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National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: MAR - 5 1997

In Reply Refer To: R-96-74 through -78

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Operations, Research, and Technology
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About 4:10 a.m. on February 1, 1996, Atchison, Topeka and Santa Fe Railway Company (ATSF) freight train H-BALT1-31, en route from Barstow, California, to Los Angeles, was traveling westbound on the ATSF south main track when it derailed at milepost 60.4 near Cajon Junction, California. After the derailment and the subsequent rail car pileup, which involved five cars containing hazardous materials, a fire ignited that engulfed the train and the surrounding area. The conductor and the brakeman sustained fatal injuries; the engineer suffered serious injuries.[1]

The National Transportation Safety Board determines that the probable cause of the derailment of freight train H-BALT1-31 was an undetermined restriction or blockage that prevented the traincrew from achieving and maintaining adequate train braking force and also the lack of adequate Federal Railroad Administration and industry, specifically the ATSF, regulations, policies, procedures, and standards to consistently utilize two-way end-of-train devices as a redundant braking system to protect trains from catastrophic brake system failure.

Safety Board investigators and representatives from each party to the investigation conducted computer simulations at Freightmaster, Inc., in Forth Worth, Texas, on March 19 and 20, 1996. The train dynamics analyzer simulation results were consistent with a blockage or restriction in the train line between the fifth and ninth cars. This simulation analysis, based on the event recorder transit time from Summit to milepost 60.4 and the calculated turnover speed of 70-plus mph at the point of derailment indicated that with three or more working dynamic brakes and a minimum of 16 cars braking, the train would have either stopped or negotiated the derailment curve without serious incident. Using the simulation data that were available, the tests disclosed that with four dynamic brakes and nine cars braking, H-BALT1-31 lacked sufficient braking power to allow it to negotiate the curve at milepost 60.4.

[1]For more detailed information, read Railroad Accident Report--*Derailment of Freight Train H-BALT1-31, Atchison, Topeka and Santa Fe Railway Company, near Cajon Junction, California, on February 1, 1996* (NTSB/RAR-96/05).

Although the simulation results indicate a blockage near the fifth through ninth cars, the Safety Board is not convinced that a blockage could occur only in that area.

The Safety Board considered the possibility that one or more factors caused the loss of continuity to the train line. A crimp or kink in the air brake hose could block or restrict the train line. Such a crimp or kink will generally occur in a worn or damaged hose or in a hose connected to an unauthorized design or repair. As H-BALT1-31 began its descent to Cajon, the slack in the train couplers and draft gear bunched together. The slack action may have bent or crimped an air brake hose that pinched off air flow from the engines to the rear of the train and resulted in the loss of air brake control. Because of the train line relationship to the undercarriage on cushioned underframe cars, these cars are more susceptible to incur a kink in their train line. The movement of the draft system requires that the train line also be fluid in motion as the rail car moves.

Initially, our investigation had focused on the cushioned underframe car, ATSF 90033, which was the last car added to the train after the repair at Barstow. The Freightmaster computer simulation later eliminated this car as a source of a blockage because the car was too far back (16 cars) in the train to have prevented the engineer from safely stopping or slowing the train for the accident curve. The simulation also indicated that most of the other cushioned underframe cars (11 through 13) in the consist were probably not involved. These cars also were not within the five- to eight-car blockage or restriction zone that the simulation identified as necessary to meet the derailment speed, time, and location.

The fifth car in the consist, SFLC 10005, was a cushioned underframe car and within the effective position for a blockage, as identified by the simulation. However, the derailment sequence, subsequent fires, and wreckage movement prevented close inspection of car SFLC 10005 and precluded constructing a timely simulation. Car repair records for car SFLC 10005 showed no history of intermittent problems indicative of hose kinking or restriction. Safety Board investigators were unable to find any brake hoses that appeared to have been kinked or crimped before the accident or that could be identified to any particular car in the suspect zone (cars five through eight) of the train.

Attempting to determine the likelihood and frequency of kinked hoses, Safety Board investigators, therefore, inspected other cushioned underframe cars. The postaccident inspection of five sister cars (ATSF 90030, 90031, 90032, 90035, and 90036) to ATSF 90033 for condition and design consistency of the end-of-car air hose arrangement revealed three predominate styles of air hose arrangements and several cars having different arrangements at each end. Each of the three predominate styles of air hose arrangement had several customized subversions. Only a few of the air hose arrangements, as found on the sister cars, remained true to the modification drawing arrangement or the manufacturer drawings. One of the greater differences between arrangements was the length of the pipe that attached to the flexible glad-hand air hose, which varied between 6.5 and 45.5 inches. The Safety Board, therefore, concluded that a wide deviation of end-of-car hose arrangements on cushioned underframe cars from the approved end-of-car hose arrangement design is not uncommon and may induce an air hose to kink in operation and block or restrict a train line. Consequently, the Safety Board believes that the Association of American Railroads should inform its member carriers about the circumstances of this accident and alert them to inspect the end-of-car hose arrangements on cushioned underframe cars and ensure the hose arrangements match the intended design.

Moreover, the ATSF Barstow car shop had repaired the car ATSF 90033 but had no references or drawings on which to base the repair of the brake pipe and the end-of-car hose arrangement of the car and, thus, made the repair to match the other end of the car. Had a reference of standardized hose arrangement drawings been readily available to the carmen, no confusion should have existed or

questionable repair have been made to car ATSF 90033. The Safety Board concluded that had the Barstow car shop made hose arrangement reference manuals readily available, the carmen could have used guidelines to properly repair the train line on ATSF 90033. Therefore, the Safety Board believes that the Association of American Railroads should ensure that its member carriers provide carmen with readily available means to identify the proper design or specific type of end-of-car hose arrangement on cushioned underframe cars to preclude a possible improper repair or modification.

Once the ATSF System Operations Center had confirmed that freight train H-BALT1-31 had derailed and that hazardous materials likely had been released and were involved in the fire, the ATSF promptly notified the California Office of Emergency Services and the National Response Center. As a result, the appropriate State and Federal agencies were notified in a timely manner. The system operations center provided copies of the train consist in a timely manner to the California Department of Forestry and Fire Protection and the San Bernardino County Communications Center. The incident commander also had other technical resources available on the properties and the hazards of the chemicals on the train. Consequently, from the onset of the emergency response operations, the first responders to arrive at the scene and the incident commander had sufficient preliminary information about the hazardous materials on the train and which products were in each tank car.

However, following this initial exchange of information, no direct notification of the chemical shippers was made because of miscommunications between personnel at the system operations center about the notification of the Chemical Transportation Emergency Center. Because the incident commander believed that he had sufficient information about the hazardous materials involved and assumed someone would contact the emergency center, he did not direct that the center be notified. The Chemical Transportation Emergency Center, which can provide a communications link between the chemical manufacturers, shippers, and emergency response agencies, was initially contacted by the California Environmental Protection Agency about 7 hours after the accident. Shippers, including the Rohm and Haas Company, learned that their products were in the derailment when the Burlington Northern and Santa Fe Railway Company logistics department contacted them about late or lost shipments.

Because of its concerns about the polymerization of butyl acrylate and the potential overpressurization of the tank car, Rohm and Haas immediately attempted to contact the ATSF and the incident command center. The Rohm and Haas technical experts in Deer Park, Texas, faxed guidance about the decomposition and polymerization of the product to the incident command center. However, Rohm and Haas encountered difficulties obtaining accurate information on the status of the butyl acrylate tank car until its response team arrived and inspected the isolated butyl acrylate tank car on the afternoon of February 4.

Although the technical information faxed by Rohm and Haas to the incident command center was received and reviewed, emergency responders were not able to positively identify the butyl acrylate tank car and most of the other tank cars because of the fire, which had burned away the identification marks and numbers on the tank cars. Because identification of the butyl acrylate car now depended on identifying unique fittings and features of the tank car, relying on the technical resources that Rohm and Haas could provide became imperative. Had the Rohm and Haas personnel been early on scene, they could have quickly determined on the morning of February 4 after the discovery of the unidentified, venting tank car that it was not the butyl acrylate tank car, and the subsequent evacuation and the shutdown of the underground pipelines might have been averted. In addition, the Rohm and Haas personnel would have also been available during the removal of the butyl acrylate tank car from the wreckage to ensure that the tank car was left upright to facilitate its venting through its safety relief valve and to verify the condition of the tank car. ATSF wreckage clearing personnel and the incident commander would have then known that the tank car was full and still a danger.

The ATSF superintendent of field operations, who was primarily responsible for wreckage clearing operations, was unsure of the number of pressure and nonpressure tank cars in the train. He believed that 13 tank cars derailed and that 10 and 3 were nonpressure and pressure tank cars, respectively. Twelve tank cars had derailed, and only one was a pressure tank car. Although identification of specific tank cars was extremely difficult, the process may have been facilitated had the tank car experts from the Association of American Railroads Bureau of Explosives or the other chemical shippers been consulted expeditiously. The bureau or the shippers could have provided certificates of construction, design drawings, and other documentation and records to verify the number of pressure tank cars and general service tank cars in the train, which tank cars were jacketed, the capacity of each tank car, and any distinguishing features. Had this information been obtained, the operations superintendent and other personnel, involved with identifying the tank cars and assessing their condition, would have known that a single pressure tank car containing butyl acrylate was in the train. Knowing the distinguishing features of a pressure tank car, such as protective domes and no bottom outlet valves, they would have been better able to identify the butyl acrylate tank car. Neither a carrier nor an incident commander are required to contact the Chemical Transportation Emergency Center, hazardous materials shippers, or bureau of explosives; however, these resources can provide specialized technical assistance about the hazardous materials and tank cars in an accident. Chemical shippers can often assist emergency responders in the identification, handling, and off loading of tank cars transporting hazardous materials. Rohm and Haas, the other chemical shippers, and the bureau of explosives were not expeditiously contacted or requested to provide technical support. Therefore, the Safety Board concluded that the ATSF officials and emergency responders failed to effectively utilize the technical resources that could have facilitated the identification and condition of the butyl acrylate tank car and the other derailed tank cars in the train.

The Association of American Railroads, Chemical Manufacturers Association, and other associations representing the chemical and transportation industries jointly sponsor the nationwide Transportation and Community Awareness and Emergency Response outreach program, which is designed to assist communities in the development and evaluation of their emergency response plans for transportation incidents involving hazardous materials. Member companies of the sponsoring associations work with local emergency planning committees and participate in exercises and training with local emergency response agencies to test individual response plans. Although this community outreach program has fostered greater communication and coordination between local emergency planners, carriers, and chemical shippers, the events in this accident indicate that a renewed emphasis is needed for railroad personnel and emergency responders in a derailment involving the release of hazardous materials to utilize available technical resources and expertise. Therefore, the Safety Board believes that the Association of American Railroads, the Chemical Manufacturers Association, and the International Association of Fire Chiefs should develop, in cooperation, and distribute to their members information reemphasizing the technical data and assistance that can be provided through the Chemical Transportation Emergency Center, the Association of American Railroads Bureau of Explosives, and the chemical shippers when tank cars transporting hazardous materials are involved in a train derailment.

The accident fire destroyed the painted identification marks and numbers on most of the derailed tank cars and prevented emergency responders and ATSF wreckage clearing personnel from positively identifying individual tank cars. In accidents where the identification and condition of the tank cars containing hazardous materials cannot be verified, emergency responders typically have been trained to evacuate to a safe distance, confer with tank car and product experts, and reach a consensus on a course of action. The difficulties encountered in this accident by emergency response personnel in identifying individual tank cars could have been greatly alleviated through greater coordination with the chemical shippers, the tank car owners, and the bureau of explosives personnel. Coordination between the railroad, emergency responders, and the appropriate experts remains the most effective means to minimize the

danger to the public and emergency response personnel from accidents involving tank cars that contain hazardous materials.

The Safety Board previously addressed the issue of tank car identification in its investigation of the derailment of an Illinois Central Gulf Railroad freight train in Livingston, Louisiana, on September 28, 1982.[2] The Safety Board concluded in that accident that the difficulty in identifying potentially dangerous tank cars and their locations in the wreckage delayed attacking the principal source of fire and heat, and as a result, the source of the fire continued to superheat two tank cars which ultimately exploded and rocketed. Consequently, the Safety Board asked the Chemical Manufacturers Association in Safety Recommendation R-83-92 to extend the use of color coding of tank cars or adopt some other effective means of identifying high-risk commodity tank cars in switching operations and in wreck clearing operations. The association responded that it did not consider color coding to be effective and would not support the color coding of tank cars because tank cars were already required to have reporting marks, numbers, and placards that served to identify the tank car and the product carried. The association also cited the practicality of color coding tank cars because of the wide variety of chemical products transported by tank cars and the use of individual tank cars to carry multiple products. The association indicated, however, that it was reviewing other means to improve the identification of tank cars, such as the use of radio transponders. Because the association did not change its position on color coding or demonstrate that other methods were seriously being investigated, the Safety Board classified Safety Recommendation R-83-92 "Closed--Unacceptable Action" on February 18, 1987.

Although color coding of tank cars relies on painted markings that may be destroyed in intense fires, as occurred in this accident, positive methods for identifying tank cars need further investigation and evaluation. The Federal Railroad Administration conducted research in the 1980s on the use of radio transponders to track tank cars, and your organization is now evaluating the use of global satellite tracking systems to collect impact data on tank cars while in transport. Enhancement of such technologies may feasibly include the identification of tank cars. Therefore, the Safety Board believes that the Association of American Railroads should investigate and evaluate means to improve the ability of emergency response personnel to identify tank cars involved in accidents.

After the derailment, conditions at the accident scene precluded the ability of emergency responders and the ATSF wreckage clearing personnel to survey and assess the conditions of the derailed tank cars. The efforts to extinguish the fire with the application of water and foam on the wreckage pile was ineffective, and a process of cooling the perimeter of the wreckage and then removing, isolating, and cooling individual freight cars was implemented. Damage assessments, therefore, could not be performed until each tank car was isolated from the other wreckage and fire. After each tank car had been removed and isolated, it should have been visually inspected to identify the specific tank car or type of tank car and to verify, if possible, whether the tank car had been breached and any cargo remained in the tank. Had a definite breach in a tank car not been seen, the most prudent assumption was that the tank car remained full and should be handled with care. Furthermore, such a tank car should have been closely monitored until its true condition could be ascertained. The lack of visual inspection of the butyl acrylate tank car after its removal from the wreckage on February 4 indicates that ATSF personnel did not perform a complete and careful damage assessment of any of the tank cars.

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[2] Railroad Accident Report--*Derailment of Illinois Central Gulf Railroad Freight Train Extra 9629 East (GS-2-28) and Release of Hazardous Materials at Livingston, Louisiana, September 28, 1982* (NTSB/RAR-83/05)

The ATSF superintendent of field operations who was responsible for wreckage clearing operations had the primary responsibility to assess the derailed tank car damage and to oversee the movement and handling of the tank cars at the site. He was assisted by the ATSF chief environmental officer. The determination of the superintendent that the butyl acrylate tank car was empty was not based on a physical examination of the tank car after its removal from the wreckage but on the impressions of the equipment operators who pulled the tank car from the wreckage and on the lengthy exposure of the tank car to fire and heat. Because he concluded that the tank car was empty, he did not perform a visual inspection to determine whether the tank car had been breached or direct that the tank car be left positioned upright, cooled with water, or monitored. The chief environmental officer resolved that the tank car could not have survived the impact forces and the fire and heat. Although both individuals had sufficient training and experience about railroad tank cars to perform their respective duties, they relied on their impressions rather than verification of the physical tank car condition. The Safety Board, therefore, concluded that both the ATSF superintendent of field operations and chief environmental officer exercised poor judgment in their assessment and handling of the butyl acrylate tank car.

Both railroad officials may have exercised better judgment had written guidance and recommended practices been available about the assessment and handling of tank cars exposed to sustained fire and heat following a derailment. Although criteria exist to assess mechanical damage to a tank car, guidance could not be found on the cumulative effects from fire, heat, and mechanical damage on the strength and integrity of a derailed tank car. The guidance about moving and handling loaded or partially loaded tank cars that have sustained mechanical or fire and heat damage or both is also lacking. The integrity of tank cars, subjected to severe accident forces and fire, should be adequately assessed before moving the tanks. Awareness of the tank car integrity minimizes the potential of a catastrophic failure of the tank car and release of any remaining cargo.

Firefighters and other emergency responders typically are not experts about tank cars and railroad operations and depend on the railroad officials for guidance. Because many emergency responders rely on railroad personnel to provide guidance about handling and moving damaged tank cars, railroad personnel involved with wreckage clearing operations should have sufficient guidance to assess all types of damages and the combination of damages that can result from a derailment. The tank car safety courses offered at the Association of American Railroads transportation test center in Pueblo, Colorado, and your annual hazardous materials seminars provide training and instruction on assessing mechanical damage to tank cars, but not the effects from fire and heat. Because tank cars involved in a derailment can sustain mechanical or fire and heat damage or both, wreckage clearing personnel need to be aware of the effects of each type of damage and any combined effects. The Safety Board, therefore, believes that the Association of American Railroads should develop written guidelines for assessing the individual and combined effects of mechanical or fire and heat damage or both to tank cars involved in a derailment and for the handling and movement of such tank cars.

Therefore, the National Transportation Safety Board recommends that the Association of American Railroads:

> Inform its member carriers about the circumstances of this accident and alert them to inspect the end-of-car hose arrangements on cushioned underframe cars and ensure the hose arrangements match the intended design. (R-96-74)

Ensure that its member carriers provide carmen with readily available means to identify the proper design or specific type of end-of-car hose arrangement on cushioned underframe cars to preclude a possible improper repair or modification. (R-96-75)

Develop, in cooperation with the Chemical Manufacturers Association and the International Association of Fire Chiefs, and distribute to your carrier members information reemphasizing the technical data and assistance that can be provided through the Chemical Manufacturers Association Chemical Transportation Emergency Center, the Association of American Railroads Bureau of Explosives, and the chemical shippers when tank cars transporting hazardous materials are involved in a train derailment. (R-96-76)

Investigate and evaluate means to improve the ability of emergency response personnel to identify tank cars involved in accidents. (R-96-77)

Develop written guidelines for assessing the individual and combined effects of mechanical or fire and heat damage or both to tank cars involved in a derailment and for the handling and movement of such tank cars. (R-96-78)

Also, the Safety Board issued Safety Recommendations R-96-67 through -69 to the Burlington Northern and Santa Fe Railway Company, R-96-70 through -73 to the Federal Railroad Administration, R-96-79 to the International Association of Fire Chiefs, and R-96-80 to the Chemical Manufacturers Association.

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-96-74 through -78 in your reply. If you need additional information, you may call (202) 382-6840.

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

By: Jim Hall
Chairman