Log R-674A

SR

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: February 25, 1998

In reply to refer to: R-98-8 and -9

Mr. M. B. Oglesby, Jr.
President
Association of American Railroads
American Railroads Building
50 F Street, N.W.
Washington, D.C. 20001

On January 12, 1997, about 11:52 a.m. Pacific standard time, the Union Pacific Railroad (UP) unit freight train 6205 west derailed 68 cars on the UP Los Angeles Subdivision, milepost 238.7, near Kelso, California. The train consisted of 3 locomotive units and 75 loaded covered hopper cars. While descending Cima Hill, the engineer inadvertently activated the multiple-unit (MU) engine shutdown switch, which shut down all the locomotive unit diesel engines and eliminated the train's dynamic braking capability. The train rapidly accelerated beyond the 20-mph authorized speed limit despite the engineer's efforts to increase the train's air braking, which the engineer placed in emergency 1 minute and 2 seconds after dynamic braking loss. The train's consist weight was listed at an average of 13 tons per car less than the train actually weighed. The train eventually reached a speed of 72 mph and derailed 68 of its 75 cars while exiting a siding near Kelso, California.[1] No fatalities, injuries, fires, or hazardous materials releases resulted from the accident. The total damage cost was $4,376,400.

Placement of safety-critical controls was one of the major safety issues raised by this accident. Early in the National Transportation Safety Board investigation, it became apparent that the locomotive engineer had inadvertently activated the MU engine stop switch inside the lead locomotive unit. The red Stop button of the MU engine stop switch was found still depressed after the accident. Also, the suddenness with which the engine shutdown occurred indicated that the switch had been struck immediately before the accident. No other reason for the engine shutdown was discovered.

The activation of the MU engine stop switch precipitated the accident. The stop switch activation shut down the diesel engines, resulting in dynamic braking loss. The dynamic brake loss

[1]For additional information, read Railroad Accident Report — *Derailment of Union Pacific Railroad Freight Train 6205 West Near Kelso, California, January 12, 1997* (NTSB/RAR-98/01).

initiated the runaway. Because neither the engineer nor the conductor was aware of what had caused the locomotive units to shut down, they did not take action to reactivate the units or immediately place the train in emergency. By the time the crewmembers put the train in emergency, it was already in runaway status.

The placement of the MU engine stop switch on the lower left panel of the engineer's control console made it subject to inadvertent activation. Investigators' informal postaccident discussions with locomotive engineers revealed that such activations had been common on locomotives equipped with switches in the same location. Sometime after 1989, General Motors Electro-Motive Division (EMD), the builder of the SD60M locomotive, became aware that inadvertent activation of the MU engine stop switch was a problem. EMD attempted to work with the purchasers of the affected locomotives to correct the poor placement of the switch.

While EMD's attempts to address the problem evidenced some concern over the safety implications of the switch location, the UP management did not consider changing the location a priority modification. Instead, the UP categorized it as a "comfort or convenience" modification. Consequently, the UP did not expedite protection or relocation of the switches. Although EMD had communicated with the UP about this issue as early as January 1990, the UP had taken steps to modify the MU engine stop switches on only 8 of its 184 affected SD60M locomotives by 1996. None of the affected UP locomotives had had their switches relocated.

Correspondence between UP representatives and EMD revealed that some UP representatives and EMD understood that the location of the MU engine shutdown switch had safety implications because crewmembers could, by inadvertently activating the switch, simultaneously shut down all locomotive units. The correspondence indicated concern regarding this possibility. Safety-conscious railroad managers should have foreseen that an unintentional shutdown of all motive power on an operating train could jeopardize train control. This danger should have been particularly conspicuous with respect to trains that traveled on steep grades such as Cima Hill, where dynamic braking has become critical. The Safety Board concluded that the failure of UP management to recognize the MU engine shutdown switch location as a safety hazard and to expedite effective switch protection or relocation created the conditions that led to the accident.

The Kelso accident also raised the issues of train speed and braking safety margins. The rapidity with which the Kelso train engineer was overtaken by events underscores the need for railroads to maintain realistic operating safety margins in case an unexpected failure occurs. Safety margins that were adequate for rail operations 20 years ago are not necessarily adequate today. As time has passed, railroad equipment technology has progressed, and so have the size and weight of freight cars and the weight and speed of trains. These changes have altered the ways trains operate, particularly in steep-grade areas, and have eroded the efficacy of braking safety margins.

Engineers' determinations of safe maximum train speeds and train-handling methods are made based on the weight of the train (trailing tonnage). The train's tonnage dictates to the engineer the maximum speeds and the braking methods that may be used and indicates whether air brake retainer valves must be set. The accuracy of the engineer's determinations regarding these train-handling limits depends on the accuracy of the figures used to report the weight of each freight car.

Unless the engineer is provided with the correct weight or appropriate maximum weight for the train on which to base his determinations, he may be placed in a potentially dangerous situation.

Of additional concern regarding train speed and braking margins, research has shown that train wheels and brake shoes cannot withstand infinite levels of friction-generated heat. Too much heat generated during braking causes brake shoes to wear and deteriorate rapidly, metal to flow on the wheel tread, and trains to lose their stopping ability. In the past, the use of air brake retainer valves (retainers) allowed engineers to control trains down long grades without exceeding the limits of the brake equipment. Then, air brake system air capacity was the limiting factor. Retainers help preserve compressed air capacity and the potential capability to brake a train. Retainers, however, still depend on the same tread-braked system that is subject to heat limitations. With or without retainers, excessive heat at the tread brake can cause the air braking system to become ineffective.

Evidence from the Kelso accident suggests that train weights and speed levels may have reached the physical limitations of the tread-braked freight car. The engineer was attempting to keep the train within the 20-mph speed limit established by the UP for a train of that weight at that location. Retainers had been set. The train's air brakes were functioning properly and the engineer used the brakes correctly. But even after he had placed the train's tread-braked cars in emergency at 30 mph, the engineer of the accident train could not stop it from running away. The air brakes alone were insufficient to keep the train from experiencing significant acceleration in these circumstances. Postaccident UP brake tests conducted on Cima Hill showed that the air brakes alone could stop a train similar to the accident train at speeds up to 25 mph but not much beyond that speed. The accident train accelerated to 25 mph within 30 seconds of MU stop switch activation.

The accident train, therefore, while it was performing as required by the UP, could not be sufficiently slowed with air brakes alone on the Cima Hill downgrade to ensure safe operation much beyond the maximum authorized speed. The data indicate that the air brakes could not function successfully in this situation because frictional tread-brake heat generation had reached performance-damaging levels. The Safety Board concluded that, due to increases in train weights and speeds, frictional tread-brake heat generation has become a limiting factor for safe train operation, particularly in steep-grade territories.

The Kelso accident also illustrated that dynamic braking use has affected safe train speeds and braking margins. While the UP in theory considers dynamic braking a nonessential mechanism, it has in practice relied on the safeguard that, as long as the dynamic braking system works, total dependence on the air brakes (with their heat-fade weaknesses) can be avoided. As the Kelso accident demonstrated, once dynamic braking is lost, a train operating on a steep downgrade can become uncontrollable within seconds, even though the air brake system is fully functional. The Safety Board therefore concluded that the UP's operational reliance on dynamic braking for controlling heavy and fast-moving trains on steep grades, without acknowledging and protecting dynamic braking as a safety-critical system, is imprudent. The fact that the accident occurred because dynamic braking was lost indicates that some railroads may have allowed their margins of safety to erode by maintaining train-handling practices rendered obsolete by the heavier weights and faster speeds of today's trains.

Operational speeds and train-stopping capability have traditionally been associated with the amount of air pressure that has been reduced from the brake pipe (the level of air braking required). The UP required that a train be stopped after an 18-psi brake pipe pressure reduction failed to control train speed. Other railroads had similar requirements. The Safety Board does not consider that such brake pipe reduction requirements provide timely operational guidance or a sufficient safety margin to traincrews. By the time a dangerous situation is recognized, it may already be too late for crewmembers to take effective corrective action. In the Kelso accident, although he was attempting to abide by the UP's maximum train speed requirement for the area, by the time the engineer realized that a problem existed and initiated a 12- to 17-psi reduction, the train still became a runaway within 62 seconds. The Safety Board therefore concluded that the UP has authorized maximum train speeds that provide insufficient safety margins in the event of dynamic braking failure.

Based on the foregoing information, the National Transportation Safety Board issues the following recommendations to the Association of American Railroads:

> Alert locomotive manufacturers and railroad operators about the dangers posed by improperly located safety-significant controls and switches in locomotives. (R-98-8)
>
> Carry out research, investigation, and analysis to determine maximum authorized train speeds for safe operation of trains of all weights, using speed-based margins of safety that can be easily measured by traincrews. (R-98-9)

Also, the Safety Board issued Safety Recommendations R-98-1 through -7 to the Federal Railroad Administration and R-98-10 through -16 to the Union Pacific Railroad.

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. Therefore, it 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-98-8 and-9 in your reply. If you need additional information, you may call (202) 314-6438.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

By: Jim Hall
Chairman