Proactive Use of Recorded Data for Accident Prevention

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INTRODUCTION

In its railroad accident investigations, the National Transportation Safety Board (NTSB) relies on data recovered from recorders to determine train speed, direction of travel, distance traveled, throttle position, brake application, cab and/or wayside signals, and applicable communications from before and during the accident. Since 1995 the Federal Railroad Administration (FRA) has had the regulatory responsibility for establishing the minimum parameters to be recorded and the standards that event recorders must meet. The railroad industry also voluntarily records information on train movements and warning devices for its own use. This paper will address the use of recorders, the regulations that govern them, the history of the Safety Board's use of event-recorder data in its investigations, and the future of event recorders in accident investigation.

PROACTIVE USE

No Federal regulations require the use of recorders or monitors. Since the creation of the Safety Board in 1967, the Board's Railroad Division has investigated more than 192 major railroad accidents. The reports about these investigations present a record of the Board's use of recorders and the development of safety recommendations for regulatory requirements, improved maintenance, better standards, and improved utilization of recorded data.

Recorded data yield a more accurate assessment of the events leading up to an accident and corroborate witness statements, helping to eliminate much of the guesswork involved in accident investigation.

Initially, railroads voluntarily installed recorders and monitors on their locomotives as a way of overseeing the engineer's operation of the train and the locomotives operational performance over the territory. However, since May 1995, the FRA has required an event recorder on any train operated faster than 30 miles per hour (49 Code of Federal Regulations [CFR] 229.5 and 229.135). Under the requirement a recorder must, at a minimum be tamper resistant and capable of recording the following: train speed, direction of motion, time, distance, throttle position, brake applications and operations, and where the locomotive is so equipped, cab signals during the most recent 48-hours of operation.

In addition, the railroad industry has voluntarily developed other uses of recorders. Recorders allow the railroads to verify the remote operation of devices that provide for safe train operations as well as for public safety. Recorders monitor rail-highway grade crossings interconnected for pre-emption of traffic signals for time, train speed, and activation of pre-emption circuitry. Selected centralized traffic controlled interlockings use recording systems to record time, sequential position of relays (signals)

controlling train movements through an interlocking, and position of the switches in the interlocking. Some of these systems can record relay positions for the related intermediate signals. Railroad wayside-equipment defect detectors can detect certain defects as a train passes over sensors/scanners at track level and can record and send important messages to the train crew. Each of these recording systems can maintain a record of the activity for parameters as prescribed by the railroad.

Railroads also voluntarily record radio communications between their dispatchers and train crews as well as the communications among railroad-emergency coordinators, emergency and law-enforcement agencies, and other organizations during an emergency. Thus railroads can monitor the dispatchers' instructions to train crews for compliance with the railroad's own rules and with the instructions authorizing train operations. Likewise, the railroads can monitor their communications with outside agencies for effectiveness, timeliness, and accuracy of information provided during emergencies.

SAFETY BOARD RECORDER HISTORY

Since the creation of the Safety Board in 1967, the Board's Railroad Division has conducted more than 192 major railroad accident investigations. The following is a chronological history of some the Safety Board major railroad accident investigations that involved the use of or need for recorders.

The first report in which a locomotive event recorder was mentioned was the one about a head-on collision on the New York Central Railroad in 1967[1]. During the late 1960s and much of the 1970s many investigations had to rely on getting train operation information from surviving crewmembers, with very few instances of data being available from a recorder. Early recorders on locomotives were of the paper-tape variety, recording only speed and distance.

In the late 1970s, few investigations involved trains that had 8-track multi-event recorders. Many railroads were still using the paper tape recorders. The railroads used the event-recorder data to monitor and evaluate the train-handling practices of their train crews, but rarely to oversee rules compliance. Early Safety Board accident investigations did not document whether improved train safety could be related to the railroads' review and evaluation of event-recorder data. However, during investigation of a 1972 head-on collision[2] the Safety Board examined more than 33 speed recorder tapes from various trains. The Board's report stated that 13 tapes showed train speeds in excess of what was allowed and that the carrier had not reviewed the tapes.

Some reports have noted problems with paper-tape recorders. More times than not the recorder was inoperative[3] for one reason or another. Paper had not been put in the recorder, the pen was out of ink, or the recorder had jammed. In such cases, Safety Board investigators had to rely on surviving crewmembers' statements supplemented by any available dispatcher recordings of communications between the dispatcher and the train crew. At the extreme end of paper-tape recorder problems, a Safety

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[1] Title—*New York Central Railroad Company, Train 1/NY-4 Extra 2020 East and Train ND-5 Extra 5305 West, Head-on Collision, New York City, New York, May 22, 1967* (NTIS order number PB-190198).
[2] Railroad Accident Report—*Head-on Collision of Two Burlington Northern Freight Trains near Maquon, Illinois on May 24, 1972* (NTSB-RAR-73-4).
[3] Railroad Accident Report—*Burlington Northern Incorporated Derailment of Extra 5701 East at Sheridan, Wyoming on March 28, 1971* (NTSB-RAR-72-4).

Board accident investigation was stymied in 1974 by the railroad management's decision to not put paper in a working recorder, thus rendering it useless.[4]

Sometimes, however, the paper-tape recorders were helpful. The recorder from another 1974 accident[5] provided information about the train's speed and evidence of a severe run-in when the emergency brakes were applied as the train entered a curve. In still another accident, a paper-tape recorder confirmed the speed and speed changes of a train that derailed.[6] A recorder provided the speed of the train in the investigation of the October 1975, derailment of an Amtrak train in Pulaski, Tennessee.[7] After the 1976 derailment of a freight train in Hastings, Nebraska, the investigators used a speed tape to determine that the crewmembers had used the train brakes more than they said, thus causing a slack run-in and derailment of the train.[8] The investigators of a derailment of an Amtrak train on the Burlington Northern near Ralston, Nebraska, found from a speed recorder that the speedometer was improperly calibrated; thus, the recorded speed was 20 mph higher than it should have been.[9] Another derailment investigation, of a freight train in a 1979 accident involved a speed recorder that registered 17 mph under the actual speed.[10]

During these early accident investigations the Safety Board recognized the inadequacies of the investigation when event-recorder data was not available. Also recognized was the inability of a railroad to conduct proper operational oversight of a train crew and their performance in train handling when locomotive event recorders were not standard equipment on all trains on main tracks outside of yard limits. Following the Board's investigation of a 1977 derailment on the Louisville and Nashville[11] the Safety Board issued Safety Recommendation R-78-044 to the FRA, asking it to require event-recorder regulations. (See appendix.)

The earliest noted usage of 8-track event-recorders in Safety Board investigations were the 1978 derailment of a passenger train at Elma, Virginia,[12] which cited excessive speed, and the 1979 derailment of an Amtrak's "Southwest Limited" at Lawrence, Kansas.[13] Since this was new technology for the time, the carrier and/or the manufacturer could only read the 8-track event-recorder cassette tapes. The Safety Board had to either rely on the carrier's ability to do an adequate readout or take the cassettes to the manufacturer of the recorder for a detailed readout.

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[4] Railroad Accident Report—*Collision of Missouri Pacific Railroad Company Freight Train Extra 615 South Collided with a Standing Locomotive in Cotulla, Texas June 1974* (NTSB-RAR-74-3).

[5] Railroad Accident Report—*Derailment and Subsequent Burning of Delaware and Hudson Railway Freight at Oneonta, NY* (NTSB-RAR-74-4).

[6] Railroad Accident Report—*Derailment of Amtrak Train on the Tracks of Atchison, Topeka and Santa Fe Railway Company at Melvern, Kansas July 5, 1974* (NTSB-RAR-75-1).

[7] Railroad Accident Report—Derailment of an Amtrak train on the Louisville and Nashville Railroad in Pulaski, Tennessee on October 1, 1975 (NTSB-RAR-76-6).

[8] Railroad Accident Report—Union Pacific Railroad Freight Train Derailment, Hastings, Nebraska on August 2, 1976 (NTSB-RAR-77-1).

[9] Railroad Accident Report—*Derailment of Amtrak Train on the Burlington Northern near Ralston, Nebraska, December 16, 1976* (NTSB-RAR-77-8).

[10] Railroad Accident Report—Derailment of Union Pacific Railroad Freight Train Granite, Wyoming, July 31, 1979 (NTSB-RAR-79-12).

[11] Railroad Accident Report—*Louisville and Nashville Railroad Company Freight Train Derailment and Puncture of Anhydrous Ammonia Tanks Cars at Pensacola, Florida, November 11, 1977* (NTSB-RAR-78-04)

[12] Railroad Accident Report—*Derailment of Southern Railway Company Train No. 2, The Crescent, at Elma, Virginia, December 3, 1978* (NTSB-RAR-79-4).

[13] Railroad Accident Report—*Derailment of Amtrak Train No. 4, the Southwest Limited on the Atchison, Topeka and Santa Fe Railway Company, Lawrence, Kansas, October 2, 1979* (NTSB-RAR-80-04).

The Safety Board's major railroad accident investigation reports from the 1980s show that speed (paper-tape)/event recorders (8-track) were beginning to be used on more trains. Following the investigation of the 1980 rear-end collision of two Union Pacific freight trains near Hermosa, Wyoming the Safety Board commended the Union Pacific for having installed 8-track event recorders in its locomotives.[14] The Safety Board issued six safety recommendations about event recorders: three to the Union Pacific and three to the Association of American Railroads (Safety Recommendations R-81-45 through -47 and R-81-49 through -51). The recommendations addressed modifying event recorders so they could record the activation of the cab signal acknowledging lever, relocating the recorders so they would be better protected in crashes, and providing emergency power so the recorders could be operated when normal power was lost. (See appendix.)

In the Safety Board's investigation of a 1984 rear-end collision of two Conrail freight trains,[15] the data recorders provided evidence that contradicted the statements provided by the operating crewmembers. According to Conrail operating rules the train should have been operated at "restricted speed," that is …not exceeding 15 mph prior to the accident. The crewmembers stated they had operated the train at "restricted speed." The data from the event recorder, however, did not support their statements.

Event-recorder data confirmed that excessive speed was a contributing factor in the derailment and release of hazardous materials from a freight train in 1985.[16] After reviewing the information from the train's event recorders the Safety Board investigators determined that the St. Louis Southwestern Railway Company (Cotton Belt) was lax in enforcing speed restrictions.

In the investigation of a1985 head-on collision between two Amtrak trains at Astoria, Queens, New York,[17] Safety Board investigators performed a comparative analysis of the data from the recorders. The recorded train operator activity data was compared to crewmember statements for cab signal indications and applicable wayside signal indications to develop findings in the investigation.

Erroneous data or the failure of a recorder to record has affected several investigations. The first reported tampering with an event recorder was noted in the investigation of a 1982 side collision of two freight trains near Possum Grape, Arkansas.[18] A deadheading conductor stated the speed-recording device was working properly prior to the accident; but several hours after the accident, a railroad official found the case broken open and the tape missing, even though the locomotive cab had not been damaged. In the investigation of a 1987 collision between two freight trains in Yuma, Arizona,[19] the Safety Board's lab determined that some information was incorrect. The digital word channel recording automatic brake, locomotive brake, throttle, dynamic brake, and direction of travel elements were being erroneously

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[14] Railroad Accident Report—*Rear End Collision of Union Pacific Railroad Freight Trains near Hermosa, Wyoming, October 16, 1980* (NTSB-RAR-81-03).

[15] Railroad Accident Report—*Rear End Collision Between Conrail Trains OIPI-6 an ENPI-6X, near Saltsburg, Pennsylvania, February 26, 1984* (NTSB-RAR-85-02).

[16] Railroad Accident Report—*Derailment of St. Louis Southwestern Railway Company (Cotton Belt) Freight Train Extra 4835 North and Release of Hazardous Materials near Pine Bluff, Arkansas, June 9, 1985* (NTSN-RAR-86-04).

[17] Railroad Accident Report—*Head On Collision of National Railroad Passenger Corporation (Amtrak) Passenger Trains Nos. 151 and 168, Astoria, Queens, New York, July 23, 1984* (NTSB-RAR-85-09).

[18] Railroad Accident Report—*Side Collision of Two Missouri Pacific Railroad Company Freight Trains at Glasie Junction, near Possum Grape, Arkansas, October 3, 1982* (NTSB-RAR-83-06).

[19] Railroad Accident Report—*Head-on Collision of Southern Pacific Transportation Company Freight Trains, Yuma, Arizona, June 15, 1987* (NTSB-RAR-88-02).

recorded. On sections of the data pack the digital word signal was weak and intermittent; however, the time, speed, distance, and power elements were all being recorded normally.

Additionally, the investigation of a 1989 derailment with the release of hazardous materials from a freight train near Freeland, Michigan was noted as being hindered by the absence of multi-event-recorder data.[20] The Safety Board's report stated that train-handling information was derived from what the train crew stated. The paper-tape-recorded train speed was of limited usefulness since the manner in which the train was controlled was more important than its speed. Vital information, such as quantified braking, throttle manipulation, and the chronological relationship between power-to-braking and braking-to-power, was not available. In the investigation of a 1990[21] collision between two freight trains on the Norfolk Southern, Safety Board investigators found that because of a splice in the recording tape media, no data had been recorded by one of the train recorders. The first time the Board mentioned an anomaly with the data from an event-recorder with an 8-track tape was in its report about the December 12, 1990, derailment and collision of an Amtrak train with an MBTA commuter train in Boston, Massachusetts.[22] The Safety Board attributed the anomaly to the carrier's improper handling of the data pack.

In the late 1980s there still were no required uniform standards for recording data on train movements. The Safety Board had recommended that the FRA require locomotives to have event recorders (Safety Recommendation R-78-044). The Safety Recommendation was closed unacceptable on August 12, 1985 following the FRA's response stating that they were not going to pursue a regulation and would, instead defer to the railroads' voluntary installation plans.

The Safety Board's report of the July 30, 1988 head-on collision between two trains near Altoona, Iowa,[23] further addressed the need for Federal requirements for standardization of event recorders. The Safety Board issued Safety Recommendation R-89-050 to the FRA to expedite the rulemaking process ordered by Congress in the Rail Safety Improvement Act of 1988 for event recorders. Provisions in the Act called for the FRA to issue, within 18 months, such rules, standards, orders, and regulations as necessary, for a requirement for event recorders on trains within 1 year of the issuance of the regulations. Following the August 1988 derailment of an Amtrak train on the Burlington Northern near Saco, Montana,[24] the Safety Board noted that 8-track event recorders were becoming commonplace in the industry. In the report the Safety Board said that recorded information is an effective tool for monitoring, evaluating, and improving the safety of train operations. In addition the report stated that event recorded information must be accurate, consistently prepared, and credibly interpreted and that ideally each locomotive on a train should be equipped with an operating multi-event-recording device. The status of the Safety Board's Safety Recommendation R-89-050 to the FRA was classified as "closed acceptable" on August 2, 1993, when the FRA advised that the final rule on event recorders, was published in the Federal Register on July 8, 1993 and would become effective on November 5, 1993. The rule required the lead locomotive on all trains operating over 30 mph to be equipped with an event recorder and specified minimum recording parameters.

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[20] Railroad Accident Report—*Derailment of CSX Transportation, Inc. Freight Train and Hazardous Material Release near Freeland, Michigan, July 22, 1989* (NTSB-RAR-91-04).

[21] Railroad Accident Report—Collision and Derailment of Norfolk Southern Train 188 with Norfolk Southern Train G-38 at Sugar Valley, Georgia, August 9, 1990 (NTSB-RAR-91-02).

[22] Railroad Accident Report—*Derailment and Collision of Amtrak Passenger Train 66 with MBTA Commuter Train 906 at Back Bay Station, Boston, Massachusetts, December 12, 1990* (NTSB-RAR-92-01).

[23] Railroad Accident Report—*Head-on Collision between Iowa Interstate Railroad Extra 470 West and Extra 406 East with Release of Hazardous Materials near Altoona, Iowa, July 30, 1988* (NTSB-RAR-89-04).

[24] Railroad Accident Report—*Derailment of National Railroad Passenger Corporation Train 7 on Burlington Northern Railroad near Saco, Montana, August 5, 1988* (NTSB-RAR-89-03).

The new Federal regulations cover all rail carriers that are a part of the general railway system. This excludes the rail rapid transit industry over which there is no Federal oversight regulatory authority. Rail rapid transit is not a new industry. Several large cities (Chicago, San Francisco, and New York City for example) have had intercity transportation for some time. Commuters, who want to avoid problems associated with intolerable driving conditions, have encouraged their local and state governments to rethink local transportation systems. With the help of Federal funding from the Federal Transit Administration rail rapid transit systems are being rediscovered in many other cities and are being modernized to provide fast efficient service. The Safety Board has been concerned that rail rapid transit systems may experience the same evolutionary understanding of problems in the value of event recorders that occurred on the railroads in the early 60's and 70's. In the Board's report for the 1996[25] collision of a Washington Metropolitan Area Transit Authority train with another standing train it was noted that no rail rapid transit system in the United States is required to or does record and monitor vital train systems and system events. The Board issued Safety Recommendation R-96-046 to the Federal Transit Administration and to the American Public Transit Association asking them to develop guidelines for monitoring/recording devices and to install them on rapid transit trains. (See appendix.)

Since the enactment of the FRA's new regulatory requirement for event recorders the Safety Board's investigations have uncovered new concerns. The event recorder's maintenance and its location within a locomotive were addressed in the Safety Board's report of the 1996 freight train derailment near Cajon, California.[26] The post-accident testing of the microprocessor type of event recorder showed that one event recorder had a broken wire in the axle generator, as a result of an improper modification, and that another was improperly programmed. In addition, the self-diagnostic indicators were insufficient to fully examine the recording status of the units. The pre-accident inspections had been inadequate. In its final rule on event recorders the FRA said that it "has determined that the recorder will be most helpful if it records the events happening in the locomotive occupied by the engineer, that is, the lead locomotive." However, the FRA later changed the rule to allow the event recorder to be positioned elsewhere, other than in the locomotive, stating it was "unnecessarily geographically strict"(*Federal Register*, Volume 60, Number 102, May 26, 1995). As a result the Safety Board issued four safety recommendations (R-96-70 through –73) to the FRA, asking the agency to revise the regulations to address the placement, location, maintenance, and testing of event recorders. (See appendix.)

The investigation of the 1996 near head-on collision and derailment of two commuter trains near Secaucus, New Jersey,[27] found that one of the event recorders did not register brake applications because the tape had not been fully inserted. The investigation disclosed that the FRA had granted the carrier a temporary waiver, with an extension until May 1997, for compliance with certain provisions of Federal regulation (49CFR229.135) that required all trains operating over 30 mph be equipped with event recorders by May 1995. The report states that the failure of the event recorder to provide information on the engineer's braking application hampered the Safety Board's investigation.

A railroad accident, whether it is a collision and/or derailment with or without fire, usually destroys the event recorder. The aviation industry has long recognized the importance of having event recorders that can survive an accident and has been addressing their improvement for crashworthiness and fire resistance; however, these issues are only now being addressed for railroad event recorder

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[25] Railroad Accident Report—*Collision of Washington Metropolitan Area Transit Authority Train T-111 with Standing Train at Shady Grove Passenger Station, Gaithersburg, Maryland, January 6, 1996* (NTSB-RAR-96-04).
[26] Railroad Accident Report—*Derailment of Freight Train H-BALTI-31 Atchison, Topeka and Santa Fe Railway Company near Cajon Junction, California, on February 1, 1996* (NTSB-RAR-96-05).
[27] Railroad Accident Report—*Near Head-on Collision and Derailment of Two New Jersey Transit Commuter Trains near Secaucus, New Jersey, February 9, 1996* (NTSB-RAR-97-01).

standards. Granted, many recorders have survived accidents, but in some accidents, the complexity of the investigation has increased and the event recorders' survivability has become more important for providing information to prevent future accidents.

In the Safety Board's report of the November 1990 collision and derailment of two freight trains near Corona, California,[28] the Board noted that significant data were lost when the multi-event recorders were destroyed by fire. The report noted that the FRA should develop requirements for crash- and fire-resistant event recorders similar to the requirements used for recorders on aircraft. However, the Board did not issue any safety recommendations because it anticipated that the FRA would address the concerns in its pending regulations that were still being developed.

Crashworthiness of event recorders was addressed again in the Safety Board's investigation of the September1993 derailment of an Amtrak train near Mobile, Alabama.[29] A solid-state memory event recorder did not sustain significant damage from the impact, but large amounts of water and mud were found inside the enclosure. Although at this time the FRA's new rule on event recorders acknowledged the need for crashworthiness of event recorders, it did not address the subject.

In November1993 two freight trains were involved in a head-on collision and derailment at Kelso, Washington.[30] The locomotives had a combined total of eight 8-track event recorders. However, only two were in good enough condition to yield any information; the others were either severely damaged by the fire or the impact of the collision. The FRA regulations (49 CFR Part 229.135a) only required the lead or controlling locomotive to have an event recorder. Following this investigation Safety Board staff held several discussions with the FRA concerning the need to address the crashworthiness of event recorders and the development of standards including the location of the event recorder on a locomotive. The FRA established a "Railroad Safety Advisory Committee" (RSAC) working group that included representatives from the event recorder industry, labor unions, and the railroad industry. The RSAC group was assigned to address these concerns and develop proposed regulatory requirements including crashworthiness standards, the proper location of the recorders within a locomotive, and the minimum parameters to record for the next generation of event recorders.

In the 1994 investigation of rear-end collision of between a moving freight train with a standing freight train at Cajon, California,[31] the Safety Board again found that 3 of the 4 solid state multi-event recorders had been destroyed by fire. Only the carrier's quick action to remove the data pack, as the fire approached the locomotive, salvaged the fourth event recorder, which provided important data for the investigation.

In June 1997 two freight trains collided and derailed in Devine, Texas.[32] All of the event-recorder data were lost because impact forces or fire, or both destroyed the recorders. The Safety Board issued Safety Recommendation R-98-030 to the FRA, asking them to develop and implement event

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[28] Railroad Accident Report—*Atchison, Topeka and Santa Fe Railway Company (ATSF) Freight Trains ATSF 818 and ATSF 891 on the ATSF Railway Corona, California, November 7, 1989* (NTSB-RAR-91-03).

[29] Railroad Accident Report—*Derailment of Amtrak Train No. 2 on the CSXT Big Bayou Canot Bridge near Mobile, Alabama, September 2, 1993* (NTSB-RAR-94-01).

[30] Railroad Accident Report—*Head-on Collision and Derailment of Burlington Northern Freight Train with Union Pacific Freight Train, Kelso, Washington, November 11, 1993* (NTSB-RAR-94-02).

[31] Railroad Accident Report—*Rear-end Collision of Atchison, Topeka and Santa Fe Railway Freight Train PBHLA1-10 and Union Pacific Railroad Freight Train CUWLA-10 near Cajon, California, December 14. 1994* (NTSB-RAR-95-04).

[32] Railroad Accident Report—*Collision and Derailment of Union Pacific Railroad Freight Trains 5981 North and 9186 South in Devine, Texas on June 22, 1997* (NTSB-RAR-98-02).

recorder crashworthiness standards for all new or rebuilt locomotives by January 1, 2000. (See appendix.)

The increasing acceptance and use of solid state multi-event recorders has resulted in the railroads voluntarily recording more parameters than required by the FRA's current regulations. Consequently the railroads have more information with which to evaluate the performance of both the train crew and the locomotive.

The locomotive event recorder is not investigator's only source of recorded data. They can get information from telephone recordings, radio communications, signal relay recorders, weather services, and wayside equipment detectors. In recent railroad accident investigations Safety Board investigators have been able to relate much of the additional information to the accident. The information from these additional sources and from the added parameters being recorded, allows the investigators to assess the circumstances of the events leading up to an accident more accurately and to corroborate witness statements more thoroughly.

One of the first times investigators used a railroad's telephonically recorded information was in the investigation of the 1982 derailment of an Amtrak train in Emerson, Iowa.[33] The information concerned the severe weather and flooding conditions being relayed to railroad personnel. The first time investigators used information from a wayside signal event recorder was in the investigation of the1987 collision of an Amtrak train on the high-speed Northeast Corridor with a light unit Conrail train at Chase, Maryland.[34] Both locomotives had event recorders; Amtrak's locomotive had a recorder with an 8-track tape, and the Conrail locomotive had a paper speed tape. The data from both the signal event recorder and the locomotive event recorders were used to analyze the movement of both trains with respect to the recorded displayed signals. Recorded data from the train's event recorders as well as from the wayside signal system were used as input in a computerized simulation to determine stopping distances for both trains.

The collision and derailment of an Amtrak train at a grade crossing accident in 1993 near Intercession City, Florida,[35] reported using of a wayside equipment defect detector for determining the passing time and speed of the train before the accident. The detector provided information that could not be recovered from the paper speed tape because the paper tape had been stained by diesel fuel. In the investigation of a 1994 multiple freight train accident,[36] Safety Board investigators used data from the multi-event recorders of three trains and the signal system's event recorders to reconstruct and simulate each train's movement.

The Safety Board's aviation accident investigators have used animated videos for some time. An animated video is developed from recorded information and is used in the analyzing and simulating the events leading up to the accident. Recently the Safety Board's railroad accident investigators have been developing animated videos for the same purpose.

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[33] Railroad Accident Report—*Derailment of Amtrak Train No. 5 (the San Francisco Zephyr) on the Burlington Northern Railroad, Emerson, Iowa, June 15, 1982* (NTSB-RAR-83-02).

[34] Railroad Accident Report—*Rear-end Collision of Amtrak Passenger Train 94, The Colonial and Consolidated Rail Corporation Freight Train ENS-121, on the Northeast Corridor, Chase, Maryland, January 4, 1987* (NTSB-RAR-88-01).

[35] Highway Accident Report—*Collision of Amtrak Train No. 88 with Rountree Transport and Rigging, Inc., Vehicle on CSX Transportation Inc., Railroad near Intercession City, Florida, November 30, 1993* (NTSB-HAR-95-01).

[36] Railroad Accident Report—*Collision and Derailment Involving Three Burlington Northern Freight Trains near Thedford, Nebraska, June 8, 1994* (NTSB-RAR-95-03).

The investigation of the 1996 Safety Board accident involving a Maryland Rail Commuter train and an Amtrak train near Silver Spring, Maryland,[37] demonstrated the potential benefits of having data from solid-state event recorders, wayside signal event recorders, and dispatcher recordings. The recorded data permitted investigators to thoroughly develop the sequence of events before the accident and to provide an animated video simulation of the sequence of events of the accident.

The most recent completed Safety Board investigation to use recorded data from the recording media was the investigation of the August 9, 1997, Amtrak train derailment near Kingman, Arizona.[38] This accident investigation had recorded data from multiple sources. Data was available from the train's solid-state multi-event recorders, the wayside signal event recorder, the equipment defect detectors, the high water detectors, the dispatchers' communications with the affected trains, and the recorded communications between the railroad operations center and local law enforcement agencies during the accident notification and response. One of the important discoveries was the Safety Board's finding that certain information recorded by the train's event recorder could not be read with the software provided to the carrier. The Safety Board issued Safety Recommendation R-98-057 to the FRA asking them to require that event recording system specifications be kept as a part of the locomotive records. (See appendix.)

The Safety Board has investigated 192 major rail accidents since 1967; the results have included more than 16 safety recommendations related to the use of recorded data to improve transportation safety.

The Safety Board is working closely with the FRA and the RSAC event-recorder-working group. The Safety Board is providing its technical expertise and experience to help develop new standards for additional recording parameters and crashworthiness to be incorporated in the proposed revisions to the present Federal recorder regulations. The future offers innovative uses of audio/visual recorded media utilizing the technical developments and experience in other modes and within the recorder industry. The implementation of audio/video recorders will enhance accident investigation and performance evaluations.

FUTURE RECORDING MEDIA FOR RAILROADS

The Safety Board's main concern regarding the use of recorded data is to increase the safety of our country's transportation systems by learning from the mistakes of the past, and enhancing the safety of the systems by insuring to the maximum extent possible, that these mistakes are not repeated. Though significant advances have been made in recent decades with regard to improving the availability of recorded rail data in the event of accidents, the Safety Board vehemently feels that there is much room for improvement in this area. The Safety board feels that by maximizing the availability of data as well as increasing the amount and type of data available, the safety of the nation's transportation systems can still be greatly enhanced.

The Safety Board currently has several recommendations open that address these issues, as presented earlier in this document.

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[37] Railroad Accident Report—*Collision and Derailment of Maryland Rail Commuter "MARC" Train 286 and National Railroad Passenger Corporation "AMTRAK" Train 29 near Silver Spring, Maryland on February 16, 1996* (NTSB-RAR-97-02).

[38] Railroad Accident Report—*Derailment of Amtrak Train 4, Southwest Chief, on the Burlington Northern Santa Fe Railway near Kingman, Arizona, August 9, 1997* (NTSB-RAR-98-03).

The crashworthiness standards considered for these regulations include fire protection, impact shock protection, crush protection, fluid immersion protection, and hydrostatic pressure protection. The issuance of these standards as a regulatory requirement is a highly anticipated event at the Safety Board. When fully implemented, these standards will increase the survivability of event recorders involved in an accident. The availability of data, as stated earlier, is invaluable in determining cause and initiating change as a result of both major and minor rail accidents.

The RSAC group is also discussing regulating the location of the recorders on the locomotives to allow for the highest chance of survival in the event of a catastrophic accident. The group is also addressing expanding the requirement for recording specific operational parameters. This regulation will make the recovery of event recorder data following an accident more likely, thus making causal determinations and safety improvements easier, more efficient, more accurate, and more timely.

Through accident investigation, the Safety Board's Vehicle Recorders Division has noticed what may be an industry wide problem with the maintenance of railroad event recorder systems. The Board has received problematic data sets and recorders from a variety of railroads, during the course of its investigations. Problems with missing or erroneous data continue to occur at an alarming rate.

These problems are not unique to a particular manufacturer or model of recording system, or to any specific railroad. The one common thread to almost all of these "failures" is the fact that the actual recording device *itself* is seldom, if ever, at fault. The recording devices themselves (particularly the microprocessor-based devices) appear to be the most reliable component in these variously configured recording systems. In fact, *none* of the microprocessor recorders that the NTSB has had tested thus far (by their respective manufacturers) has ever been found to have failed, be out of tolerance, or to have malfunctioned. Unfortunately there is a frequently recurring problem with bad data from these types of recorders.

The anomalous (or missing) data is frequently the result of an inoperative, incorrectly installed, or out-of-calibration "sensors" in the recording system, such as an axle generator or other sensor that sends a signal to the recording device. For example, if an axle generator were to fail, and send a constant signal representing 0 mph to the recorder, then 0 mph would be continuously recorded regardless of the train's speed.

Other system problems include:

> Incorrectly configured recording systems: Many of the newer generation recorders can be configured, or programmed, to suit specific needs. Improper setup or programming can cause certain parameters to be recorded incorrectly, or not recorded at all.
>
> Outdated or incorrect readout software: In most applications, microprocessor based recording systems are configured differently, to meet the customer's specific requirements. One operator's requirements may be different form another's, an individual operator may change their own requirements over time, and the recorder manufacturers periodically update or revise configuration as technology advances.

As a result, a single recorder (or recording system) may have a wide variety of different configurations, each requiring a particular software program to read the recorded data. A recording

system installed on a particular operator's locomotive requires a readout program that is unique to that operator. The same recording system installed on another operator's locomotive, may be configured differently, and would require a different readout program. A single recorder manufacturer may support 50 or more different recording systems, each requiring it's own readout program to properly extract the data.

If a recorder is read out using an incorrect or outdated readout program, its possible that certain parameters will be missing, or erroneous. The resulting data could be misleading.

Current FRA regulations do not adequately address the maintenance of event recorders. There are no requirements for records to be kept about recorder system specifications, or applicable readout software. The existing requirements for the testing and inspection of recorder systems are insufficient. While a readout of the data is required every 92 days for tape-based recorders only, there is no requirement (for any type of recorder) to test the sensors or other system components or to verify that accurate data is actually being recorded.

Furthermore, under current FRA regulations, microprocessor based recorders are not required to be readout, tested, or examined unless the recorder itself indicates a fault from its self-diagnostic test. Operators must check the recorder's self-test status every 92 days, which is typically indicated by a light on the recorder case. Unless a fault is indicated, the recorder system may go its entire life without any maintenance, readouts, or further inspection.

Most self-test functions on modern day recorders do a reasonable job of testing the general "health" of the recording device itself, but they cannot assure proper operation of the other components that actually send the signals to the recorder. Virtually all recorder self-diagnostic tests cannot detect any of the problems noted above. While some recorders can test for the presence of certain sensors (whether or not they are connected, and powered if applicable) they cannot test the validity of the signals coming from the sensors. If an errant axle generator continuously sends a signal representing 0 mph, the self-test feature will not detect a malfunction. Failures such as this one may never be detected**,** because there are no requirements to ever read out, test, or evaluate this type of recorder. Additionally, self-test features can not detect improper "programming" or set-up of the recording system. Many systems have optional software configuration settings that can be adjusted by the operator. These settings may be inadvertently set to omit or restrict the data that the recorder stores limiting the information that would otherwise be available after an accident. Because these types of optional settings simply configure the recorder to do what the operator desires, they are not "faults" of the recorder.

As a result of these maintenance problems, the reliability of event recorders to provide vital information after an accident is significantly jeopardized. The NTSB has issued several recommendations to the FRA that address these very issues. The FRA has elected to delegate the evaluation of these recommendations to the RSAC. To date, no action has been taken by the RSAC or the FRA to address these maintenance issues.

The development of new technologies within the rail industry creates new opportunities for data gathering to further aid in the pursuit of safer systems. Since the early 1980's, the railroad industry has recognized the possibility of using data radio communications, emerging microprocessor-based systems, and other technologies to perform enhanced train control functions. These concepts have matured to form a system now referred to as Positive Train Control (PTC). PTC utilizes radio signals to automatically control certain brake applications on trains in order to insure proper separation between

trains running on the same set of tracks. This system makes high-speed rail traffic safe in areas of high rail traffic, and all rail traffic separated at a safe distance respective to the speed of the train.

PTC should make it possible to prevent most train-to-train collisions, enforce restrictions on train speed, and enhance protection for roadway workers, at a cost lower than would be expected using traditional approaches. The business benefits of such a system make it attractive to the rail industry, and the potential safety benefits make it attractive to the Safety Board.

This new system presents an entire new way of controlling a train, and presents a new set of data elements that need to be tracked and recorded. PTC is an example of new technology that, when introduced, creates a need for a recording mechanism, be it on board the train or at the control point, to track the data and make it available in the event of an accident.

Since 1964 all transport category aircraft have been required to maintain a Cockpit Voice Recorder (CVR). Providing the same capability for locomotives can hardly be labeled as new technology. The technology has existed for some time to make this equipping a practical measure. The data from the many CVRs recovered by the Safety Board in accident investigation have proven extremely valuable in solving for cause in a great number of aviation accidents. The CVRs provide a level of detail about the cockpit environment before, during, and after incidents and accidents that are generally not available in the many instances where the crew does not survive. CVRs are also used to study noises in the cockpit and to identify potential sources of problems in accidents where the pilots and much of the aircraft have not survived.

The Safety Board issued Safety Recommendation R-97-009 to the FRA that calls amending the regulations to require the recording of train crewmembers' voice communications for exclusive use in accident investigations and with appropriate limitations on the public release of such recordings. Considering the unfortunate yet oft encountered circumstances of a locomotive crew not surviving an accident, a cab voice recorder could provide pieces to the accident puzzle that have heretofore not been available. Cab voice recorders could provide information concerning ambient conditions within the locomotive cab, back-up data concerning control inputs made from the cab position, information involving signal calling from within the cab, and identification of conditions within and without the cab that may have contributed to an accident or incident. They can also record crew conversations, radio transmissions, and alerts and alarms that occur within the cab. (See appendix.)

Use of cab video recording is another area that the Safety Board feels the rail industry could benefit from. Video footage of the locomotive's controls, as well as the outside viewpoint from inside the cabin and outside the cabin, if made available in the investigation of an accident, could provide information that could bring to light reasons for accidents in many circumstances. Video could provide data on signals viewed by the crew, weather that may affect visibility conditions, and provide back up to the event recorders and crew statements on circumstances of any accident or incident. Again, in the unfortunate event of crew fatalities, the video could provide information that would otherwise be completely unavailable.

Already the utility and necessity of capturing video feed from locomotive operations has been acted upon. The Arkansas & Missouri Railroad has installed cameras at the front and rear of all of its trains. The reasons that this short line railroad has undertaken this program are many.

The railroad is responding to a need for more information regarding train operations, specifically in the investigations into grade crossing incidents. The railroad also has used video to address the issue of locomotive cab blind spots. Video monitors have been placed in the cab to provide the crews with live

feed of any activity occurring in areas that are not visible from within the cab. The railroad also uses the recorders to enhance their crew efficiency program. Each crew has their own 12-hour tape that they install at the start of a shift and remove at the end of a shift. This allows the railroad to monitor crew efficiency at regular intervals instead of removing a crew from active service and test-running them on separate trains at annual reviews. The videos created by this system are used as an aid for training crews for locomotive operations. The reality that the videos present make them an invaluable tool in training crews for actual operations. Finally, the railroad has used video to monitor various passive grade crossings and identify any unsafe practices by both locomotive operators and highway drivers at the crossings.

The Arkansas & Missouri Railroad has recognized the benefits of video recording in day-to-day operations as a crew aid and efficiency monitor, as a valuable source if information to augment the locomotive event recorders, and as a preventive measure concerning safety at passive grade crossings. The Safety Board is hopeful that other railroads recognized the vast benefits of video recording and begins their own video programs.

The three goals of the Safety Board with regard to the future of locomotive event recorders are:

- Insure the availability of recorded data by housing the data memory unit in a crash protected environment,
- insure the integrity and accuracy of the data by utilizing appropriate inspection and maintenance techniques, and
- take advantage of available technology (PTC, Audio, Video) to make available the greatest amount and types of data practicable.

Creating an environment where these three concepts are applied will insure ease in accident investigation, maximize the lessons learned from mistakes of the past, and create a safer railroad transportation environment for rail employees and customers both.

CONCLUSIONS

The appropriate data from recorders can provide a more accurate assessment of the circumstances of the events leading up to an accident; and, corroboration of witness statements can be derived from this data which helps eliminate much of the guesswork involved in accident investigation.

BIOGRAPHIES

Ed Dobranetski is the Safety Recommendations Coordinator for the Office of Safety Recommendations and Safety Accomplishments of the National Transportation Safety Board. His previous NTSB positions were in the NTSB's Office of Railroad Safety as Track and Signal Specialist, Chief Major Investigations, and National Resource Specialist. He has been with the NTSB for about 13 years and prior to joining the NTSB he was an engineering manager with a former Class I railroad for more than 19 years.

Dave Case is the Mechanical Engineer for the Office of Research and Engineering (RE) of the National Transportation Safety Board. He is a recorder specialist for the Vehicle Recorders Division within RE. He was a General Engineer for the U. S. Department of Energy for 6 years prior to coming to the NTSB.

A P P E N D I X

SAFETY RECOMMENDATIONS

Recommendation # R-78-044
Issue Date 7/31/78 PENSACOLA, FL
Overall Status CUA

ABOUT 6:06 P.M. ON NOVEMBER 9, 1977, 2 SD-45 LOCOMOTIVE UNITS AND 35 CARS OF LOUISVILLE AND NASHVILLE FREIGHT TRAIN NO. 407 DERAILED WHEN ENTERING A 6 DEGREES 04' CURVE AT PENSACOLA, FLORIDA. THE ADJACENT TANK HEADS OF THE 18TH AND 19TH CARS WERE PUNCTURED DURING THE DERAILMENT BY A LOOSE WHEEL AND AXLE ASSEMBLY; THIS RELEASED ANHYDROUS AMMONIA INTO THE ATMOSPHERE. TWO PERSONS DIED AND 46 WERE INJURED AS A RESULT OF THE DERAILMENT, RELEASE OF ANHYDROUS AMMONIA, AND EVACUATION OF ABOUT 1,000 PERSONS. PROPERTY DAMAGE WAS ESTIMATED TO BE $724,000.

THE NTSB RECOMMENDS THAT THE FEDERAL RAILROAD ADMINISTRATION: PROMULGATE REGULATIONS TO REQUIRE LOCOMOTIVES USED IN TRAINS ON MAIN TRACKS OUTSIDE OF YARD LIMITS TO BE EQUIPPED WITH OPERATING EVENT RECORDERS.

FRA CLOSED - UNACCEPTABLE ACTION

Recommendation # R-81-045
Issue Date 4/22/81 HERMOSA, WY
Overall Status CAA

ON OCTOBER 16, 1980, UNION PACIFIC RAILROAD COMPANY (UP) FREIGHT TRAIN EXTRA 3749 WEST (NPH-16) STRUCK THE REAR OF UP GRAIN TRAIN EXTRA 3557 WEST (SGTLB-635) WHILE IT WAS STANDING ABOUT 100 FEET WEST OF INTERMEDIATE SIGNAL NO. 5517 NEAR HERMOSA, WYOMING. TWO TRAIN CREWMEMBERS WERE KILLED AND TWO CREWMEMBERS WERE INJURED. THE 3 LOCOMOTIVE UNITS OF NPH-16 AND 16 CARS, INCLUDING THE CABOOSE, OF SGTLB-635 WERE DERAILED. TOTAL DAMAGE WAS ESTIMATED TO BE $993,000.

THE NTSB RECOMMENDS THAT THE UNION PACIFIC RAILROAD COMPANY: MODIFY EVENT RECORDERS TO RECORD ACTIVATION OF THE CAB SIGNAL ACKNOWLEDGING LEVER.

UNION PACIFIC RAILROAD CLOSED - ACCEPTABLE ACTION

Recommendation # R-81-046
Issue Date 4/22/81 HERMOSA, WY
Overall Status CNLA

THE NTSB RECOMMENDS THAT THE UNION PACIFIC RAILROAD COMPANY: RELOCATE EVENT RECORDERS SO AS TO LESSEN THE LIKELIHOOD OF THEIR BECOMING DAMAGED IN AN ACCIDENT.

UNION PACIFIC RAILROAD CLOSED - NO LONGER APPLICABLE

Recommendation # R-81-047
Issue Date 4/22/81 HERMOSA, WY
Overall Status CUA

THE NTSB RECOMMENDS THAT THE UNION PACIFIC RAILROAD COMPANY: PROVIDE THE CABS OF LOCOMOTIVES WITH EMERGENCY POWER SO THAT EMERGENCY LIGHTS, RADIOS, AND EVENT RECORDERS CONTINUE TO OPERATE WHEN NORMAL POWER IS LOST.

UNION PACIFIC RAILROAD CLOSED - UNACCEPTABLE ACTION

Recommendation # R-81-049
Issue Date 4/22/81 HERMOSA, WY
Overall Status CNLA

THE NTSB RECOMMENDS THAT THE ASSOCIATION OF AMERICAN RAILROADS: ENCOURAGE MEMBER RAILROADS TO HAVE EVENT RECORDERS WHICH RECORD ACTIVATION OF CAB SIGNAL, AUTOMATIC TRAIN STOP, OR OTHER SIMILAR SAFETY SYSTEM DEVICES.

ASSOCIATION OF AMERICAN RAILROADS CLOSED - NO LONGER APPLICABLE

Recommendation # R-81-050
Issue Date 4/22/81 HERMOSA, WY
Overall Status CNLA

THE NTSB RECOMMENDS THAT THE ASSOCIATION OF AMERICAN RAILROADS: ENCOURAGE MEMBER RAILROADS TO INSTALL OR RELOCATE EVENT RECORDERS SO AS TO LESSEN THE LIKELIHOOD OF THEIR BECOMING DAMAGED IN AN ACCIDENT.

ASSOCIATION OF AMERICAN RAILROADS CLOSED - NO LONGER APPLICABLE

Recommendation # R-81-051
Issue Date 4/22/81 HERMOSA, WY
Overall Status CNLA

THE NTSB RECOMMENDS THAT THE ASSOCIATION OF AMERICAN RAILROADS: ENCOURAGE MEMBER RAILROADS TO PROVIDE THE CABS OF LOCOMOTIVES WITH EMERGENCY POWER SO THAT EMERGENCY LIGHTS, RADIOS, AND EVENT RECORDERS CONTINUE TO OPERATE WHEN NORMAL POWER IS LOST.

ASSOCIATION OF AMERICAN RAILROADS CLOSED - NO LONGER APPLICABLE

Recommendation # R-89-050
Issue Date 7/14/89 ALTOONA, IA
Overall Status CAA

ABOUT 11:44 A.M. CENTRAL DAYLIGHT SAVINGS TIME ON JULY 30, 1988, IOWA INTERSTATE RAILROAD LTD. (IAIS) FREIGHT TRAINS EXTRA 470 WEST AND EXTRA 406 EAST COLLIDED HEAD ON WITHIN THE YARD LIMITS OF ALTOONA, IOWA, ABOUT 10 MILES EAST OF DES MOINES, IOWA. ALL 5 LOCOMOTIVE UNITS FROM BOTH TRAINS; 11 CARS OF EXTRA 406 EAST; AND 3 CARS, INCLUDING 2 TANK CARS CONTAINING DENATURED ALCOHOL, OF EXTRA 470 WEST DERAILED. THE DENATURED ALCOHOL, WHICH WAS RELEASED THROUGH THE PRESSURE RELIEF VALVES AND THE MANWAY DOMES OF THE TWO DERAILED TANK CARS, WAS IGNITED BY THE FIRE RESULTING FROM THE COLLISION OF THE LOCOMOTIVES. BOTH CREWMEMBERS OF EXTRA 470 WEST WERE FATALLY INJURED; THE TWO CREWMEMBERS OF EXTRA 406 EAST WERE ONLY SLIGHTLY INJURED. THE ESTIMATED DAMAGE (INCLUDING LADING) AS A RESULT OF THIS ACCIDENT EXCEEDED $1 MILLION.

THE NTSB RECOMMENDS THAT THE FEDERAL RAILROAD ADMINISTRATION: EXPEDITE THE RULEMAKING REQUIRING THE USE OF EVENT RECORDERS IN THE RAILROAD INDUSTRY.

FRA CLOSED - ACCEPTABLE ACTION

Recommendation # R-96-046
Issue Date 11/14/96 GAITHERSBURG, MD
Overall Status CAA

ABOUT 10:40 P.M. ON 1/6/96, WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY (WMATA) METRORAIL SUBWAY TRAIN NO. T-111, OPERATING ON THE 'RED LINE" SEGMENT OF THE METRORAIL SYSTEM, FAILED TO STOP AS IT ENTERED THE ABOVE-GROUND SHADY GROVE PASSENGER STATION NEAR GAITHERSBURG, MARYLAND, THE FINAL STATION ON THE RED LINE. THE FOUR-CAR TRAIN RAN BY THE STATION PLATFORM & CONTINUED ABOUT 470 FEET INTO THE METRORAIL YARD NORTH OF THE STATION, WHERE IT STRUCK A STANDING, UNOCCUPIED SUBWAY TRAIN WAS AWAITNG ASSIGNMENT. THE T-111 TRAIN OPERATOR WAS FATALLY INJURED; THE TRAIN'S TWO PASSENGERS WERE NOT INJURED. TOTAL PROPERTY DAMAGES WERE ESTIMATED TO BE BETWEEN $2.1 & 2.6 MILLION.

THE NTSB RECOMMENDS THAT THE FEDERAL TRANSIT ADMINISTRATION: DEVELOP, WITH THE ASSISTANCE OF THE AMERICAN PUBLIC TRANSIT ASSOCIATION GUIDELINES FOR MONITORING/RECORDING DEVICES THT CAPTURE CRITICAL PERFORMANCE & EVENT DATA FOR RAPID RAIL TRANSIT CARS & URGE TRANSIT AGENCIES TO INSTALL THESE DEVICES ON NEW & REHABILITATED CARS.

FTA CLOSED - ACCEPTABLE ACTION

Recommendation # R-96-047
Issue Date 11/14/96 GAITHERSBURG, MD
Overall Status OAA

THE NTSB RECOMMENDS THAT THE AMERICAN PUBLIC TRANSIT ASSOCIATION: DEVELOP, WITH THE ASSISTANCE OF THE FEDERAL TRANSIT ADMINISTRATION, GUIDELINES FOR MONITORING/RECORDING DEVICES THAT CAPTURE CRITICAL PERFORMANCE & EVENT DATA FOR RAPID RAIL TRANSIT CAR & URGE TRANSIT AGENCIES TO INSTALL THESE DEVICES ON NEW & REHABILITATED CARS.

APTA OPEN - ACCEPTABLE RESPONSE

Recommendation # R-96-070
Issue Date 3/5/97 CAJON JUNCTION, CA
Overall Status OAA

ABOUT 4:10 A.M. ON 2/1/96, ATCHISON, TOPEKA & 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 & THE SUBSEQUENT RAIL CAR PILEUP, WHICH INVOLVED FIVE CARS CONTAINING HAZARDOUS MATERIALS, A FIRE IGNITED THAT ENGULFED THE TRAIN & THE SURROUNDING AREA. THE CONDUCTOR & THE BRAKEMAN SUSTAINED FATAL INJURIES; THE ENGINEER SUFFERED SERIOUS INJURIES.

THE NTSB RECOMMENDS THAT THE FRA: REVISE 49 CODE OF FEDERAL REGULATIONS 229.25(E)(2) TO REQUIRE THAT EVENT RECORDERS, INCLUDING MICROPROCESSOR-BASED EVENT RECORDERS THAT ARE EQUIPPED WITH A SELF-TEST FUNCTION, BE TESTED DURING THE QUARTERLY INSPECTIONS OF THE LOCOMOTIVE IN SUCH A MANNER THAT THE ENTIRE EVENT RECORDING SYSTEM, INCLUDING SENSORS, TRANSDUCERS, & WIRING IS EVALUATED. SUCH TESTING SHOULD INCLUDE, AT A MINIMUM, A REVIEW OF THE DATA RECORDED DURING ACTUAL OPERATION OF THE LOCOMOTIVE TO VERIFY PARAMETER FUNCTIONALITY AS WELL AS CYCLING ALL REQUIRED RECORDING PARAMETERS & DETERMINING THE FULL RANGE OF EACH PARAMETER BY READING OUT RECORDED DATA.

FRA OPEN - ACCEPTABLE RESPONSE

Recommendation # R-96-071
Issue Date 3/5/97 CAJON JUNCTION, CA
Overall Status OUA

THE NTSB RECOMMENDS THAT THE FRA: DEVELOP & IMPLEMENT A PROGRAM THAT SPECIFICALLY ADDRESSES CARRIER COMPLIANCE WITH 49 CODE OF FEDERAL REGULATIONS 229.25(E)(5).

FRA OPEN - UNACCEPTABLE ACTION

Recommendation # R-96-072
Issue Date 3/5/97 CAJON JUNCTION, CA
Overall Status OUA

THE NTSB RECOMMENDS THAT THE FRA: REVISE YOUR FORM F6180-49A TO INCLUDE EVENT RECORDERS IN THE OTHER ITEMS TO BE INSPECTED SECTION ON THE FORM.

FRA OPEN - UNACCEPTABLE ACTION

Recommendation # R-96-073
Issue Date 3/5/97 CAJON JUNCTION, CA
Overall Status OUA

THE NTSB RECOMMENDS THAT THE FRA: INFORM THE INDUSTRY THAT THE PLACEMENT OF EVENT RECORDERS OTHER THAN IN THE LEAD LOCOMOTIVE WILL NOT RECORD THE REQUIRED DATA AS THOUGH THE EVENT RECORDERS WERE IN THE LEAD LOCMOTIVE & ENSURE COMPLIANCE WITH 49 CODE OF FEDERAL REGULATIONS 229.135(A).

FRA OPEN - UNACCEPTABLE ACTION

Recommendation # R-97-009
Issue Date 8/28/97 SILVER SPRING, MD
Overall Status ORR

ABOUT 5:38 P.M. ON 2/16/96, EASTBOUND MARYLAND RAIL COMMUTER (MARC) TRAIN 286 COLLIDED WITH WESTBOUND NATIONAL RAILROAD PASSENGER CORPORATION (AMTRAK) TRAIN 29, THE CAPITOL LIMITED, AT

MILEPOST 8.55 ON CSX MAIN TRACK NEAR SILVER SPRING, MARYLAND. THE MARC TRAIN WAS OPERATING IN THE PUSH MODE IN REVENUE SERVICE BETWEEN BRUNSWICK, MARYLAND, & WASHINGTON, D.C.; IT CONSISTED OF A LOCOMOTIVE & THREE COMMUTER CARS. THE AMTRAK TRAIN, OPERATING IN REVENUE SERVICE BETWEEN WASHINGTON D.C., & CHICAGO, ILLINOIS, CONSISTED OF 2 LOCOMOTIVES & 15 CARS.

THE NTSB RECOMMENDS THAT THE FRA: AMEND 49 CODE OF FEDERAL REGULATIONS PART 229 TO REQUIRE THE RECORDING OF TRAIN CREWMEMBERS' VOICE COMMUNICATIONS FOR EXCLUSIVE USE IN ACCIDENT INVESTIGATIONS & WITH APPROPRIATE LIMITATIONS ON THE PUBLIC RELEASE OF SUCH RECORDINGS.

FRA OPEN RESPONSE RECEIVED

Recommendation # R-98-030
Issue Date 6/25/98 DEVINE, TX
Overall Status OAR

AT 10:52 P.M. ON 6/22/97, UNION PACIFIC RAILROAD (UP) FREIGHT TRAINS 5981 NORTH & 9186 SOUTH COLLIDED HEAD-ON IN DEVINE, TEXAS. THE TRAINS WERE OPERATING ON A SINGLE MAIN TRACK WITH PASSING SIDINGS IN DARK NONSIGNALIZED) TERRITORY IN WHICH TRAIN MOVEMENT WAS GOVERNED BY CONDITIONAL TRACK WARRANT CONTROL AUTHORITY THROUGH A DISPATCHER. THE CONDUCTOR FROM 5981 NORTH, THE ENGINEER FROM 9186 SOUTH, & TWO UNIDENTIFIED INDIVIDUALS WHO MAY HAVE BEEN RIDING ON 5981 NORTH WERE KILLED IN THE DERAILMENT SUBSEQUENT FIRE. THE ENGINEER FORM 5881 NORTH RECEIVED MINOR INJURIES & THE CONDUCTOR FROM 9186 SOUTH WAS SERIOUSLY BURNED. ESTIMATED DAMAGES EXCEEDED $6 MILLION.

THE NTSB RECOMMENDS THAT THE FRA: WORKING WITH THE RAILROAD INDUSTRY, DEVELOP & IMPLEMENT EVENT RECORDER CARSHWORTHINESS STANDARDS FOR ALL NEW OR REBUILT LOCOMOTIVES JANUARY 1,2000.

FRA OPEN - INITIAL RESPONSE 2/4/99

Recommendation # R-98-057
Issue Date 9/16/98 KINGMAN, AZ
Overall Status OAR

ABOUT 5:56 A.M., ON 8/9/97, NATIONAL RAILROAD PASSENGER CORPORATION (AMTRAK) TRAIN 4, THE SOUTHWEST CHIEF, DERAILED ON THE BURLINGTON NORTHERN SANTA FE RAILWAY (BNSF) TRACKS ABOUT 5 MILES NORTHEAST OF KINGMAN, ARIZONA. AMTRAK TRAIN 4 WAS ENROUTE FROM LOS ANGELES, CALIFORNIA, TO CHICAGO ILLINOIS, & HAD JUST LEFT THE KINGMAN STATION. THE TRAIN WAS TRAVELING ABOUT 89 MPH ON THE EASTBOUND TRACK WHEN BOTH THE ENGINEER & ASSISTANT ENGINEER SAW A "HUMP" IN THE TRACK AS THEY APPROACHED BRIDGE 504.1S. THEY APPLIED THE TRAIN'S EMERGENCY BRAKES. THE TRAIN DERAILED AS IT CROSSED THE BRIDGE. SUBSEQUENT INVESTIGATED REVEALED THAT THE GROUND UNDER THE BRIDGE'S SUPPORTING STRUCTURE HAD BEEN WASHED AWAY BY A FLASH FLOOD. OF THE 294 PASSENGERS & 18 AMTRAK EMPLOYEES ON THE TRAIN, 173 PASSENGERS & 10 AMTRAK EMPLOYEES WERE INJURED. NO FATALITIES RESULTED FROM THE ACCIDENT. THE DAMAGES WERE ESTIMATED TO TOTAL APPROXIMATELY $7.2 MILLION.

THE NTSB RECOMMENDS THAT THE FRA: REQUIRE THAT EVENT RECORDER SYSTEM SPECIFICATIONS BE KEPT AS PART OF THE LOCOMOTIVE'S RECORDS.

FRA OPEN - AWAIT RESPONSE