National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: June 1, 1999

In reply refer to: P-99-12

Honorable Kelley S. Coyner
Administrator
Research and Special Programs Administration
Washington, D.C. 20590

During the 1980s, the National Transportation Safety Board investigated several accidents that involved operator fatigue.[1] Following completion of these accident investigations, the Safety Board in 1989 issued three recommendations to the U.S. Department of Transportation (DOT):

> Expedite a coordinated research program on the effects of fatigue, sleepiness, sleep disorders, and circadian factors on transportation system safety. (I-89-1)
>
> Develop and disseminate educational material for transportation industry personnel and management regarding shift work; work and rest schedules; and proper regimens of health, diet, and rest. (I-89-2)
>
> Review and upgrade regulations governing hours of service for all transportation modes to assure that they are consistent and that they incorporate the results of the latest research on fatigue and sleep issues. (I-89-3)

[1] (a) National Transportation Safety Board. 1985. *Collision of Tuba City School District Schoolbus and Bell Creek, Inc., Tractor-Semitrailer, U.S. 160 Near Tuba City, Arizona, April 29, 1985*. Highway Accident Report NTSB/HAR-85/06. Washington, DC. (b) National Transportation Safety Board. 1986. *Grounding of the Panamanian-Flag Passenger Carferry M/V* A. Regina, *Mona Island, Puerto Rico, February 15, 1985.* Marine Accident Report NTSB/MAR-86/02. Washington, DC. (c) National Transportation Safety Board. 1986. *China Airlines, Boeing 747-SP, N4522V, 300 Nautical Miles Northwest of San Francisco, California, February 19, 1985*. Aircraft Accident Report NTSB/AAR-86/03. Washington, DC. (d) National Transportation Safety Board. 1987. *Trailways Lines, Inc., Intercity Bus Collision With Rising Fast Trucking Company, Inc., Interstate Highway 40 Near Brinkley, Arkansas, July 14, 1986.* Highway Accident Report NTSB/HAR-87/05. Washington, DC. (e) National Transportation Safety Board. 1988. *Collision Between the* USS Richard L. Page *(FFG-5) and the U.S. Fishing Vessel* Chickadee, *the Atlantic Ocean, April 21, 1987*. Marine Accident Report NTSB/MAR-88/04. Washington, DC. (f) National Transportation Safety Board. 1988. *Collision Between U.S. Passenger/Car Ferries M/V* North Star *and M/V* Cape Henlopen *on Long Island, Orient Point, New York, July 9, 1987*. Marine Accident Report NTSB/MAR-88/06. Washington, DC. (g) National Transportation Safety Board. 1989. *Head-End Collision of Consolidated Rail Corporation Freight Trains UBT-506 and TV-61 Near Thompsontown, Pennsylvania.* Railroad Accident Report NTSB/RAR-89/02. Washington, DC.

Fatigue has remained a significant factor in transportation accidents since the Safety Board's 1989 recommendations were issued. Although generally accepted as a factor in transportation accidents, the exact number of accidents due to fatigue is difficult to determine and likely to be underestimated. The difficulty in determining the incidence of fatigue-related accidents is due, at least in part, to the difficulty in identifying fatigue as a causal or contributing factor in accidents. There is no comparable chemical test for identifying the presence of fatigue as there is for identifying the presence of drugs or alcohol; hence, it is often difficult to conclude unequivocally that fatigue was a causal or contributing factor in an accident. In most instances, one or more indirect or circumstantial pieces of evidence are used to make the case that fatigue was a factor in the accidents. This evidence includes witness statements, hours worked and slept in the previous few days, the time at which the accident occurred, the regularity or irregularity of the operator's schedule, or the operator's admission that he fell asleep or was impaired by fatigue.[2] Despite the difficulty in identifying fatigue as a causal factor, estimates of the number of accidents involving fatigue have been made for the different modes of transportation; the estimates vary from very little involvement to as high as about one-third of all accidents.

Although the data are not available to statistically determine the incidence of fatigue, the transportation industry has recognized that fatigue is a major factor in accidents. Further, the Safety Board's in-depth investigations have clearly demonstrated that fatigue is a major factor in transportation accidents.

In the 10 years that have passed since the three intermodal safety recommendations were issued, the Safety Board has issued an additional 70 fatigue-related safety recommendations,[3] which were the result of major accident investigations, special investigations, or safety studies that identified operator fatigue as a factor. This includes 11 accident reports or studies in aviation regarding air tours and operations conducted under Parts 91, 121, and 135; 7 in highway regarding busdrivers and truckdrivers; 3 in marine regarding passenger vessels and tankships; 4 in railroad regarding freight trains, passenger trains, and rail transit operations; and 1 in pipeline regarding pipeline controllers.

Operator fatigue has been on the Safety Board's list of Most Wanted Transportation Safety Improvents since the list's inception in 1990.[4] Had the DOT acted more aggressively on the three intermodal recommendations issued in 1989, the need for the 70 additional recommendations to the States and industry may have been minimized.

In November 1995, the Safety Board and the National Aeronautics and Space Administration (NASA) cosponsored a symposium to discuss fatigue countermeasures and to

[2] The Safety Board recognizes that people have a limited ability to predict the onset of sleep and to determine their level of sleepiness. (Itoi, A.; Cilveti, R.; Voth, M.; and others. 1993. *Can Drivers Avoid Falling Asleep at the Wheel? Relationship Between Awareness of Sleepiness and Ability To Predict Sleep Onset*. Washington, DC: AAA Foundation for Traffic Safety. p. 25.)

[3] Thirty-four of these recommendations were issued to the DOT or modal administrations. The remainder of the recommendations were issued to the States, industry, or industry associations.

[4] In October 1990, the Safety Board adopted a program to identify the "Most Wanted" transportation safety improvements. The purpose of the Board's Most Wanted list, which is drawn up from safety recommendations previously issued, is to bring special emphasis to the transportation safety issues the Board deems most critical.

demonstrate how they can be applied to prevent accidents in all modes of transportation.[5] The symposium was designed to practically illustrate the intent of one of the Safety Board's 1989 intermodal recommendations (I-89-2): to develop and disseminate educational material. More than 500 people from 16 countries representing all the modes of transportation attended the symposium, which attests to the magnitude and interest in the fatigue problem. As part of the symposium, the participants were divided into modal-specific groups to discuss scheduling, countermeasures, and education. All of the groups indicated that education was needed for the operators as well as for the management of transport companies. While the groups believed there was a need for additional technological countermeasures, they also believed there were some steps that could already be taken or could easily be implemented. For example, both an aviation group and the railroad group discussed the need for quality sleeping areas while away from home, pointing out that many hotels do not have rooms that are adequate for daytime sleeping. There was broad support voiced regarding a need for changes to the hours-of-service regulations. The participants wanted these regulations to be updated and based on scientific research.

The Safety Board recently completed a safety report that provides an update on the activities and efforts by the DOT and the modal administrations to address operator fatigue and, consequently, the progress that has been made in the past 10 years to implement the actions called for in the three intermodal recommendations and other fatigue-related recommendations.[6]

The various Secretaries of the DOT and modal Administrators over the years have expressed their concerns about operator fatigue. In a 1995 summary of the DOT's fatigue safety effort, Federico Peña, then Secretary of the DOT, stated that "fatigue among transportation operators remains a critical safety problem."[7] In a 1999 update, Secretary Rodney Slater stated, "We know that alertness is a key to safe vehicle operation. To reduce crashes and accidents and their personal and financial consequences, we need to ensure that vehicle operators are ready and capable of operating their vehicles or other transportation equipment."[8] Despite the many statements made by the DOT about the importance of addressing fatigue in transportation, only one of the three intermodal recommendations issued to the DOT more than 10 years ago has been fully implemented (I-89-1).

Safety Recommendation I-89-1

Safety Recommendation I-89-1 asked the DOT to expedite a coordinated research program on the effects of fatigue, sleepiness, sleep disorders, and circadian factors on transportation system safety. In its August 1989 response, the DOT stated that coordinated

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[5] National Transportation Safety Board; NASA Ames Research Center. 1996. *Fatigue Symposium Proceedings, November 1–2, 1995*. Washington, DC: National Transportation Safety Board.

[6] National Transportation Safety Board. 1999. *Evaluation of U.S. Department of Transportation Efforts in the 1990s To Address Operator Fatigue.* Safety Report NTSB/SR-99/01. Washington, DC.

[7] U.S. Department of Transportation. November 1995. *Sharing the Knowledge: Department of Transportation Focus on Fatigue*. Washington, DC.

[8] U.S. Department of Transportation. March 1999. *Managing Fatigue: A Significant Problem Affecting Safety, Security, and Productivity*. Washington, DC.

research efforts on human factors—including the effects of fatigue, sleepiness, sleep disorders, and circadian factors—on transportation safety was a top priority. The Human Factors Coordinating Committee, formed in 1988 and comprising representatives from each of the DOT administrations, serves as a means to share research information. A subcommittee has been created to focus on fatigue-related issues. In addition, the DOT briefed the Safety Board about the various ongoing fatigue-related projects several times over the years. Safety Recommendation I-89-1 was classified "Closed—Acceptable Action" on July 19, 1996, because the DOT had generally made Department-wide research efforts on operator fatigue. At the time this recommendation was closed, the Federal Aviation Administration (FAA), the Federal Highway Administration (FHWA), the National Highway Traffic Safety Administration (NHTSA), the Federal Railroad Administration (FRA), and the United States Coast Guard (USCG) all had fatigue-related research projects underway.

The Safety Board is disappointed, however, that more research efforts have not been made by the Research and Special Programs Administration (RSPA) in the pipeline mode. In 1998, the Board asked RSPA to assess the potential safety risks associated with rotating pipeline controller shifts and to establish industry guidelines for the development and implementation of pipeline controller work schedules that reduce the likelihood of accidents attributable to controller fatigue (Safety Recommendation P-98-30).[9] The RSPA responded to the recommendation on May 4, 1999.

The DOT's efforts to coordinate operator fatigue research have generally been responsive, with the exception of the RSPA regarding pipeline operations. The Safety Board encourages the DOT to continue its research, particularly on technology and in the pipeline mode, and to share information across the modes and with industry.

Safety Recommendation I-89-2

Safety Recommendation I-89-2 asked the DOT to develop and disseminate educational material for transportation industry personnel and management regarding shift work; work and rest schedules; and proper regimens of health, diet, and rest. In its 1989 response, the DOT acknowledged the unique demands placed on transportation workers such as shift-work, long-haul operations, and nighttime duty and that it would review its current policy on developing educational materials. In a more detailed response in 1996, the DOT indicated that it had published its 1995 report *Sharing the Knowledge: Department of Transportation Focus on Fatigue* and produced two videotapes that addressed fatigue: one on human factors and one entitled *Fatigue Busters—How to Survive Fatigue in the '90s*. In addition, the FAA also published a fatigue buster brochure. The Safety Board replied that it was pleased that information had been produced for aviation and highway, but it was concerned that similar information had not been developed for railroad, marine, and mass transit. On May 4, 1999, the DOT provided the Safety Board with an update of FRA education activities. Safety Recommendation I-89-2 is currently classified "Open—Acceptable Response."

[9] National Transportation Safety Board. 1998. *Pipeline Rupture and Release of Fuel Oil Into the Reedy River at Fork Shoals, South Carolina, June 26, 1996*. Pipeline Accident Report NTSB/PAR-98/01. Washington, DC.

In the early 1990s, NASA developed an education and training module entitled "Alertness Management in Flight Operations." It contains information about fatigue with an emphasis on aviation. The module has three primary objectives: to explain (1) the current state of knowledge about the physiological mechanisms that underlie fatigue; (2) misconceptions about fatigue; and (3) fatigue countermeasures. The NASA and the FAA have cosponsored many courses to educate pilots for a large segment of the major U.S. air carriers as well as for corporate management. The FRA, the Federal Transit Administration (FTA), and the FHWA along with industry organizations have used the NASA countermeasures training module as the basis for training modules in the other modes of transportation.

In addition to Safety Recommendation I-89-2, the Safety Board has issued other recommendations to the individual modal administrations calling for increased educational efforts regarding the effects of fatigue. In 1995, the Safety Board asked the FHWA to develop and disseminate, in consultation with DOT's Human Factors Coordinating Committee, a training and education module to inform truckdrivers of the hazards of driving while fatigued (Safety Recommendation H-95-5).[10] The FHWA and the American Trucking Associations, Inc., adapted the NASA module for use with the commercial driving industry and developed a train-the-trainer course on fatigue and fatigue countermeasures. To date more than 2,000 people have been trained; 16 seminars are being offered in 1999. Safety Recommendation H-95-5 to the FHWA was classified "Closed—Acceptable Action" on July 7, 1998.

In 1996, the Safety Board also asked the FTA, in cooperation with the American Public Transit Association, to develop a fatigue educational awareness program and to distribute it to transit agencies to use in their fitness-for-duty training for supervisors and employees involved in safety-sensitive positions (Safety Recommendation R-96-20).[11] The FTA has developed a seminar, available in four different formats, for a variety of attendees including employees, managers, and persons involved in scheduling. The Safety Board is pleased with this effort of the FTA and is aware that more than 600 persons have attended the seminars. As a result of these efforts, the Safety Board has classified Safety Recommendation R-96-20 "Closed—Acceptable Action."

In aviation, the Safety Board asked the FAA to require U.S. air carriers operating under 14 CFR Part 121 to provide educational programs for pilots (Safety Recommendation A-94-5),[12] to require 14 CFR Part 135 air carriers to provide fatigue countermeasure information to air crews in initial and recurrent training (A-94-73),[13] and to provide fatigue information to the

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[10] National Transportation Safety Board. 1995. *Factors That Affect Fatigue in Heavy Truck Accidents*. Safety Study NTSB/SS-95/01 and NTSB/SS-95/02. Washington, DC.

[11] National Transportation Safety Board. *Collision Involving Two New York City Subway Trains on the Williamsburg Bridge in Brooklyn, New York, June 5, 1995*. Railroad Accident Report NTSB/RAR-96/03. Washington, DC.

[12] National Transportation Safety Board. 1994. *A Review of Flightcrew-Involved, Major Accidents of U.S. Air Carriers, 1978 through 1990*. Safety Study NTSB/SS-94/01. Washington, DC.

[13] National Transportation Safety Board. 1994. *In-Flight Loss of Control, Leading to Forced Landing and Runway Overrun, Continental Express, Inc., N24706, Embraer EMB-120 RT, Pine Bluff, Arkansas, April 29, 1993*. Aircraft Accident Report NTSB/AAR-94/02/SUM. Washington, DC.

general aviation community (A-97-20).[14] The FAA revised Advisory Circular 120-51B to include fatigue as one of the topics discussed in crew resource management training. The FAA also developed educational materials to address the hazards of fatigue for use in safety meetings. These three recommendations have been classified "Closed—Acceptable Action."[15]

In 1997, the Safety Board asked the USCG to advise marine pilots about the effects of fatigue on performance and about sleeping disorders such as sleep apnea (Safety Recommendation M-97-41).[16] In a letter dated November 11, 1998, the USCG indicated that it has discussed the effects of fatigue and sleeping disorders with the American Pilots Association and independent pilot associations, requesting that they inform their members of the dangers of sleeping disorders such as sleep apnea through their internal media. Further, Navigation and Vessel Inspection Circular No. 2-98, *Physical Evaluation Guidelines for Merchant Marine's Documents and Licenses*, contains guidelines for use by physicians performing physical examinations of mariners and includes sleeping disorders as conditions to be evaluated for original and renewals of marine pilots' licenses and for the required pilots' physicals. Safety Recommendation M-97-41 was classified "Closed—Acceptable Action" on April 6, 1999.

The Safety Board is aware that the USCG has developed a research and educational program on crew endurance. The Board is also aware that the USCG held a workshop on fatigue on April 6, 1999, aimed at masters and safety management personnel of tugs and barges, passenger vessels, and fishing vessels as well as USCG personnel. The Board encourages the USCG to add more workshops to its agenda. Such programs could be promoted through the USCG's Prevention Through People program. The USCG has not developed any brochures on operator fatigue for the mariner community.

The Safety Board also issued a recommendation to the FHWA asking that educational materials be developed for commercial truckdrivers (H-90-21, classified "Closed—Acceptable Action"). The FHWA has developed and disseminated the brochure *Awake at the Wheel* and fatigue videos; it has also developed courses to educate truckdrivers about the dangers of driving while drowsy. In February 1999, the Board asked the FHWA to ensure that the dangers of inverted sleep periods are discussed in the fatigue video being developed for motorcoaches (Safety Recommendation H-99-4A).

The Safety Board is pleased to see the increase in educational efforts on fatigue among the DOT modal administrations, particularly the current activities within the FTA. The Safety Board would like to see more efforts in marine and pipeline to develop and disseminate educational materials on fatigue and will continue to monitor these activities. The FAA, FHWA, FRA, and

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[14] National Transportation Safety Board. 1997. *In-Flight Loss of Control and Subsequent Collision With Terrain, Cessna 177B, N35207, Cheyenne, Wyoming, April 11, 1996.* Aircraft Accident Report. NTSB/AAR-97/02. Washington, DC.

[15] Safety Recommendations A-94-5 and A-94-73 were classified "Closed—Acceptable Action" on January 16, 1996; Safety Recommendation A-97-20 was classified "Closed—Acceptable Action" on June 11, 1997.

[16] National Transportation Safety Board. 1997. *Grounding of Liberian Passenger Ship* Star Princess *on Poundstone Rock, Lynn Canal, Alaska, June 13, 1995.* Marine Accident Report NTSB/MAR-97/02. Washington, DC.

FTA have satisfactorily met the intent of this recommendation; however, the Board urges these modal administrations to continue their efforts in this area. Pending further efforts by the RSPA and the Coast Guard to develop and disseminate educational information on fatigue in marine and pipeline operations, respectively, Safety Recommendation I-89-2 remains classified "Open—Acceptable Response."

Safety Recommendation I-89-3

Safety Recommendation I-89-3 asked the DOT to review and upgrade regulations governing hours of service to assure that they are consistent and that they incorporate the results of the latest research on fatigue and sleep issues. In 1989, the DOT stated that it was reviewing the regulations pertaining to hours of service. It had not found research to suggest that the regulations should be consistent across all modes of transportation and that it would continue with research efforts to determine what changes might be made.

The Board has been very disappointed in the DOT's lack of progress in revising the hours-of-service regulations. Only the FAA and the FHWA have taken any action with respect to rulemaking. The FAA issued a notice of proposed rulemaking (NPRM) on December 20, 1995. That rulemaking has been effectively abandoned, and according to the FAA, rather than proceed to a final rule with the NPRM, it will likely issue a supplemental NPRM.

In November of 1996, the FHWA issued an advance notice of proposed rulemaking (ANPRM) that requested additional fatigue research.[17] Rather than proposing any changes to the current hours-of-service regulations, the ANPRM was a general solicitation for comments on hours-of-service regulations. Currently, the FHWA has reported that it is pursuing two different avenues of rulemaking—traditional rulemaking and negotiated rulemaking.[18] Although the FHWA indicated in a letter dated November 3, 1998, that it intended to publish an NPRM in early 1999, an NPRM has yet to be issued.

Although the DOT and the modal administrations have taken positive steps in the area of education and research, they have not acted decisively to revise the antiquated hours-of-service regulations. In fact, as outlined above, little regulatory action has been initiated. The DOT believes that countermeasures to fatigue are preferred over regulation because sleep during a rest period cannot be enforced.[19] The Safety Board points out that hours-of-service rules exist to set limits on allowable scheduling practices, not to prescribe those schedules, and while the Board agrees that sleep cannot be regulated, it also believes that time for adequate sleep must be guaranteed by any Federal regulation related to hours of service.

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[17] *Federal Register*, Vol. 61, No. 215, dated November 5, 1996.

[18] Basically, a procedure by which representatives of all interests affected by a rulemaking are brought together to discuss fully the issues under conditions conducive to narrowing or eliminating differences and to negotiating a proposed rule acceptable to each interest.

[19] U.S. Department of Transportation. 1999. *Managing Fatigue: A Significant Problem Affecting Safety, Security, and Productivity*. Washington, DC.

The Safety Board is aware that the FHWA, and others, are looking at onboard devices to test fitness-for-duty and monitor impairment of operator performance. Although the Safety Board supports pre-duty testing for performance as a result of fatigue, alcohol, drugs, or other condition, it does not believe that operators should be driving up to the point that they fail a valid fitness-for-duty test as a result of fatigue, which could occur in the middle of a trip.

In 1998, DOT Secretary Slater launched the ONEDOT program. This program is to build on collaborative efforts among the various transportation agencies to reduce duplication and save resources. One of the goals of ONEDOT is to develop a common, positive framework relating to work hours, overtime, and incentives. Within the concept of ONEDOT, the DOT Safety Council works toward development of a safety policy for the Department. Fatigue is one of the areas on which the Council intends to act. The Safety Board acknowledges this as yet another initiative to address fatigue and revisions to hours-of-service regulations; nevertheless, the Board remains extremely disappointed in the lack of rulemaking by the DOT.

Scientific research has shown that certain sleep factors can affect fatigue and performance: insufficient sleep, irregular and unpredictable schedules, working during low points in the circadian rhythm. The current hours-of-service regulations do not accommodate these concerns. The Safety Board believes these factors should be considered when revising the hours-of-service regulations. Therefore, the Safety Board is recommending that the DOT require the modal administrations to modify the appropriate *Codes of Federal Regulations* to establish scientifically based hours-of-service regulations that set limits on hours of service, provide predictable work and rest schedules, and consider circadian rhythms and human sleep and rest requirements. The Safety Board is also recommending that the DOT seek Congressional authority, if necessary, for the modal administrations to establish these regulations. Based on the issuance of this new recommendation, Safety Recommendation I-89-3 is being classified "Closed—Unacceptable Action/Superseded." The Safety Board is also recommending separately that each modal administration—the FAA, FHWA, FRA, USCG, and RSPA—establish, within 2 years, scientifically based hours-of-service regulations that set limits on hours of service, provide predictable work and rest schedules, and consider circadian rhythms and human sleep and rest requirements.

Therefore, the National Transportation Safety Board recommends that the Research and Special Programs Administration:

> Establish within 2 years scientifically based hours-of-service regulations that set limits on hours of service, provide predictable work and rest schedules, and consider circadian rhythms and human sleep and rest requirements. (P-99-12)

As a result of this safety report, the Safety Board also issued recommendations to the U.S. Department of Transportation, the Federal Aviation Administration, the Federal Highway Administration, the Federal Railroad Administration, and the U.S. Coast Guard.

Please refer to Safety Recommendation P-99-12 in your reply. If you have any questions, you may call (202) 314-6517.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

Original Signed

By: Jim Hall
Chairman