National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: September 9, 1987

In reply refer to: R-87-19 through -22

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President
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On July 10, 1986, Union Pacific Railroad (UP) eastbound freight train No. CLSA-09 struck standing UP freight train No. WPX-08, 8 miles west of North Platte, Nebraska. Due to unusually heavy fog, visibility was limited to about 300 to 400 feet. Train No. CLSA-09 was traveling about 40 mph as it approached the area where train WPX-08 was stopped. The engineer applied the brakes when the caboose of the standing train became visible, but the train's speed was reduced to only about 32 mph when the trains collided. Three locomotives and 11 cars from both trains were derailed. The rear brakeman of train WPX-08 was killed and the conductor injured. The engineer and head brakeman of train CLSA-09 were injured when they jumped from the train. 1/

The fog on the morning of July 10, 1986, was not an intermittent pocket of fog; the National Weather Service and all train crewmembers interviewed indicated that heavy fog conditions existed from the time the two trains left South Morrill, shortly after midnight, until the accident at 6:12 a.m. Therefore, the engineer of train CLSA-09 operated through the fog for about 6 hours before the accident. The engineer of train WPX-08 stated that, because of the limited visibility, he recognized the need to operate his train at a slower speed in order to see the signal indications.

Trains can be operated safely in fog, but only at speeds that permit time to see and respond to the signals. However, the National Transportation Safety Board believes that in the existing foggy condition of July 10, 1986, a speed of 40 mph (the speed of train CLSA-09) was too fast for the engineer to see and interpret wayside signal indications. The head brakeman of train CLSA-09 did state that the last signal indication he observed was a yellow (approach), which required that the speed of the train be reduced to 30 mph in preparation to stop before any part of the train or engine passed the next signal. However, the Pulse tape readout indicated the engineer did not slow down. With reported visibility at the time of the collision at 1/16 of a mile and the train's recorded speed at 40 mph, the signal would have been visible from the locomotive cab for slightly less then 6 seconds. Since UP operating rule 101 requires engineers to reduce the speed of their trains in limited visibility, and since the engineer knew and had been operating the train through dense fog conditions, it would be expected that he would slow down in order to observe the signals more carefully. Had he seen and complied with the yellow signal at

1/ For more detailed information, read Railroad Accident Report, "Rear-End Collision and Derailment of Two Union Pacific Freight Trains Near North Platte, Nebraska, on July 10, 1986" (NTSB/RAR-87/03).

milepost 296.5, he would have reduced the speed of the train to 30 mph and been prepared to stop. The engineer's statement that he operated in fog on a regular basis is not supported by the records of the weather conditions in this area. His actions indicated poor judgment and little appreciation for the dangers posed by the limited visibility.

In addition to the fog, another factor that should have caused the engineer to reduce the train's speed was the North Platte Yardmaster's comment that he would get back to them. The crew interpreted the comment to mean that the train was going to be held on the main line track. The engineer should have realized from those instructions that other trains were probably being held out of the yard ahead of his train on the main line since he had been following another coal train for the entire trip. In addition, he should have anticipated being held since he stated it was not unusual to be held out of the yard at North Platte.

At a speed of 40 mph in dense fog, the MP294 signal indication ahead of the collision site was visible for about 6 seconds, but seeing it would have required vigilant observations ahead. Apparently, however, neither the engineer nor the head brakeman of train CLSA-09 was as vigilant as necessary. Several factors may have affected the engineer's attentiveness. Because the engineer had been operating the train in the limited visibility for 6 hours, which required intense concentration, he may have become fatigued and less vigilant than the environment required. In addition, the conversation between the head brakeman and the engineer as the train approached signal 294 may have caused the engineer to turn away from his observation ahead, and in the 6 seconds that the signal would have been visible, he may have missed seeing it. These assumptions are borne out by the engineer's statement that, although he was maintaining a lookout ahead, he did not remember seeing the previous signal indication, which the head brakeman saw as a yellow signal. For these reasons, the Safety Board could not determine whether distraction, inattentiveness, fatigue, or a combination of these caused him to miss the red signal indication of signal 294.8.

However, it is possible that the numerous restrictive signals received on the North Platte subdivision conditioned the engineer to disregard the requirement to operate the train in accordance with their indications. This was demonstrated by the engineer's statements that he disregarded restrictive cab signals on the North Platte subdivision because they occurred 10 to 15 times on every trip, and that restrictive cab signals happened quite a few times on the trip on the day of the accident. Thus, while he apparently operated the cab signal lever to acknowledge a restrictive signal, he continued to operate the train at speeds greater than authorized by the signal indications. Having done this for quite some time, it is likely that he continued to do so after entering the main track, which did not have a history of signal problems. The engineer may have attended solely to cab signal indications and neglected to correlate them with wayside signals, since he said he did not remember seeing any of the wayside signal indications from the time he passed O'Fallons and traveled the 5.2 miles to the point of collision.

Research on signal detection and operator behavior 2/ can help to explain this type of conditioned response to a high number of restrictive signals. When an operator receives numerous restrictive signals that he interprets as false alarms (i.e., there is no penalty for noncompliance), his sensitivity to their meaning changes. Where once he may have responded conservatively, he gradually relaxes his behavior and takes greater risks. As a consequence, when there is legitimate reason to comply with a restrictive signal, as in this case with WPX-08 stopped ahead, the operator is not prepared to make the appropriate response.

2/ Wickens, Christopher D. (1984). Engineeering Psychology and Human Performance, Columbus, Ohio: Charles E. Gerrill Publishing Company.

The UP's failure to correct the frequent restrictive signal indications on the North Platte subdivision, caused by track maintenance conditions that were unrelated to train movements, and their failure to notify engineers of these conditions, could have diminished the engineer's sense that complying with cab signal indications was important. During the Safety Board's investigation, each of the engineers interviewed with experience on the North Platte subdivision stated that they could not rely on the cab signal indications along that subdivision. Since typical operation is 160 miles on the North Platte subdivision and only 14 on the main line, those learned operating practices would be reinforced by the preponderant division miles and hours of service, with a corresponding tendency to apply them after leaving the subdivision for the main line.

The UP neglected track conditions for 18 months, which affected the signal indications on the North Platte subdivision. This situation indicates a failure to properly inspect and maintain both the track and signal system. The UP officers at the deposition hearing insisted that the engineers should comply with the signal indications and operate their trains in compliance with the restrictions. However, the UP cannot expect engineers to comply with faulty signals. The UP is obligated to correct conditions that result in more restrictive signal indications than required.

The Safety Board believes that the engineer and head brakeman were not maintaining a vigilant observation ahead for signal indications as required by UP operating rule 34. Such vigilant observation of signal indications, which is required at all times, is especially important under conditions of limited visibility, as in this accident.

The head brakeman moved from his seat on the left side of the locomotive, where he could see the signals, and was talking to the engineer immediately before the accident. Therefore, he did not support the engineer as intended by rule 34, which requires that the head brakeman and engineer inform each other of signal indications. When the head brakeman moved, he also restricted his ability to monitor the operation of the train and to take action to bring the train within signal and speed requirements as prescribed by UP rule 34. The rule states in part, "... that other crewmembers must take immediate action to ensure safety, using emergency brake valve to stop the train if necessary." The head brakeman also probably did not act to slow the train to the speed required by the yellow signal indication he observed because he did not understand that the speed of the train was to be reduced to 30 mph immediately. After sighting the yellow signal, the head brakeman moved about the locomotive cab and conversed with the engineer. It is likely that the yellow signal he saw was signal 296.5 since this would have been the only yellow signal displayed on the main line. While conversing with the engineer, the head brakeman was not looking ahead as the train approached signal 294.8; therefore, since he saw the yellow signal indication at 296.5, it would indicate that the signal system was functioning as designed. Testing of the signal system later verified that the signal system was functioning as designed.

Several preceding trains had operated without incident through the area where the accident occurred, providing further evidence that the signal system was functioning properly. The engineers of the preceding trains took no exception to the signal system that morning. They had been operating in the same limited visibility caused by the fog, and had been on duty about the same length of time as the crewmembers of train CLSA-09, yet had operated their trains safely. Therefore, the Safety Board concludes that the engineer and head brakeman on train CLSA-09 were distracted, inattentive, and/or fatigued, or the engineer may have assumed that another moving train was ahead of him and that he had another block ahead that he could run before having to stop outside the North Platte yard. Since the engineer did not make an emergency stop of his train

when he received the red over yellow cab signal indication, but instead made a brake application for slowing the train, it is possible that he did realize that a train was ahead in the block but assumed it was moving and expected to bring his train to a stop at the next signal.

The only way to prevent this type of failure to comply with signal indications is to have a system in place that enforces the restrictions of the signal indication. Since 1967, the Safety Board has investigated 50 major railroad collision accidents including 24 head-on and 26 rear-end collisions. Most of these accidents could have been prevented had a system that mandated train separation been in effect. Four recent railroad collisions, including this UP collision on July 10, 1986, resulted in a total of 19 fatalities, 356 injuries, and total estimated damages of $21.1 million. These figures emphasize the need for an operating system that will provide positive train separation.

The Safety Board is aware that the railroad industry is joined in an effort known as the Advanced Train Control Systems (ATCS) Project, which is adapting modern technology to train operating problems. The project involves designing and testing systems that could be applied to U.S. railroads regardless of their length or present method of operation. This would allow railroads to select the system that best suits their operational and economic needs. A safety aspect of the ATCS system is enforced train separation, which includes the ability of the system to stop trains when they exceed authorized limits.

The Safety Board is aware that the UP is involved in the ATCS Project and that the North Platte subdivision is one of the areas selected to test the system. The Safety Board believes that the railroad industry and the Federal Railroad Administration (FRA) should formulate the operational and safety aspects of these systems to provide the needed train control system on mainline tracks that would provide for positive separation of all trains. The Safety Board on April 28, 1987, recommended that the FRA:

R-87-16

> Promulgate Federal standards to require the installment and operation of a train control system on mainline tracks which will provide for positive separation of all trains. 3/

On train WPX-08, the conductor and rear brakeman failed to follow UP rule 109, which requires that a walking inspection be conducted while the train is standing. Instead of walking forward and inspecting the cars while the train was stopped, they reboarded the caboose. The conductor stated he did not inspect the cars because of the limited visibility. However, UP management informed Safety Board investigators that the inspection must be conducted regardless of conditions.

This accident occurred on a middle track of a three-track section of the UP railroad. For the conductor and rear brakeman to conduct their inspection, they would have had to walk between two tracks or outside the three tracks. In the first instance, a train passing on the adjacent track would have placed them between the two trains. In the second instance, a train passing on an adjacent track would have separated them from their train. In the foggy conditions that prevailed on the morning of the accident, conducting such an inspection in a multiple track location would be dangerous.

3/ For more detailed information, read Railroad Accident Report—"Rear-End Collision between Boston and Maine Corporation Commuter Train No. 5324 and Consolidated Rail Corporation Train TV-14, Brighton, Massachusetts, May 7, 1986" (NTSB/RAR-87/02).

In addition, the crewmembers faced the possibility of having their own train move forward. In view of the limited visibility, the Safety Board believes that conducting such an inspection would have been dangerous and that the conductor's decision was prudent.

The results of the dispatcher's drug tests were reviewed by a toxicologist at the Center for Human Toxicology and by a toxicologist at the Safety Board. Each toxicologist stated that the absence of Delta 9 THC at the time of sampling indicates the dispatcher had not smoked marijuana for about 3 to 8 hours prior to sampling. In sworn testimony given to the Safety Board, the dispatcher admitted that he had used marijuana during the previous July 4 weekend but had used none since that time. Both toxicologists considered this claim to be questionable, given the relatively high carboxy levels at the time of sampling.

Studies on the effects of marijuana 4/ indicate its effects to be dose related, so that lower doses have smaller effects than larger doses. However, research has shown marijuana to impair motor coordination (for example, hand steadiness, accuracy of executing movements), reaction time, and tracking (that is, the ability to follow a moving stimulus). Even in naive users, tracking impairment has been observed to persist for 4 to 8 hours following use. Impairment of intellectual and cognitive functions has also been noted, particularly in verbal fluency, short-term memory, learning ability, calculation skills, ability to follow complex directions, and time sense. One study 5/ found impairment from marijuana to affect pilot performance of complex tasks for up to 24 hours following use.

The situation is confounded by the dispatcher's work hours. Research 6/ on "midnight" shifts, from 11:30/12 midnight to 7:30/8 a.m., has shown that human metabolic rates, such as body temperature and certain hormone levels, tend to drop as part of a circadian cycle during the early morning hours. This change exacerbates the natural tendency to sleep and can lead to an overall decrease in productivity, a greater propensity for errors, and a reduced ability to perform tasks that require concentration and vigilance. As a consequence, accidents tend to occur more often during these hours 7/ than at other times of the day.

The high risk to safety from operator impairment underscores the need for transportation companies to enforce their drug and alcohol prohibitions. After the accident, the dispatcher entered the UP Counseling Employees Assistance Program. After several weeks in the program, counselors recommended his return to normal duties.

A regular monitoring of event recorder tape readouts would have indicated when engineers were violating cab signal restrictions and train order speed restrictions. However, the supervisor in charge of engineers had not been reviewing readout tapes of locomotives with cab signal equipment. It is difficult to understand why engineers misunderstood the cab signal rules when each of them had successfully completed an examination of the operating rules less than a year before the accident. Since the road

4/ Division of Health Science Policy, Institute of Medicine, Marijuana and Health, National Academy Press, Washington, D.C. 1982.

5/ Yesavage, J.A., Leirer, V.O., Denari, M., and Hollister, L.E., "Carry-Over Effects of Marijuana Intoxication on Aircraft Pilot Performance: A Preliminary Report," American Journal of Psychiatry 142.11, November 1985.

6/ Alluisi, E.A. and Fleishman, E.A. (Eds.), Human Performance and Productivity, Vol. 3: Stress and Performance Effectiveness, Hillsdale, NJ: Lawrence Erlbaum Associates, 1982.

7/ Langlois, P.H., Smolensky, M.H., Hsi, B.P., and Weir, F.W., "Temporal Patterns of Reported Single-Vehicle Car and Truck Accidents in Texas, U.S.A. During 1980-1983," Chronobiology International, Vol. 2, pp 131-146, 1985.

foreman indicated he was riding with engineers to observe their performance, he should have become aware that engineers were misinterpreting cab signal rules. Other railroads are using the event recorder tape readouts to detect operating rule violations and to correct any misunderstanding that operating employees may have. The event recorder has proven itself to be an excellent tool for this type of monitoring and the UP should establish a mandatory program that requires supervisors involved in train operations to frequently and regularly review event recorder tape readouts and correct any employee violating operating rules.

Another area of failure to comply with UP rules is the train crewmembers' practice of switching from the train dispatcher's radio channel after they leave the North Platte subdivision and enter the main line at O'Fallons. The timetable instructions for the Sidney subdivision are that radio communications should be via channel two (the train dispatcher's channel); instead, the practice is to use channel three (the yardmaster's channel). This violation would have been discovered if UP supervisors assigned to the yard at North Platte had monitored the radio communications. UP management either did not know that timetable rules were being violated or they were condoning the practice. Whatever the reason, the UP failure to correct the violation could have discouraged operating employees from complying with other rules.

As a result of an accident at Granite, Wyoming, on July 31, 1979, the Safety Board made Safety Recommendation R-79-80 to the UP to establish a monitoring system for rule compliance of employees operating trains. 8/ On August 25, 1981, the UP responded that they place extreme importance on monitoring rule compliance of operating employees. They also said that extensive efficiency testing for rules compliance was an ongoing effort throughout the UP with the vice president of operations personally reviewing the results on a monthly basis. As a result of this response, the Safety Board classified Safety Recommendation R-79-80 as "Closed--Acceptable Action." The circumstances of this accident indicate, however, that steps outlined by the UP in 1981 have not proven to be effective or were not adequately implemented. Consequently, as a result of this accident and the numerous rule violations involved, the Safety Board is making a new recommendation for the UP to review again the effectiveness of the supervisory checks of employee performance when operating in train service.

The dispatcher position is critical to safe train operations. A dispatcher must constantly make decisions involving the movement of trains while communicating instructions to trains. Scientists from the Institute for Social Research at the University of Michigan have performed extensive research on job demands, worker health, and occupational differences. 9/ They analyzed data from a broad spectrum of occupations, including variables related to demography, personality, stresses, psychological strains, and health-related behaviors. Results of their analyses were reported as correlations or indices of associations or relationships among variables.

In comparison with other occupations, train dispatchers were found to be older (average age of 45 years) and in their jobs longer. As a group, they reported greater workloads, more work than they preferred, more responsibilities, more boredom, and more requirements to concentrate than a group of air traffic controllers. (The researchers selected these two occupations for comparison because both are involved in the

8/ For more detailed information, read Railroad Accident Report--"Derailment of Union Pacific Railroad Freight Train, Granite, Wyoming, July 31, 1979" (NTSB/RAR-79/12).

9/ Caplan, R.D., Cobb, S., French, T.R., Van Harrison, R., and Pinneau. S.R., Job Demands and Worker Health. Survey Research Center, Institute for Social Research, Universtiy of Michigan, 1980.

"monitoring and dispatching of major conveyances in the nation's transportation system.") The data also revealed that dispatchers are at a greater risk of coronary heart disease than other workers.

An interesting aspect of this study concerned dispatcher communications and feelings of responsibility. In comparing communications of air traffic controllers with dispatchers, the scientists hypothesized:

> Differences in the content of communications associated with the jobs may in part account for the high responsibility for persons reported by train dispatchers. The contact between air traffic controllers and pilots is typically extremely brief and limited to work related communications. The contact between dispatchers and engineers and other railroad personnel is often more prolonged. Also, train dispatchers are likely to personally know men on the train crew. These more developed interpersonal relationships may increase the feeling of dealing with real people, and hence, feelings of responsibility for them (pp. 163).

A second important finding concerning dispatcher workload is that as a group, they reported both more work on the job (quantitative workload) and more work than they preferred, as compared with other groups. These dimensions were positively related to job dissatisfaction, job stress, and psychological strains.

Therefore, it is extremely important that dispatchers, because of the high job demands and workloads, be alert and free of any substance that would impair their intellectual and cognitive functions. It is also imperative that UP management monitor the activities and workload of dispatchers to require that they are able to perform their duties since their role is so critical to the safety of train movements.

Therefore, the National Transportation Safety Board recommends that the Union Pacific Railroad Company:

> Install a train control system which will provide for positive separation of trains. (Class II, Priority Action) (R-87-19)
>
> Review the program presently in use and evaluate the supervisory checks of employee performance in the operating rules for rule compliance, especially on the Nebraska division. (Class II, Priority Action) (R-87-20)
>
> Establish a mandatory program that requires supervisors involved in train operations to frequently and regularly review event recorder tape readouts and correct any employee violating operating rules. (Class II, Priority Action) (R-87-21)
>
> Monitor the activities and workload of dispatchers to determine that they are able to perform their duties, which are critical to the safety of train movements. (Class II, Priority Action) (R-87-22)

As a result of this investigation, the National Transportation Safety Board also issued Safety Recommendation R-87-23 to the Federal Railroad Administration.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility ". . . to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any action taken as a result of its

safety recommendations and would appreciate a response from you regarding action taken or contemplated with respect to the recommendations in this letter. Please refer to Safety Recommendations R-87-19 through -22 in your reply.

BURNETT, Chairman, GOLDMAN, Vice Chairman, and LAUBER, NALL, and KOLSTAD, Members, concurred in these recommendations.

By: Jim Burnett
Chairman