CLEAR (R/G)
MP 4.73
69 mph
8:35:16
Crossover lined
7:41:10
3,483'
West Absolute Signal CP 53rd ST.
APPROACH DIVERGING (Y/Y)
MP 5.39
57 mph
8:34:40
Route of Train 504 inbound
Signal 058
"59th St."
CLEAR (G)
MP 6.00
41 mph
8:33:45
Red Board Location
MP 6.68
11 mph
8:32:40
Englewood signal lined 8:28:00
West Absolute Signal Englewood
CLEAR (G/R)
MP 6.70
4 mph
8:32:27
Signal 068
CLEAR (G)
MP 7.00
Yellow-Red Board
Intended Location
MP 7.68
Signal 078
CLEAR (G)
MP 7.91
70 mph
8:30:48
All speed and times are from event recorder.
Train 504 Departs Gresham
8:28:30
Metra
ENGINEERING
CHICAGO, ILLINOIS
SIGNAL AND SIGN DATA FOR
EASTBOUND TRAIN 504
--REVISED 07-05-2006 --
SCALE: .5mile:1in PRINT NOT TO SCALE
CAD FILE NUMBER:
DATE:
DRAWN
CHECKED
APPROVED
TCHL
PRINT NUMBER
DERAILMENT SIGNAL DIAGRAM.DGN

Figure 2: Map.

At 8:32:27 a.m., by which time the train had slowed to 4 mph and was passing the Englewood signal, which was displaying a *clear* signal indication, the engineer contacted the employee in charge. (The engineer told Safety Board investigators he had earlier attempted unsuccessfully to contact the employee in charge.) The employee in charge stated that he had given permission for the train to operate through the work zone at the authorized track speed, which was 40 mph. He said that he had believed the train had come to a stop and that the engineer had not mentioned that the yellow/red advance flag was not in place. The engineer stated that he had tried to notify his conductor of the missing advance flag. The conductor said that he had told the engineer his communication was being transmitted through the train's public address system and that he would come up to the control cab to talk to him. Several passengers[9] stated that they had heard something unintelligible on the public address system. One passenger, who had been in the third car from the front, stated that the conductor was "hurrying" through the car with his hand-held radio.

Between MP 6.65 and MP 6.55, the track curves to the left in a 3° 40' curve then straightens to and beyond the crossover at MP 4.7, near control point (CP) 48th Street,[10] where the derailment occurred. There was no vegetation overgrowth or other sight obstructions along the 2-mile approach to CP 48th Street. About 8:33:45 a.m., after accelerating to 41 mph,[11] the train passed a *clear* signal indication (green aspect) displayed at signal 058, 59th Street at MP 6.0.

Signal data logs indicated that the next signal, at CP 53rd Street, was displaying an *approach diverging*[12] indication (yellow over yellow aspect)[13] and that the next signal after that, at CP 48th Street, was displaying a *diverging clear*[14] indication (red over green aspect).[15] However, the engineer told Safety Board investigators that the signal at MP 5.39, CP 53rd Street, was displaying a *clear* indication (green over red aspect). He also said that he could see the signal at MP 4.73, CP 48th Street, and that it was displaying a *clear* indication. The signal and train movement records indicated that the crossover had been lined for the crossover move since about 7:41 a.m.

Recorder data showed the train passed the *approach diverging* signal at CP 53rd Street about 8:34:40 a.m. at a speed of 57 mph and passed the *diverging clear* signal at CP 48th Street about 8:35:16 a.m. at a speed of about 69 mph.

[9] Four passengers noted this message on their Safety Board followup accident questionnaires.

[10] CP 48th Street is Metra's name for the signal location near 47th Street in Chicago.

[11] The authorized speed through the work zone was 40 mph.

[12] An *approach diverging* indication (yellow over yellow aspect) tells a train engineer to proceed prepared to advance on diverging route at the next signal at prescribed speed through turnout.

[13] Signals logs showed this signal had displayed for 22 minutes 24 seconds before the train passed.

[14] A *diverging clear* indication (red over green aspect) tells a train engineer to proceed on diverging route at prescribed speed through turnout.

[15] Signal logs showed that this signal had displayed for 54 minutes 2 seconds before the derailment.

Track 2 leading to the crossover was designated by Metra as meeting the Federal Railroad Administration (FRA) standards for Class 4 track.[16] Metra's maximum allowable operating[17] speed between MP 7.0 and MP 3.9 was 70 mph for passenger trains and 30 mph for freight trains, except between MP 6.9 and MP 6.6, where passenger and freight train speeds were restricted to 40 mph and 20 mph, respectively. In addition, all trains operating through the crossover at CP 48th Street, MP 4.7, were limited to 10 mph. This 10-mph speed restriction is intended to provide for a safe transition of equipment through the crossover. The train derailed about 8:35:19 a.m., when it was 242 feet past the CP 48th Street signal and operating at 69 mph, as it attempted to traverse the crossover. No emergency brake application was recorded before the derailment. (See figure 3.)

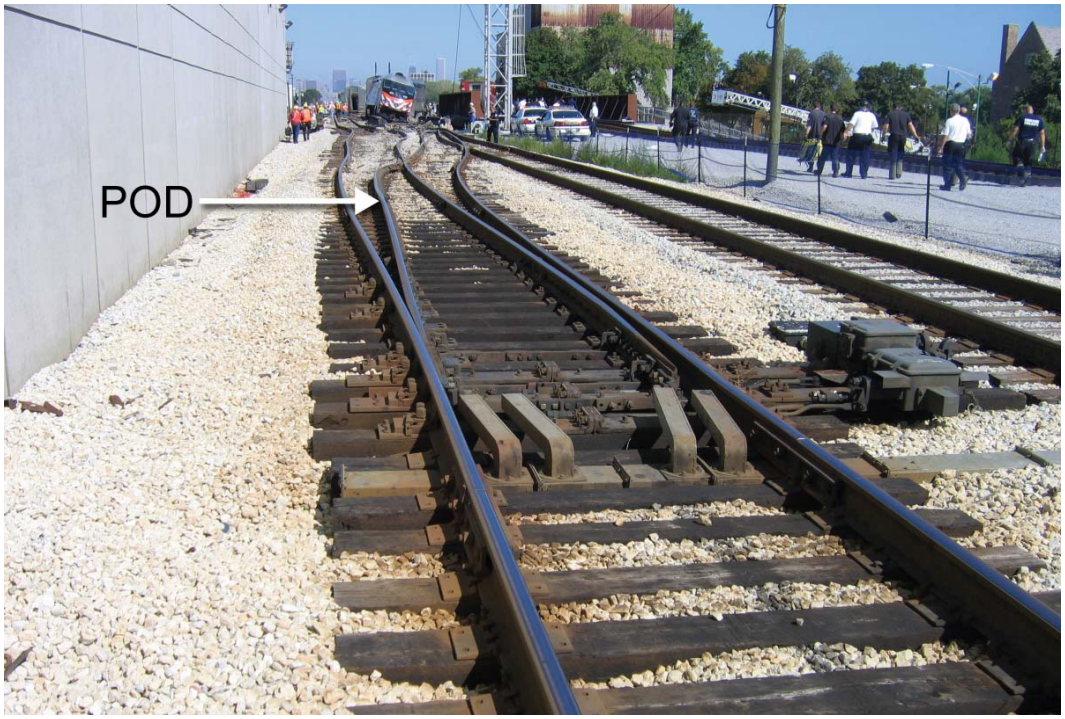

Figure 3. The point of derailment (POD); the beginning of the crossover is in the foreground.

The first supervisor to arrive after the accident stated to Safety Board investigators that when he asked the engineer what had happened, he responded, "I didn't see it, I didn't see it." Metra officials stated that the engineer failed to comply with the *approach diverging* and *diverging clear* signal aspects, as well as with the 10-mph speed restriction through the crossover. Following two Metra internal hearings and a formal investigation, the engineer was dismissed from Metra service on May 31, 2006, and his train engineer's license was revoked for a month (from September 21, 2005, to

[16] FRA track safety standards (49 *CFR* 213.9) for class 4 track allow 80 mph for passenger trains and 60 mph for freight trains.

[17] Metra System Timetable No. 1 was effective 3:01 a.m. Sunday, April 3, 2005.

October 21, 2005). As noted above, train 504 had a recorded speed of 69 mph while traveling into the crossover. The excessive train speed and the severe angle of attack between the wheel flanges of the lead set of trucks of the cab control car and the gage corner of the curve closure rail caused the wheels to cross over the railhead and derail. The leading cab control car (8570) derailed first and passed through the 47th Street Bridge[18] without impact. The second car (7331) derailed and scraped the bridge girder. The third through fifth cars (8548, 7488, and 7351) derailed, struck, and rode over the low girder of the bridge. (See figure 4.)

Figure 4. Damage to the 47th Street Bridge and adjacent walkway and handrail.

Engineer Attentiveness

Although the accident trip was principally a routine trip, some activity along the tracks may have diverted the engineer's attention from the aspects of the CP 53rd Street and CP 48th Street signals. The engineer would have been able to see the signal at CP 53rd Street after exiting the curve at MP 6.55. Sight distance tests performed by Safety Board investigators showed that the CP 53rd Street *approach diverging* signal could be seen from a distance of about 3,223 feet and that the CP 48th Street *diverging clear* signal could be seen from a distance of 1,860 feet.

[18] The 47th Street Bridge was a typical highway overhead crossing for the former Chicago, Rock Island and Pacific Railroad built in 1897-98. It was a 70-foot-through girder span, and the top of the girder projected 1.8 feet above the top of rail.

Two Metra signal department employees had completed their work at the CP 53rd Street crossover and were standing north of the signal waiting for train 504 to pass them so they could cross the tracks and return to their vehicle. The engineer did not mention the two workers during the postaccident Safety Board interviews; however, it is likely that he did observe them and their vehicle, to determine they were safely clear of the tracks.

The engineer stated that he had observed other Metra employees who were filming a training video for Metra in the yard west of the train (on the engineer's left), after the train passed the CP 53rd Street signal. The engineer told investigators that he had seen the employees, but spent only a brief time looking at them. He said:

> I really didn't pay too much attention to them, just kept my eyes forward until I looked down, noticed that the switch was lined for a diverging route. By the time I saw it, there was nothing I could do. I don't believe I was able to put the train into emergency.

It is unclear whether or to what extent the presence of the Metra employees around the tracks diverted the engineer's attention from the signal aspects displayed at CP 53rd Street and CP 48th Street. Most likely, the engineer did not observe the signal aspect at CP 53rd Street and assumed that it must have been a *clear* aspect, consistent with his belief that the subsequent CP 48th Street signal was displaying a *clear* aspect. He may also have assumed that the dispatcher would be routing his train on a direct route to the LaSalle Street station to keep his train on time,[19] in light of the fact that all the other signal aspects he had passed after departing the stop at Gresham station had been *clear*. Finally, it is also possible that the engineer was preoccupied with whether or how to notify others of the missing advance flag before the work zone. Although the investigation could not determine the exact reason for the engineer's inattentiveness, it is clear that he did not observe or comply with the signal indications that he passed as he approached the crossover at CP 48th Street.

Postaccident Actions

After the accident, Metra placed crossover speed restriction signs in advance of crossover locations on the Rock Island District. The signs display the prescribed speed for the crossover and are intended to provide a point of reference for engineers to regulate the train's speed prior to traversing a crossover.

In addition, Metra has revised its procedures to require an engineer to reduce immediately a train's speed by 5 mph when an *approach diverging* aspect is displayed. At the time of the accident, Metra's rules did not require any immediate action in

[19] Metra's on time operating policy is that when a train arrives within 5 minutes of its designated arrival time it is still considered on time.

response to an *approach diverging* signal aspect. An engineer only had to be prepared to cross over at the next signal at the prescribed speed for the turnout.

Metra had a similar accident on October 12, 2003, when another Metra commuter train, operating in the opposite direction (outbound), derailed at the same crossover.[20] The Safety Board determined that the probable cause of that accident was the engineer's loss of situational awareness because of his preoccupation with certain aspects of train operations that led to his failure to observe and comply with signal indications. As a result, the Safety Board recommended on November 16, 2005, that Metra:

R-05-13

Install a positive train control system on your commuter train routes.

Following the Metra accident on September 17, 2005, the Safety Board issued an urgent safety recommendation to Metra on December 22, 2005, asking it to:

R-05-18

Install an automatic train control system with cab signals and train control enforcement over the entire Joliet Sub District, until a positive train control system is installed.

Metra responded[21] that such an interim measure would cost nearly $125 million and take at least 9 years to accomplish and proposed an alternative. Instead, Metra is moving forward on the development and installation of an Electronic Train Management System (ETMS), which would control the train if an engineer failed to properly respond to a restricting signal. Metra is finalizing a contract with Wabtec to install ETMS on the Rock Island District. Phase I of the system will automatically enforce all permanent speed restrictions such as crossover moves or physical constraints such as curves. The funding for the Phase I work is in place and includes 12 miles that will be initially equipped. It will later be expanded to the remaining Rock Island District in Phase II after testing and FRA approval. ETMS cutover for Phase I is expected in October 2007 for the test period. Metra has had preliminary meetings with the FRA to discuss the ETMS project. Metra anticipates that material delivery will begin in the first quarter of 2007. The balance of the material should be delivered in 2007 with installation, testing, and FRA approval extending into 2008.

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

[21] Letters to the Safety Board in response to outstanding safety recommendations dated December 14, 2005, and January 24, 2006.

Engineer

The engineer began his railroad employment as a switchman with CSX Transportation (CSXT) on October 10, 1998, at Riverdale, Illinois. He was certified as a locomotive engineer on June 29, 1999, and transferred about mid-year to through-freight service, operating freight trains between Garrett, Indiana, and Chicago, Illinois. During his last 3 years as an engineer on CSXT, he was operationally tested by supervisors on 110 occasions, which resulted in 12 recorded failures.

While an engineer on CSXT, he maintained his certification pursuant to the FRA requirements in 49 *Code of Federal Regulations* (*CFR*) Part 240. However, he had several field administration sessions with his CSXT supervisor; the most recent, on March 20, 2005, was for failing to comply with CSXT Rule 3A (by using an unauthorized radio) and CSXT Rule 2 (by quarreling with a conductor while on duty and on company property).[22] There was no record that CSXT gave this information to Metra.

FRA regulations, 49 CFR 240.113, require an individual to furnish data on prior safety conduct as an employee of a different railroad when seeking certification with another railroad. On March 29, 2005, the engineer asked CSXT to give Metra a copy of his engineer's certificate data, which showed that CSXT had re-certified him on December 31, 2003. However, he did not ask CSXT to provide a copy of his service record, as required by 49 CFR 240.113, and Metra claimed that it could not independently make this request of CSXT. Regardless, Metra hired the engineer on April 18, 2005. Five days later, he voluntarily resigned from CSXT. Metra has since changed its method of reviewing employment records from other railroads. An applicant must now sign a general release form that allows Metra to request information from the applicant's former employer(s).

Metra certified the engineer as a locomotive engineer on August 30, 2005, after he had participated in an accelerated training program for which he qualified, because he had been employed and certified previously as an engineer by CSXT. His Metra training evaluation was noted as excellent. The supervisor of locomotive engineers rated him as a 10 (on a scale of 1 to 10). He was qualified and began operating as an engineer, without being accompanied by another engineer, on the Rock Island District on August 30, 2005, 18 days before the accident.

Train 504

The train consisted of cab car 8570 (the operating cab), coach 7331, cab car 8548, coach 7488, coach 7351, and locomotive 409. Cab car 8570 and coach 7351 were not

[22] Previous sessions occurred on May 29, 2002, as a result of being late for work; July 7, 2003, for failing to follow instructions; December 14, 2003, for excessive lay-off pattern; and, December 27, 2004, for failure to comply with CSXT Train Handling and Air Brake Instructions.

carrying passengers at the time of the accident. The train was operating in the push mode, with cab car 8570 at the lead end and locomotive 409 at the trailing end.

Metra passenger cars are constructed of stainless steel and are called "gallery cars" because they have two levels. The cars are 85 feet long,[23] 9 feet 9 inches wide, and 16 feet 3 inches high, above the top of the rail. Each car has eight emergency windows for passenger egress (four per level) and another eight emergency windows (four per level) for emergency responder ingress.[24]

The area above the center aisle is open and extends to the ceiling of the car with a railing on the side of the upper-level aisle. The 7300-series cars have 46 windows per car, whereas the 7400-series and 8500-series cars have 44 windows per car so the car can accommodate a handicapped restroom. The cars can hold 130 to 157 seated passengers, depending upon the car configuration.[25]

At the center of the car is a vestibule-like area with platform-level doors on either side for entry and exit for a low track-level platform. The vestibule bisects the car, there are two sets of stairs for on either side (four stair wells), which lead to an upper-level narrow aisle and seating along the outside for some fixed single seats (some facing toward the center aisle), some with "walkover"[26] seat backs, and fixed double seats at the bulkheads. The lower level has double seats on either side of the center aisle, most with a walkover seat back, and a few fixed single seats.[27]

A postaccident inspection of the seats showed that some had sustained extensive damage. For example, car 7488 had 12 seat backs that had separated from their frames (3 of the 12 seat backs had broken frames). Nine seat backs had lifted up and completely separated from their frames, exposing the two vertical posts that held the seat back onto the seat assembly. An inspection of car 7351 showed that 22 seat backs were dislodged, including 1 that had an exposed seat post. In car 8548, four seat backs were dislodged, including one that had completely separated from the seat frame.

The fourth car (7488) sustained substantial impact damage at its right front corner from striking the bridge girder, and the damage extended rearward for a distance of about 20 feet, resulting in open breaches in that area of the car body. The leading end/lower side-sills of the car were bowed outward about 2 inches and 15 inches on the left and right sides, respectively. Corresponding segments of car body sidewall, directly above the

[23] Over the coupler faces.

[24] Passenger egress windows have signs on the inside of the train telling passengers how to remove the windows; while emergency responder ingress windows have signs on the outside of the train telling responders how to remove the windows.

[25] The 7300-series cars have seating for 157 passengers; the 7400- and 8500-series cars, when fitted to accommodate three wheelchairs, have seating for 130 and 137 passengers, respectively. Without accommodations for wheelchairs, there is seating for 138 and 146 passengers, respectively.

[26] Walkover seat backs can be moved across the seat to face either direction of travel.

[27] Some cars (8500-series and car 7488) have single seats on the lower level.

leading end/lower right side-sill, displayed severe sheet metal crushing and displacement/distortion damage where a 19-foot segment of car body floor had separated and lifted from its supporting structural members. The separated segment of car body floor, at the right front corner, had lifted at least 24 inches, resulting in seat backs located in that area of the car contacting the underside panel of the upper-gallery level.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the September 17, 2005, derailment of Northeast Illinois Regional Commuter Railroad Corporation (Metra) train 504 in Chicago, Illinois, was the engineer's inattentiveness to signal indications and his failure to operate the train in accordance with the signal indications and the speed restriction for the crossover at Control Point 48th Street. Contributing to the accident was lack of recognition by Metra of the risk posed by the significant difference between track speed and crossover speed at the accident location and its inaction to reduce that risk through additional operational safety procedures or other means. Also contributing to the accident was the lack of a positive train control system.

Recommendations

As a result of its investigation of the Chicago, Illinois, railroad accident, the National Transportation Safety Board made the safety recommendations listed below. For more information about these recommendations, see the safety recommendation letters[28] to the recipients.

To the Federal Railroad Administration:

1. Immediately require all rail passenger car seat backs be secured to the seat assembly. (R-06-24)

2. Revise the language in 49 *Code of Federal Regulations* 238.233 to define seat to include all components of the seat assembly, such as seat cushions and seat backs, that could become dislodged when subjected to accelerations specified in that section. (R-06-25).

3. Require all rail passenger car seat assemblies to be dynamically tested to withstand the accelerations specified in 49 *Code of Federal Regulations*

[28] These letters are available on the National Transportation Safety Board's web site.

238.233, and require both upward and downward vertical acceleration tests. (R-06-26)

4. Establish crashworthiness standards for passenger car body floor structure systems. (R-06-27)

To the Northeast Illinois Regional Commuter Railroad Corporation (Metra):

5. Conduct a risk assessment of all crossovers on your system and determine those that pose an unacceptable level of risk due to the speed differential between maximum allowable track speed immediately before the crossover and maximum allowable speed through the crossover. For those crossovers where an unacceptable level of risk is determined, develop guidelines and procedures to effectively manage those risks, including procedures for communicating those risks with train crews. (R-06-28)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

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Adopted: December 21, 2006