National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: August 6, 2001

In reply refer to: R-01-14 through -16

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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 adequacy of the Union Pacific Railroad's (UP's) oversight of track maintenance and the adequacy of the UP's procedures for communicating changes in track classifications. The recommendations are derived from the Safety Board's investigation of the December 20, 1998, derailment of Amtrak train No. 21 while operating on UP tracks in Arlington, Texas, and are consistent with the evidence we found and the analysis we performed. As a result of this investigation, the Safety Board has issued five safety recommendations, three of which are addressed to the UP. 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.

About 7:00 p.m. central standard time, on December 20, 1998, Amtrak train No. 21, the *Texas Eagle*, derailed on UP track No. 1 in Arlington, Texas. Train 21 was en route from Chicago, Illinois, to San Antonio, Texas. The train was traveling westbound at a reduced speed of about 36 mph due to reports of rough track near milepost (MP) 231. Three locomotives and six cars derailed in a curve at MP 230.62. Of the 198 passengers and 18 employees on the train, 12 passengers and 10 employees were injured. No fatalities resulted from the accident. The damages were estimated at about $1.4 million.[1]

The National Transportation Safety Board determined that the probable cause of the December 20, 1998, derailment of Amtrak train No. 21 in Arlington, Texas, was (1) track

[1] For more information, see National Transportation Safety Board, *Derailment of Amtrak Train 21 on the Union Pacific Railroad at Arlington, Texas, December 20, 1998*, Railroad Accident Report NTSB/RAR-01/02 (Washington, D.C.: NTSB, 2001).

conditions that were inadequate for the speed of the train, (2) the decision of the dispatcher to delay notifying track department personnel that a train crew had reported encountering rough track, (3) the inadequate effort on the part of the engineer of Amtrak train 22 to contact the dispatcher to report the observed track defect and its location, (4) the failure of the tamper operator to adequately resurface the track 4 days before the accident, (5) inadequate Union Pacific Railroad oversight of track maintenance work on this section of track, and (6) inadequate Union Pacific Railroad requirements for restricting train speed over track with reported rough conditions until track department personnel can assess track condition.

When, almost 3 hours before the derailment, an eastbound freight train crew reported to the train dispatcher that they had encountered rough track on main track No. 1 in the area of MP 231, the dispatcher did not place a speed restriction on the area, nor did he notify track maintenance personnel and ask that the track be checked. He stated that he did not believe the warning from the freight train was serious enough to warrant delaying trains so that the track could be inspected, but he did plan to notify the track department after the two Amtrak trains (trains 22 and 21) had cleared the area. But he had no way of knowing the actual condition of the track or if that condition had been further degraded by the passage of the freight train itself. He had the authority to put a speed restriction in place at the location of the reported rough track, but he did not do so. A speed restriction of 10 mph, for example, may have been appropriate until the actual condition of the track could be determined. In the almost 3 hours that elapsed between the initial report and the derailment, the UP track department may have had ample opportunity to inspect the track and evaluate its safety. Even if immediate repairs were not possible, the speed restriction may have allowed safe passage until repairs could be made. The Safety Board therefore concluded that if the dispatcher had implemented an appropriate speed restriction and/or notified track maintenance personnel immediately after he received the report of rough track, the accident may not have occurred.

The Safety Board notes that the day after the accident, the UP added additional requirements to its Operating Rule 21.9 via Train Dispatcher's Bulletin No. 60 for the Protection of Defects, requiring the dispatcher to immediately advise any train approaching an area that had been reported to have a defect on the same track to reduce its speed to no more than 10 mph and to notify the appropriate manager of track maintenance. A Safety Board survey of the policies and practices of other class I railroads indicated that they require the train dispatcher to immediately call a track supervisor after receiving a report of rough track. These policies generally require that if a train reaches the rough track location before a track supervisor can evaluate the track, the train must stop and protect the location. Once stopped and once a supervisor—or, possibly, the crew—determines that the track is safe, the train may proceed at restricted speed. The survey revealed that the UP, the Burlington Northern Santa Fe Railroad, and Amtrak each have a specific operating rule or written dispatcher instruction that addresses events such as occurred in this accident.

The Safety Board is concerned that the guidance for dispatchers at most railroads does not have the force of a rule and therefore may not be adequate to ensure maximum safety for operating crews and intercity train passengers. The Safety Board therefore has made the following safety recommendation to the Association of American Railroads and the American Short Line and Regional Railroad Association:

R-01-13
Inform your member railroads of the circumstances of the December 20, 1998, derailment in Arlington, Texas, and urge them to ensure that their rules require train dispatchers, upon receiving reports of track problems, to immediately implement an appropriate speed restriction for the affected area and to immediately notify track maintenance personnel of the reported condition.

According to the UP, track and signal work necessary to upgrade the main No. 1 track from class 3 to class 4 was done before the end of October 1998. The track had been resurfaced, and the super-elevation had been increased from 1.25 inches to 3.5 inches. (The managers of track maintenance stated that the track may have been resurfaced one other time after November 1; however, the UP did not have a record of the work.)

On October 25, 1998, the UP redesignated the track as class 4. Beginning on November 1, the UP raised the speed limit (then 40 mph) by 5 mph each week until the limit reached 60 mph, which was the speed limit the company imposed on both freight and passenger trains using this track. The UP was not required to notify Federal Railroad Administration (FRA) headquarters of the reclassification.

An FRA track inspection, using a T-10 car, took place on November 18, 1998. According to the FRA inspector, the track was inspected using standards for class 3, instead of class 4, track. The regional FRA inspector who conducted the November 18 inspection said she based the inspection on a timetable she had been provided by the FRA, which she believed to be the current UP timetable for the track. That timetable reflected the previous, class 3, classification. Before beginning the inspection, she did not check with the UP track department or request a copy of the latest timetable.

The November 18 test did not uncover any defects using class 3 standards. After the accident, Safety Board investigators reviewed the results of the FRA's November 18 test and compared the results to the requirements for class 4 track. By class 4 standards, the test results revealed problems with gage, cross level, track warp, and surface alignment. The gage in three places was too wide; one gage exception was as much as 57.64 inches wide and 3 feet long.[2] The average super-elevation was 1.25 inches, which met standards for class 3 track but not for class 4, which required 3.25 inches. The track had warped where the cross-elevation changed quickly from 2 inches to level; the warped area was 1.91 inches wide and 17 feet long. The left (high) rail had a 1-inch dip, and the right (low) rail had a 1.38-inch dip. The alignment and surface of the track were irregular. These conditions would have prevented the UP from legally operating trains at the 60 mph speed authorized at the time.

Because the FRA inspector relied on outdated information when the inspection was performed and made no effort to obtain the most recent information, the Safety Board concluded that FRA track inspection procedures were inadequate to ensure that track inspectors obtain up-to-date track classification information before beginning an inspection, with the result that the November 18, 1998, FRA inspection of the accident track did not reveal deficiencies that would

[2] Maximum allowable gage for class 4 track is 57.5 inches.

have required either corrective action or a lowering of the maximum authorized speed. The Safety Board therefore has made the following safety recommendation to the FRA:

> R-01-12
> Revise your procedures to ensure that all Federal Railroad Administration track inspectors obtain current track classification documentation before they inspect a track.

On December 16, 1998, 4 days before the derailment, the UP manager of operating practices informed a manager of track maintenance of rough track in the area of MP 231. On the same day, the manager of track maintenance sent a crew consisting of a tamper operator and a ballast regulator operator to work in this area. The crew did not have a supervisor, and each worker was responsible for the quality control of his own work.

In a December 22, 1998, interview, the tamper operator said that after performing an initial plot of the curve with the tamping machine, he measured an average super-elevation of 0.75 inch. He said he decided to add an additional 0.75-inch elevation to the curve to bring it up to a 1.5-inch super-elevation. The 1.5 inches of super-elevation would have met the super-elevation requirement indicated on the curve chart on the machine. This super-elevation standard was based on a UP standard of 40 mph operation (appropriate for class 3 track) on a 2-degree 5-minute curve with a 1-inch unbalanced super-elevation.

In a follow-up interview on December 29, the tamper operator told investigators that before he started the December 16 work, the manager of track maintenance told him that the curve required 3.25 inches of super-elevation to meet the standards of class 4 track. But the supervisor stated that he did not remember giving the tamper operator such an instruction, and the instruction was not mentioned by the tamper operator in his more contemporaneous interview 2 days after the accident. Furthermore, the tamper operator had only enough ballast to raise the super-elevation to 1.5 inches. Had he been given specific instructions to raise the elevation by more than twice that amount, he would likely have informed his supervisor that he could not. That he did not inform his supervisor suggests that he was not told to bring the super-elevation to 3.25 inches but only to resurface the curve. Finally, the curve chart available to the tamper operator reflected the super-elevation requirements of class 3 track, which the tamper operator said he was able to achieve. The Safety Board concluded that because the tamper operator who resurfaced the track in the accident area 4 days before the derailment was not aware that the track had been designated class 4 track, he did not raise the track super-elevation the amount that was necessary for the higher classification or that was appropriate for the train speeds the UP had authorized for this track.

According to the UP, maintenance-of-way employees, such as the tamper operator, are required before beginning work to review the general orders or timetable and for comparing the allowable track speed to the UP maintenance-of-way rule book to get the proper super-elevation information. The tamper operator did not update the information before resurfacing the curve on December 16, and the UP had no effective procedure in place to verify that its track maintenance employees always obtained the latest track information before beginning work. The Safety Board therefore concluded that the UP's procedures were inadequate for ensuring that information

about changes in track classification were communicated in a timely fashion to all of its track inspection and maintenance personnel.

UP managers of track maintenance told the Safety Board that the accident area was a high-maintenance area in which track crews found it difficult to maintain track cross-level and alignment. The engineer of train 22 told investigators that the track in the accident area had always been "a little rough." An engineering evaluation of the subgrade (the finished earthen surface of the roadbed below the ballast and track) in the area indicated the presence of "plastic" clay-type soils that exhibit a tendency to shrink in dry conditions, then expand when moisture is returned to the material. Such physical changes in the subsurface soil could be transmitted to the running surface of the track. These changes might cause track conditions that train crews describe as "rough track."

Meteorological conditions in the Arlington area during several months preceding the accident included a drought followed by a period of significant rain. Such conditions are conducive to the changes in subgrade soil described above. Fluctuations in the subgrade, combined with the effects of high-speed, high-tonnage train traffic, can significantly alter a track's load-bearing capacity. Postaccident measurements revealed that the average super-elevation in the undamaged track near the accident site was 0.61 inch. One location measured a reverse elevation of 0.19 inch. Using the average of these measurements in calculations prescribed in 49 *Code of Federal Regulations* 213.57, investigators determined that the track leading to the accident site was capable of supporting passenger train speeds of about 50 mph, which was 10 mph slower than trains normally operated over this section of track. In this case, train 21 derailed at 36 mph, indicating that the reverse elevation and track warp were even greater nearer the point of derailment.

The statements of the managers of track maintenance and the evidence developed during this investigation confirmed that the accident area was problematic. For example, in the 2 months preceding the accident, significant changes in track super-elevation occurred. At the end of October 1998, the super-elevation was 3.25 inches, in accordance with the UP's redesignation of the track from class 3 to class 4. On November 18, the FRA inspection found that the average super-elevation of the curve had dropped to 1.32 inches, which was sufficient to meet only class 3 standards. (With this amount of super-elevation, the maximum authorized speed for freight trains should have been 40 mph rather than the 60 mph authorized by the UP for this track.) On December 16, after rough track was reported, the super-elevation was measured as 0.75 inch and was resurfaced to bring it to 1.5 inches. On December 20, just hours before the derailment, crewmembers from two trains felt and observed rough track, likely indicating another change in super-elevation. Finally, just after the derailment, the average super-elevation in the accident area was measured as 0.61 inch, with one location measuring a reverse elevation of minus 0.19 inch. The movement of the track from a super-elevation on December 16 to a reverse elevation on December 20 represented a change of 1.69 inches in just 4 days. (Between December 16 and December 20, the area had received almost an inch of rain.) Considering the nature of the soil in the vicinity of the derailment site, the drought in the area, and the wet weather before the derailment, the Safety Board concluded that increases in subgrade soil moisture under the derailment area could have caused the changes in track geometry that led to the accident.

Several solutions are available to the problem of maintaining surface profile, cross-elevation, and super-elevation of track on a subgrade that is subject to shrinking and swelling. Some, such as chemical stabilization, are long term. Chemical stabilization consists of pumping chemical slurry deep into the ground; the slurry reacts with subgrade soil and reduces its affinity for water. Another long-term solution is to drive pilings into the embankment to keep the subgrade from spreading out or widening beneath the track structure. Other long-term solutions include excavating the roadbed and installing drainage systems using either geo-synthetic fabric to control water run-off or honeycomb ballast containment systems.

The UP chose a short-term solution—adding ballast as needed. Ballast promotes track stability by anchoring the track in place against lateral, vertical, and longitudinal movement and by transmitting the load of the track and railroad traffic over the subgrade with diminished unit pressure. Done properly, adding ballast can be an effective way to maintain track surface, but only if the area to which the ballast is applied is closely monitored for traffic (tonnage) and subsequent movement of the track. The railroad must be prepared to add more ballast as frequently as is necessary. Based on the evidence gathered in this investigation, the UP did not adequately monitor track conditions in the accident area. The rapidity of the changes should have alerted the UP to the necessity of constantly checking the amount of the ballast and increasing the amount as necessary.

On December 16, 4 days before the accident, the super-elevation had dropped to 0.75 inch, and the tamper operator said insufficient ballast would have been available to bring the super-elevation to 3.25 inches. The ballast regulator operator also noted that insufficient ballast was available to provide the required 12 inches of ballast shoulder on the curve. Postaccident investigation found that the tie cribs were not full of ballast near the rails and that the shoulder area contained only 8 inches of ballast. Insufficient ballast in the tie cribs and at the tie shoulder can allow the track, under certain conditions, to develop a kink of the type the engineer of train 22 said he observed shortly before train 21 derailed. Insufficient ballast under the tie can also reduce the bearing capacity of the subgrade soil. After the accident, 27 to 30 carloads of ballast were required to return the track to the proper super-elevation in the accident area.

A track bed normally acquires both vertical and lateral stability as train traffic compacts it; however, much of this stability is lost when the track is disturbed, as it is by tamping. According to railroad industry standards, about 1 million tons of train traffic is required to stabilize track properly after it has been disturbed by resurfacing.[3] On December 16, upon completing his work, the tamper operator allowed one train to pass over the location at 10 mph. He then allowed a second train to pass over the location at 25 mph. No other speed restrictions were imposed. Even if the two trains that transited the area at reduced speeds were high-tonnage trains, their total weight would not likely have exceeded about 30,000 tons, which is far short of the amount required for optimum compaction and stabilization of the track. If the track was not adequately compacted by train traffic before trains were allowed to operate at 60 mph, the development of track irregularities may have been accelerated, and these irregularities could have been the source of the rough track reported in the hours before the accident on December 20.

[3] Simmons-Boardman Publishing Corporation, *Railway Track and Structures, 1998.*

On the day after the derailment, a relief tamper operator working to repair the derailment damage attempted to use the tamper machine that had been used to resurface the track 4 days before the accident. He found that he could not resurface the track accurately because the actuator on the machine was improperly positioned. The investigation could not determine conclusively whether the actuator had been misaligned when the December 16 work was performed or whether the misalignment had occurred when the machine was in transit. Based on statements of the tamper operator and the machine manufacturer, and the fact that no track problems were reported between December 16 and December 20, the misalignment most likely occurred after the work on December 16. But the tamper operator could not have been certain on December 16 that the machine was operating properly and providing the correct super-elevation because, even though UP maintenance procedures required it, he did not use the level board on his machine to verify his work, and the job was not assigned a supervisor who could have performed quality control.

Although track managers said that this was a high-maintenance area, the track inspector, who rode the track in the area twice weekly in a Hy-Rail vehicle, stated that he was not aware that the area was particularly problematic. He used his standard inspection procedures for this area and did not, for example, note any anomalies in the track surface when he inspected the track 6 hours before the rough track report and 9 hours before the derailment.

Thus the investigation revealed that the UP did not ensure (1) that sufficient ballast was available in the accident area to achieve the appropriate super-elevation, (2) that the tamper operator verified his work after resurfacing the track and that he took the necessary action to ensure that the track bed was sufficiently stabilized before trains were allowed to operate at the maximum allowable speeds, and (3) that track inspection procedures were adequate to identify track surface irregularities in an area identified by UP track maintenance managers as problematic. The Safety Board therefore concluded that in the months leading up to the accident, the UP did not exercise adequate management oversight of its track inspection and maintenance programs on this portion of the Dallas subdivision.

Based on its investigation of the Arlington, Texas, accident, the National Transportation Safety Board makes the following safety recommendations to the Union Pacific Railroad:

> Revise your procedures for disseminating documentation for the current classification of track to all track inspection and maintenance employees so that up-do-date information is available to them when they inspect, repair, or maintain the track. (R-01-14)
>
> Develop an action plan to address known subgrade problems on the Dallas subdivision. (R-01-15)
>
> Revise your track maintenance policies and practices to establish quality control procedures for track repair and maintenance activities. These procedures should be designed to ensure that the type of maintenance to be performed is appropriate to address the specific problem and that the maintenance itself is performed correctly. (R-01-16)

As noted above, the Safety Board also issued safety recommendations to the Federal Railroad Administration, the Association of American Railroads, and the American Short Line and Regional Railroad Association. In your response to the recommendations in this letter, please refer to Safety Recommendations R-01-14 through -16. If you need additional information, you may call (202) 314-6607.

Acting Chairman CARMODY and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

Original Signed

By: Carol J. Carmody
Acting Chairman