National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: October 26, 2007

In reply refer to: R-07-17 through -22

Mr. Ron Huberman
President
Chicago Transit Authority
567 West Lake Street
Chicago, Illinois 60661

The National Transportation Safety Board is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge your organization to take action on the safety recommendations in this letter. The Safety Board is vitally interested in these recommendations because they are designed to prevent accidents and save lives.

These recommendations address the need for the Chicago Transit Authority (CTA) to correct all safety deficiencies identified by the Regional Transportation Authority (RTA) and to improve its system safety program, track inspections, training for track inspectors and supervisors, tunnel ventilation system, and ability to communicate with passengers and perform emergency evacuations. The recommendations are derived from the Safety Board's investigation of the July 11, 2006, derailment of CTA train 220 in Chicago, Illinois, and are consistent with the evidence we found and the analysis we performed. As a result of this investigation, the Safety Board has issued 14 safety recommendations, 6 of which are addressed to the CTA. Information supporting these recommendations is discussed below. The Safety Board would appreciate a response from you within 90 days addressing the actions you have taken or intend to take to implement our recommendations.[1]

On Tuesday, July 11, 2006, about 5:06 p.m., central daylight time,[2] the last car of northbound[3] CTA Blue Line train number 220 derailed in the subway between the Clark/Lake and Grand/Milwaukee stations in downtown Chicago, Illinois. About 1,000 passengers were on board the eight-car rapid transit train. Following the derailment, the train came to a stop, and electrical arcing between the last car and the 600-volt direct current third rail generated smoke. The single operator in the lead car received a number of calls on the train intercom. The operator

[1] For more information, see http://www.ntsb.gov/publictn/2007/RAR0702.pdf. National Transportation Safety Board, *Derailment of Chicago Transit Authority Train Number 220 Between Clark/Lake and Grand/Milwaukee Stations, Chicago, Illinois, July 11, 2006*, NTSB/RAR-07/02 (Washington, DC: NTSB 2007).

[2] All times are central daylight time.

[3] The Blue Line track is generally aligned in a geographical north to south direction; however, the track in the area of the derailment was aligned in an east to west direction.

exited the control compartment, stepped onto the catwalk, and walked beside the train to investigate.

Electrical power was removed from the third rail, and most passengers walked to an emergency exit stairway about 350 feet in front of the train that led to the street level. Some passengers had to be assisted in their evacuation by emergency responders. The Chicago Fire Department reported that 152 persons were treated and transported from the scene. There were no fatalities. Total damage exceeded $1 million.

The National Transportation Safety Board determined that the probable cause of the July 11, 2006, derailment of Chicago Transit Authority train number 220 in the subway in Chicago, Illinois, was the Chicago Transit Authority's ineffective management and oversight of its track inspection and maintenance program and its system safety program, which resulted in unsafe track conditions. Contributing to the accident were the Regional Transportation Authority's failure to require that action be taken by the Chicago Transit Authority to correct unsafe track conditions and the Federal Transit Administration's ineffective oversight of the Regional Transportation Authority. Contributing to the seriousness of the accident was smoke in the tunnel and the delay in removing that smoke.

CTA Oversight

Direct supervision of the CTA track inspectors is provided by the section roadmasters. A section roadmaster is responsible for a given territory and several track inspection teams. Although the section roadmaster for the derailment area communicated with his track inspectors by phone or radio throughout the day, he did not often review the quality and completeness of their work. In fact, he stated that during the 5 months prior to the accident, he had performed the required monthly inspection only once.

The investigation revealed hundreds of missing or incomplete track inspection records. It also revealed records that showed track defects without parallel records showing that repairs had been made. The lack of critical records and the poor preparation of those that did exist indicate that some roadmasters were not reviewing the records in accordance with CTA requirements. The CTA's Track Engineer IV Maintenance and the Manager of Track stated that they were unaware of this problem and they relied on the roadmasters to review the records.

The CTA utilized a System Safety Program Plan approach to monitor and inspect the varying functions within its departments, including the track department. System safety personnel were responsible for reviewing the track inspection and maintenance program. However, they did not monitor the inspection of the track structure or check the inspection records for completeness, and they did not have the technical track expertise to perform those functions. The system safety personnel stated that they primarily concentrated on the walkway areas in the tunnels and the emergency exits and left the oversight of track inspection to the track department. In fact, the 2005 annual internal safety audit did not identify any problems with the track or inspection records.

Overall, a deficient safety culture existed at the CTA that allowed the track infrastructure to deteriorate to an unsafe condition. Industry standards for inspecting and testing the track were

not incorporated into CTA practices. Inspection records across the system were either missing or incomplete. Training and qualification requirements for track inspectors were less than those of other rail passenger carriers. There was a lack of effective supervisory oversight. The system safety program failed to identify track program deficiencies. Further, when an outside review raised questions about deficient track conditions and the number of track inspection and maintenance employees available to do the work as compared to other similar operations within the industry, the CTA did not take corrective action to address the issues. The investigation found a series of latent conditions and active failures at many levels throughout the CTA corporate structure. Such a series is characteristic of an organizational accident.[4] The Safety Board concludes that because the CTA failed to establish an effective track inspection and maintenance program, unsafe track conditions and deficiencies were not corrected. Since the accident, the CTA has informed the Board that it has significantly increased staff in the track inspection and maintenance areas and reorganized its engineering and maintenance departments to separate track inspection activities from track maintenance activities. Thirty-six positions were added to the 69 inspector/maintenance positions, resulting in a new total of 105 positions. Although the Board notes that the CTA is making improvements, the Board remains concerned about the CTA's failure to recognize and correct unsafe track conditions identified by the RTA before the accident. Therefore, the Safety Board believes that the CTA should correct all safety deficiencies identified by the RTA in its most recent and future safety inspections and reviews, regardless of whether those deficiencies are labeled as "findings," "observations," or some other term.

Other Track Inspection Methods

The limited lighting conditions and high train frequency in the subway systems made it difficult for inspectors to detect evidence of track problems. Also, some of the corrosion and fractures on the lag screws involved in the derailment would not have been readily observable because some of the damage was below the tie plates. Most U.S. railroads and transit agencies supplement the ability of their track inspectors to identify track problems by performing periodic inspections of the track using track geometry strength and condition test vehicles. These vehicles can detect track gage problems that are not readily observable by a track inspector. The vehicles also measure the track gage under load. The CTA used a track geometry vehicle to inspect all of its mainline track in October 2006. As a result, several areas of poor gage were detected that resulted in either repairs being made or slow zones being placed in effect. The Safety Board concludes that the use of a track geometry strength and condition test vehicle would have simulated train loads and better identified areas of poor track gage and the need for corrective action.

Many potentially dangerous internal rail defects have no external indications and can be detected only through other means (for example, ultrasonic testing). Therefore, U.S. railroads and transit agencies periodically use automated equipment on their tracks to perform a continuous search along the entire rail length for internal defects. The RTA Triennial On-Site Safety Review report stated that the CTA had "no rail testing for track geometry or internal rail defects (ultrasonic testing)." Both types of testing provide important backups to visual

[4] Dr. James Reason states that "organizational accidents have multiple causes involving many people operating at different levels of their respective companies." J. Reason, *Managing the Risks of Organizational Accidents* (Burlington: Ashgate Publishing Company, 1997) 1.

inspections and detect track flaws that are normally imperceptible to track personnel. The CTA has informed the Safety Board that it is procuring contracts for annual track geometry and ultrasonic testing that will be in place and in use by the end of 2007. However, the regular use of track geometry vehicles and periodic inspection of rail for internal defects has not been incorporated into the CTA's System Safety Program Plan, which would help to ensure continued use as part of a long-term program. The American Public Transportation Association's (APTA's) standard for transit track inspection and maintenance recommends the annual use of track geometry cars and ultrasonic inspection of rails. The standard also addresses other actions needed to address many of the safety deficiencies listed in the RTA's safety review. Therefore, the Safety Board believes that the CTA should, as part of the effort to improve its track safety program, examine all of the elements in APTA's "Standard for Rail Transit Track Inspection and Maintenance" and incorporate all appropriate elements of this standard in its system safety program. Specifically, the CTA should include the regular use of track geometry vehicle inspections and the inspection of rail for internal defects in its system safety program.

Environment and Length of Territory

A postaccident walking inspection of the territory that included the area of the derailment found that the inspection conditions within the tunnel were not ideal. The tunnel lighting was limited,[5] standing water covered areas of the tunnel floor, and mud and debris covered drainage areas. Also, a train came every 7 minutes, and the track inspectors had to step over the exposed 600-volt third rail and stand against the tunnel wall until it passed. Despite these limitations, there was ample evidence of track problems. The Safety Board concludes that the dark area on the inner rail of the curve, the abrasion on the tie plates and ties, the broken lag screws, the tie plates' elongated fastener holes, and poor drainage in the area of the derailment were all readily observable and should have been documented during walking inspections.

The section roadmaster for the area of the derailment stated that he did not have any backup inspectors to cover a territory when an inspector was absent. He said that inspections were halted when a priority maintenance situation occurred and he used a group of his inspectors to make the necessary repairs. The investigation also revealed that hundreds of inspection records were missing, which further indicates that critical track inspections were not being performed.

The review of the amount of time available to conduct the inspection, the distance of track to be inspected, and the train density revealed that the track inspectors could not complete an inspection of the entire 6.22-mile territory during the 9:00 a.m. to 3:00 p.m. timeframe allotted for the inspection. The review of the inspection records for the accident area and other track territories on the CTA system found that routine inspection reports often had multiple track defects concentrated in certain areas while no defects were noted in the remainder of the territory. This uneven distribution of defects further indicates that track inspectors did not complete their inspections during the allotted hours. The Safety Board concludes that track inspectors in the Dearborn Subway did not have sufficient time allotted for inspecting all of their assigned territory twice a week as prescribed. Therefore, the Safety Board believes that the CTA

[5] Since the accident, the CTA has reported that subway lighting is being upgraded in multiple tunnels, including the Dearborn Subway tunnels.

should evaluate all territories to determine the number of inspectors and the amount of time needed to ensure that adequate track inspections are conducted, and implement appropriate changes.

Qualifications and Training

The track problems in this accident were evident and should have been identified. This prompted a review of the CTA track inspector training and qualifications as compared to that of other rail passenger programs in the industry. A survey of several transit agencies and passenger railroads revealed that the CTA had the lowest experience and training requirements for its track inspectors. The CTA can select track maintenance workers to become inspectors after only 1 year of track experience. Also, a prospective inspector may have little real track maintenance experience or knowledge. In comparison, the surveyed agencies and railroads have an application process, and only the most qualified senior track workers or foremen are selected to be track inspectors.

The CTA's General Manager of Power and Way Maintenance stated that he believed that a track inspector's position requires more experience and comprehensive training than it is currently given and that the track inspector's status should be higher than that of maintenance workers and laborers. He compared the position to that of CTA's signal inspectors, who are required to complete apprenticeships before being considered for those positions.

The CTA's 1 day of classroom training in track inspection that was in place before the accident was the least amount of classroom training required by the transit agencies and/or railroads surveyed. The other agencies and railroads not only select experienced personnel, but also they typically require from 1 to 4 weeks of training in track inspection and have recurrent training thereafter to ensure that their employees maintain continued competency in critical areas.

The CTA 1-day classroom training covered the CTA's *Track Maintenance Standards Manual*. This manual listed 16 possible indications of a gage problem, including dark streaks on the inside rail of a curve, lateral movement of tie plate on the tie or rail on the tie plate, missing spikes, and poor tie conditions. Most of these conditions were observed during the postaccident inspections of the derailment area. However, as one CTA track inspector pointed out, the class covered too much information in too short a time.

The CTA's classroom training also did not cover conditions found in tunnels or on elevated structures. Unique conditions, such as standing water, electrolysis, and darkness that requires working by flashlight, can occur in tunnels. These conditions can cause track problems to differ depending on the environment and the construction, and track inspection methods may therefore vary depending on the visibility and the location of the track. The Safety Board concludes that the CTA track inspection training program did not adequately prepare inspectors to perform their required duties and it did not address the unique demands of inspecting and maintaining elevated track structures or track structures located inside tunnels. Since the accident, the CTA has informed the Board that it has lengthened its track training program and now mandates track refresher training on an annual basis. It also is developing a new comprehensive track inspection training program to be completed by 2008. The Federal Transit

Administration (FTA) has recognized that most transit agencies need assistance with track inspection and maintenance programs, and it is developing a program that includes workshops as well as classroom training to address this need. Although the CTA has taken action to improve its track inspector training program, the FTA is developing a course for all transit agencies' track inspector programs that would likely enhance the CTA's efforts. Therefore, the Safety Board believes that the CTA should schedule as a priority the maintenance oversight workshop and the training course that the FTA plans to develop for track inspectors and supervisors that will address the unique demands of track inspection in the rail transit environment.

Tunnel Ventilation

The ability to fully and efficiently control all aspects of a ventilation system can play a pivotal role in removing smoke and aiding passenger evacuation during an emergency. When fire, smoke, or fumes are present, CTA's standard practice is to confirm the location of an incident and the circumstances involved before activating ventilation. This helps ensure that the power controller knows which fans to turn on and in which direction the airflow will best assist emergency response efforts.

The CTA personnel in the northbound tunnel reported (by radio) that smoke was moving toward the Clark/Lake station. Upon receiving this information, the power controller initiated ventilation efforts to remove the smoke at 5:18 p.m., about 11 minutes after the accident. Initially, exhaust fan 133 was activated; then about 8 minutes later, the Clark/Lake station under-platform fan and all the Washington, Monroe, and Jackson continuous platform fans were operated in the exhaust mode. However, fan 133 was north of the accident site, and the other fans were south of the accident site. As a result, the Safety Board concludes that the initial efforts to remove smoke were inefficient because the fans were pulling against each other from opposite sides of the smoke source.

The CTA personnel later reported heavy smoke from the vent shaft for fan 108 just south of the accident site and directed the power controller to put the under-platform fan at the Clark/Lake station and the under-platform fans at the Washington, Monroe, and Jackson stations' continuous platform into the supply mode. Once this was done, the smoke flowed northward through exhaust fan 133, and conditions inside the tunnel and stations improved greatly. However, because fan 133 was not reversible, the smoke had to be exhausted through it and northward in the same direction that people were moving to exit. The Safety Board concludes that had fan 133 been capable of dual direction (reversible), the smoke could have been removed in a direction opposite that of the path of evacuation. Exhaust fan 108, which had been removed in 2001, was located just to the south of the accident site. The Safety Board concludes that if fan 108 had been reinstalled and operational, the smoke could have been eliminated faster and in a direction opposite that of the path of evacuation.

During the accident response, the CTA found that fan 157 would not start. However, once the under-platform fans at the Clark/Lake station and the fans in the continuous platform at the Washington, Monroe, and Jackson stations were put into supply mode, fan 133 efficiently removed the smoke from the tunnel. Therefore, in this case, it does not appear that fan 157 would have appreciably improved the smoke removal process even if it had been operational.

Because of the problems encountered with ventilation of the smoke generated during the accident, the Safety Board believes that the CTA should perform a comprehensive computational study of the existing ventilation system using various fire and smoke scenarios to identify potential deficiencies, and make improvements to the ventilation system and smoke removal procedures based on the findings of the study. These actions should address reinstalling fan 108 and replacing unidirectional fans (including fan 133) with dual direction fans as needed.

Train Evacuation

Instructions for emergencies are posted in each railcar. The instructions tell passengers to listen for instructions and wait on the train. Some passengers exited the train before they were given instructions to do so. Considering the arcing and smoke being generated at the end of the train, it is understandable that passengers in the rear of the train started exiting the train immediately.

According to the CTA's *Rail System Rule Book*, when a train goes into emergency the operator should notify the control center and attempt to find and correct the trouble. After CTA train number 220 went into emergency, the operator exited the control compartment and walked out onto the catwalk to determine what had happened. He saw thick smoke at the rear of the train and passengers on the catwalk. Using a portable two-way radio, he informed the rail controller of what was happening and went from car to car telling passengers to exit the train. He did not use the intercom to make a train-wide announcement because he had exited the train to assess the situation.

Once the operator had assessed the situation from the catwalk and decided to tell the passengers to exit the train, he could have reentered the control compartment and made an announcement via the intercom rather than run from car to car. Although more passengers would have heard such a train-wide announcement, the actions of the operator were not unreasonable considering how quickly events occurred immediately after the derailment. The operator was in regular contact with the control center using his portable radio, and he could be heard providing information to passengers about how to open the car doors and directing them toward the emergency exit. However, in response to postaccident questionnaires, some passengers stated that they did not hear the operator's instructions. Therefore, the Safety Board believes that the CTA should examine and improve, as necessary, its ability to communicate with passengers and perform emergency evacuations.

Therefore, the National Transportation Safety Board makes the following recommendations to the Chicago Transit Authority:

> Correct all safety deficiencies identified by the Regional Transportation Authority in its most recent and future safety inspections and reviews, regardless of whether those deficiencies are labeled as "findings," "observations," or some other term. (R-07-17)

Examine all of the elements in the American Public Transportation Association's "Standard for Rail Transit Track Inspection and Maintenance" and incorporate all appropriate elements of this standard in your system safety program. Specifically, include the regular use of track geometry vehicle inspections and the inspection of rail for internal defects in your system safety program. (R-07-18)

Evaluate all territories to determine the number of inspectors and the amount of time needed to ensure that adequate track inspections are conducted, and implement appropriate changes. (R-07-19)

Schedule as a priority the maintenance oversight workshop and the training course that the Federal Transit Administration plans to develop for track inspectors and supervisors that will address the unique demands of track inspection in the rail transit environment. (R-07-20)

Perform a comprehensive computational study of the existing ventilation system using various fire and smoke scenarios to identify potential deficiencies, and make improvements to the ventilation system and smoke removal procedures based on the findings of the study. These actions should address reinstalling fan 108 and replacing unidirectional fans (including fan 133) with dual direction fans as needed. (R-07-21)

Examine and improve, as necessary, your ability to communicate with passengers and perform emergency evacuations. (R-07-22)

The Safety Board also issued safety recommendations to the Federal Transit Administration, the State of Illinois, the Regional Transportation Authority, and the Chicago Transit Board. In your response to the recommendations in this letter, please refer to Safety Recommendations R-07-17 through -22. If you need additional information, you may call (202) 314-6177.

Chairman ROSENKER, Vice Chairman SUMWALT, and Members HERSMAN, HIGGINS, and CHEALANDER concurred in these recommendations. Vice Chairman SUMWALT and Member HIGGINS filed concurring statements, which are attached to the Railroad Accident Report for this accident.

[*Original Signed*]

By: Mark V. Rosenker
Chairman