National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: April 10, 2007

In reply refer to: A-07-30 through -32

Honorable Marion C. Blakey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

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The National Transportation Safety Board has long been concerned about the effects of fatigue on persons performing critical functions in all transportation industries,[1] including the effects of fatigue on air traffic controllers' performance. This concern was again raised in connection with the August 27, 2006, accident involving Comair flight 5191, a Bombardier CL-600-2B19 (CRJ-100), N431CA, that crashed during takeoff from Blue Grass Airport, Lexington, Kentucky, about 0607 eastern daylight time. The airplane had been cleared by air traffic control (ATC) for takeoff on runway 22, which is 7,003 feet long and equipped with high-intensity runway lights; however, the crew mistakenly taxied onto runway 26, which is 3,500 feet long and unlighted,[2] and attempted to take off. The airplane ran off the end of runway 26, impacted the airport perimeter fence and trees, and crashed. Of the 47 passengers and 3 crew members on board the airplane, 49 were killed, and one received serious injuries. The airplane was destroyed by impact forces and postcrash fire. The flight was operating under the provisions of 14 *Code of Federal Regulations* (CFR) Part 121 and was en route to Hartsfield-Jackson Atlanta International Airport, Atlanta, Georgia.

During its ongoing investigation of this accident, the Safety Board has learned that the air traffic controller who cleared the accident airplane for takeoff had worked a shift from 0630 to 1430 the day before the accident, then returned 9 hours later to work the accident shift from 2330 until the time of the accident at 0607 the next morning. The controller stated that his only sleep in the 24 hours before the accident was a 2-hour nap the previous afternoon between these two shifts. Such limited sleep can degrade alertness, vigilance, and judgment. The evidence thus far

[1] The Safety Board has issued more than 80 fatigue-related safety recommendations since 1989.

[2] Runway 26 was also restricted for use only in daylight visual flight rules conditions.

in this investigation has presented a complex scenario in which to evaluate the extent, if any, to which controller fatigue may have influenced controller actions as they related to the accident. The Board continues to evaluate the specific circumstances of this accident.

However, the Safety Board has investigated four other incidents that provide clear and compelling evidence that controllers are sometimes operating in a state of fatigue because of their work schedules and poorly managed utilization of rest periods between shifts and that fatigue has contributed to controller errors. This evidence and a consideration of the important safety role ATC plays in the National Airspace System (NAS) have prompted the Board to review the issue of controller fatigue and to recommend changes to controller work-scheduling policies and training requirements.

Background

The more than 80 fatigue-related safety recommendations that the Safety Board has issued since 1989 have addressed topics, such as the adequacy of rest periods, scheduling practices, fatigue awareness training, and hours-of-service regulations. The Board also addressed controller fatigue in a 1981 special investigation report on the nation's ATC system.[3] Citing extended work schedules among controllers in the aftermath of the 1981 strike, the Board issued Safety Recommendation A-81-145, which recommended that the Federal Aviation Administration (FAA) establish and implement a program to detect the onset of, and to alleviate, controller fatigue and stress. This recommendation was superseded by two more specific recommendations from the Board's 1983 follow-up study of the ATC system.[4] Safety Recommendation A-83-35 urged the FAA to disseminate guidelines for controller stress and fatigue detection and management, and Safety Recommendation A-83-36 asked the FAA to expedite the development and implementation of a controller performance assessment program that would include attention to stress and fatigue. In 1989, after several years of no progress, the Board classified both recommendations "Closed—Unacceptable Action."

The Safety Board has since issued several recommendations[5] on operator fatigue, but there are currently no open recommendations regarding air traffic controller fatigue. Evidence developed from the Board's investigations of the following four runway incursions highlights the impact fatigue can have on controller performance.

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[3] National Transportation Safety Board, *Air Traffic Control System*, Special Investigation Report NTSB/SIR-81-7 (Washington, D.C.: NTSB, 1981).

[4] National Transportation Safety Board, *Follow-up Study of the United States Air Traffic Control System*, Special Investigation Report NTSB/SIR-83-01 (Washington, D.C.: NTSB, 1983).

[5] As a result of its evaluation of the U.S. Department of Transportation's (DOT) efforts to address operator fatigue in all modes of transportation, the Safety Board issued several recommendations, most notably Safety Recommendation I-99-1, which recommended that the DOT require the modal administrations to modify the CFR 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, and to seek congressional authority, if necessary, to establish these regulations. Safety Recommendation I-99-1 is currently classified "Open—Acceptable Response."

March 23, 2006, Chicago, Illinois[6]

On March 23, 2006, about 0907 central standard time, a controller issued conflicting clearances to two airplanes resulting in a runway incursion at Chicago O'Hare International Airport (ORD). The controller cleared an Airbus A320 passenger airplane to cross runway 4L and, less than 15 seconds later, cleared a Boeing 737 passenger airplane to take off on the same runway. The pilots in the departing 737 observed the A320 moving toward the runway, rejected the takeoff, and stopped before reaching the taxiway intersection where the A320 was to cross.

The controller later stated that, when he issued the takeoff clearance for the 737 he had forgotten that he had instructed the A320 to cross runway 4L. He stated that he was sequencing incoming flight progress strips when he forgot about the crossing clearance and that he had neglected to use a memory aid to remind himself about the crossing traffic, as required by facility operating procedures. The investigation determined that the controller had worked an 8-hour shift the previous day until 2130 and was then off duty for 9 hours. Because of commuting and personal activities, he slept only about 4 hours before returning to work for the incident shift, which began at 0630. He reported that he felt "semi-rested" during his shift but was "not as sharp as [he] could have been." He stated that the second shift had been a quick turnaround with "no coffee."

August 19, 2004, Los Angeles, California[7]

On August 19, 2004, about 1455 Pacific daylight time, a controller error resulted in a runway incursion at Los Angeles International Airport, Los Angeles, California. A controller cleared a Boeing 737 passenger airplane to taxi onto and take off from runway 24L at the same time that another passenger airplane, a Boeing 747, had been cleared to land on the same runway and was on a short final approach. The pilots in the landing airplane saw the 737 taxi onto the runway and discontinued their approach about 12 seconds before the impending collision would have occurred, passing approximately 200 feet above the 737 during the go-around.

The investigation determined that when the controller began working the local control position, he received a correct position-relief briefing that the 747 was approaching runway 24L. The controller later indicated that he subsequently developed a mistaken belief that the 747 was landing on the adjacent parallel runway 24R. The investigation determined that the controller had worked a shift the previous evening from 1530 until 2330, then went home and slept between 5 and 6 hours before returning to work the incident shift, which began at 0730. The controller described the portion of his shift before the incident as a "hard day" and attributed his error, in part, to fatigue.

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[6] A description of this incident, OPS06IA007, can be found on the Safety Board's Web site at <http://www.ntsb.gov>.

[7] A description of this incident, LAX04IA302, can be found on the Safety Board's Web site at <http://www.ntsb.gov>.

September 25, 2001, Denver, Colorado[8]

On September 25, 2001, about 0348 mountain daylight time, a Boeing 757 cargo airplane with two crewmembers aboard, departed from runway 8 (a closed runway) at Denver International Airport, Denver, Colorado, in nighttime visual meteorological conditions. Runway 8 had been closed because of construction workers and equipment operating near its departure end and, during takeoff, the aircraft passed within 32 feet of lights that had been erected to illuminate the construction area. The controller handling the 757 was aware of the runway closure and had instructed the crew to taxi to a different runway. However, after the crew requested to take off on runway 8, the controller agreed and instructed the crew to taxi and take off from the closed runway.

The investigation determined that the controller had worked a shift at the tower from 0530 until 1330 the day before the incident,[9] then had a 9-hour rest period during which she obtained between 60 and 90 minutes of sleep. She then returned to work the incident shift, which began at 2230. When asked why the incident occurred, the controller stated that she was "…probably tired, not alert enough."

July 8, 2001, Seattle, Washington[10]

On July 8, 2001, about 2252 Pacific daylight time, a controller error resulted in a runway incursion at Seattle/Tacoma International Airport, Seattle, Washington. The controller issued a taxi clearance to a Boeing MD-80 passenger airplane to cross runway 34R at the same time a Boeing 767 passenger airplane was on short final approach to the same runway. The pilots in the landing airplane reported applying maximum braking to avoid a collision with the crossing airplane, and the 767 stopped only 810 feet short of the MD-80.

The investigation determined that the controller had assumed responsibility for his position shortly before the incident and had received a position-relief briefing addressing all applicable traffic, including the landing 767. However, the controller forgot about that airplane and did not identify its presence on short final approach because he did not perform the required visual scan of the runway and its approach area before he issued the runway crossing clearance. The investigation determined that, on the night of the incident, the controller was working his third shift in 2 days, with an 8-hour rest period between shifts. The day before the incident, the controller worked from 1400 to 2200, slept between 4 and 5 hours at home, worked from 0555 to 1355 the day of the incident, slept 3 hours at home, then returned to work the incident shift, which began at 2245. The controller stated that he tried to avoid midnight shifts whenever possible because of fatigue and said that, at the time of the incident, he was feeling tired, in part because he knew he "…had to be up all night long on a double quick turnaround."

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[8] A description of this incident, OPS01SA001, can be found on the Safety Board's Web site at <http://www.ntsb.gov>.

[9] The controller stated that she woke at 0345 on September 24 to prepare for the 0530-to-1330 shift.

[10] A description of this incident, OPS01SA002, can be found on the Safety Board's Web site at <http://www.ntsb.gov>.

Discussion

These four examples highlight situations in which tired controllers made errors in performing required or necessary actions that resulted in serious runway incursions. In postincident interviews, the controllers involved in all four incidents stated that they felt tired before the incidents, and two cited fatigue as a likely factor in their errors. The errors made by these controllers were similar in nature and were consistent with the known effects of fatigue. In each case, critical information about the traffic situation was forgotten, resulting in the controller issuing a conflicting or inappropriate clearance. In three of the incidents, the controllers compounded this error by inadequately monitoring runways and/or displays, thereby failing to recognize and correct the developing conflict. Studies have shown that errors among sleep-deprived participants are similar to those made by the controllers in the above-described incidents.[11] Fatigue is known to degrade performance on cognitive tasks involving working memory and vigilance and has been associated with decreased motivation. Controller fatigue was most likely a significant factor in the performance deficiencies observed in these four runway incursions.

Controller Scheduling Policies and Practices

Current FAA regulations and policies place limits on controller work schedules, but they do not adequately consider the potential impact of work scheduling on fatigue and performance. Title 14 CFR 65.47, "Maximum Hours," allows tower controllers to be scheduled for up to 10 consecutive hours of operational duty and requires that they be given a rest period of at least 8 hours between shifts and be provided at least one full 24-hour day off per week. FAA Order 7210.3, "Facility Operations and Administration," section 2-6-7, "Basic Watch Schedule," requires that controllers be provided a rest period of at least 12 hours after every midnight shift.[12] Beyond these requirements, FAA policy requires facility managers to ensure that facility watch schedules "take into account normal traffic flow" and are designed in accordance with collective bargaining rules.

The most recent contract between the FAA and the National Air Traffic Controllers Association (NATCA), dated June 5, 2006, stipulates that parties at the local level are responsible for negotiating controller assignments to the basic watch schedule.[13] It specifies that controller shifts are to be assigned through a bidding process that gives priority to controllers with greater seniority. The contract also describes procedures for adjusting shift schedules as required to allow employees to swap shifts, flex start/stop times, and work credit hours. However, these procedures are designed primarily to provide adequate notice of scheduling changes, ensure continuous coverage of watch schedules, and promote equitable distribution of premium pay. The contract does not require local evaluations of the impact that the basic watch

[11] H.P.A Van Dongen, G. Maislin, et al, "The Cumulative Cost of Additional Wakefulness: Dose-Response Effects on Neurobehavioral Functions and Sleep Physiology From Chronic Sleep Restriction and Total Sleep Deprivation," *Sleep*, Vol. 26, No. 2 (2003): 117-126.

[12] The FAA defines a midnight shift as a shift in which the majority of hours are worked between 10 p.m. and 8 a.m.

[13] Under current regulations, controllers could work four consecutive 10-hour shifts in less than 72 hours, with 8-hour rest periods in between. However, the current contract states that an operational controller's basic workday shall consist of 8 consecutive hours and their basic workweek shall consist of 5 consecutive days.

schedule or deviations from the basic watch schedule (shift-swapping, etc.) may have on controller fatigue and performance.

About 61 percent of controllers work rapidly rotating[14] counterclockwise[15] schedules, and about 40 percent of the controllers in this group (about 25 percent of all controllers) are assigned at least one midnight shift per week.[16] Many controllers in this latter group commonly work a type of schedule referred to as a "2-2-1" rotation.[17] An example is shown below:

Day 1:	1500 to 2300
Day 2:	1400 to 2200
Day 3:	0700 to 1500
Day 4:	0600 to 1400
Days 4 - 5:	2200 to 0600

Advantages of the 2-2-1 schedule are typically considered to be that it provides a longer weekend for controllers, it eliminates the need to work more than one midnight shift in a single week, and it allows a long recovery period following the single, weekly midnight shift.

Despite these commonly accepted advantages, counterclockwise schedules are problematic because they oppose normal sleep-wake patterns, which have a natural cycle slightly longer than 24 hours and are, therefore, more adaptable to slow clockwise shift rotations.[18] Rapidly rotating counterclockwise schedules, such as the 2-2-1, are especially problematic for two reasons. First, they typically include short rest periods between shifts of just 8 or 9 hours. This allows minimal opportunity for sleep when the time required for commuting, eating, personal hygiene, and other necessary daily activities is taken into account.[19] Second, some of these rest periods are scheduled during daytime hours when quality sleep is difficult to obtain. The short rest period between shifts 4 and 5 can be especially problematic because controllers adapted to night sleeps must return to work an overnight shift after a short rest period during the afternoon and early evening. The rapid rotation and short rest periods found in many controllers'

[14] Rapidly rotating shift schedules are characterized by varying start and stop times that change too rapidly for circadian rhythms to adapt.

[15] Counterclockwise shift schedules are characterized by progressively earlier start times.

[16] P.S. Della Rocco, L.P. Dobbins, and K.T. Nguyen, *Shift Schedule Sampling from FAA Air Traffic Control Towers*. Paper presented at the 70th Annual Scientific Meeting of the Aerospace Medical Association, Detroit, Michigan (1999).

[17] The "2-2-1" rotation is so named because it consists of two afternoon shifts, followed by two day shifts, followed by one midnight shift.

[18] D.I. Tepas and T.H. Monk, "Work Schedules." In G. Salvendy (Ed.), *Handbook of Human Factors.* New York, NY: John Wiley and Sons.

[19] The scientific literature on sleep and fatigue indicates that people need about 8 hours of sleep per night, on average, to feel adequately rested. Survey and sleep diary studies have indicated that average daily adult sleep length is about 7.5 hours, with a standard deviation of about 1 hour (W.B. Webb, "Sleep and Biological Rhythms," In W.B. Webb (Ed.), *Biological Rhythms, Sleep, and Performance*, New York, NY: John Wiley and Sons [1982]). Additional research has indicated that restriction of sleep to just 6 hours per night over multiple days reduces cognitive performance (H.P.A. Van Dongen, G. Maislin, et al, pp.117-126).

work schedules are likely reasons why controllers report sleeping an average of just 6.5 hours before day shifts and 2.3 hours before midnight shifts.[20]

Recent FAA Research on Controller Shift Work and Fatigue

In 1999, the FAA's Civil Aerospace Medical Institute (CAMI) began a congressionally mandated research program assessing air traffic controller shift work and fatigue.[21] The research program included a survey of controllers,[22] a field study conducted at two ATC facilities,[23] and a laboratory study of shift schedules.[24] The CAMI research supported previous findings on shift work, which have found disrupted sleep patterns from rapid shift rotations, an accumulation of sleep debt over the workweek, and decreased cognitive performance. Specifically, the research documented highest ratings of sleepiness, lowest mood, and poorest cognitive performance during midnight shifts and shifts with early morning start times. In addition, the controller survey documented widespread evidence of fatigue among shift-working controllers, with approximately 60 to 80 percent of controllers reporting that they had caught themselves about to doze off during early morning or midnight shifts; 66 to 79 percent of survey respondents reporting attention lapses while driving to work for early morning or midnight shifts; and 36 percent reporting that they had actually fallen asleep while driving to or from a midnight shift.[25]

In June 2000, CAMI researchers met with scientific and administrative advisory groups[26] to review the results of the research program and developed a list of four high-priority recommendations to address the problem of controller fatigue.[27] The administrative advisory group subsequently met with the FAA's associate administrator for air traffic and the NATCA National Executive Board in 2001 to brief them on the recommendations. Among the

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[20] P.S. Della Rocco and T.E. Nesthus, "Shift Work and Air Traffic Control: Transitioning Research Results to the Workforce." In B. Kirwan, M.D. Rodgers, and Dirk Schaefer (Eds.), *Human Factors Impacts In Air Traffic Management*. Aldershot, UK: Ashgate (2005).

[21] P.S. Della Rocco and T.E. Nesthus (2005).

[22] Federal Aviation Administration (2001). FAA Air Traffic Control Shift Work Survey Results (ATCS – Terminal and Enroute Issue). FAA Human Resources Organization (HumRRO).

[23] T.E. Nesthus, K. Holcomb, L. Dobbins, and J. Becker, "Comparisons of Sleep Duration, Subjective Fatigue, and Mood Among Four Air Traffic Control Shift Schedule Types," Aerospace Medical Association 73rd Annual Scientific Meeting, Montreal, Canada, May 6 to 9, 2002, Meeting Abstracts, p. 88.

[24] C. Cruz, C. Detwiler, T. Nesthus, and A. Boquest, "A Laboratory Comparison of Clockwise and Counter-Clockwise Rapidly Rotating Shift Schedules on Complex Task Performance," Aerospace Medical Association 73rd Annual Scientific Meeting, Montreal, Canada, May 6 to 9, 2002, Meeting Abstracts, p. 98.

[25] In addition, 48 percent of controllers who reported experiencing an operational error or deviation in the previous year said they believed that fatigue had contributed to their error.

[26] The scientific advisory group comprised Dr. Timothy Monk, Department of Neurology and Neuropsychology, University of Pittsburgh; Dr. Roger Rosa, National Institute of Occupational Safety and Health; Dr. Ron Heslegrave, St. Michael's Hospital, Toronto, Canada; Dr. Giovanni Costa, University of Verona, Italy; and Dr. Carlos Comperatore, U.S. Coast Guard Research and Development Center. The administrative advisory group consisted of representatives from FAA headquarters and field offices, the FAA Supervisors Committee, NATCA, and CAMI scientists.

[27] The four recommendations urged the FAA to disseminate the results of the shift-work survey to controllers; educate the workforce on shift work and fatigue; allow napping during break periods; and encourage facilities to review and improve work-scheduling practices at the local level.

recommendations urged by this group was that the FAA encourage its air traffic facilities to evaluate controller work schedules at the local level to identify opportunities to apply ergonomic principles identified in the CAMI research, such as providing longer rest periods, that could improve controller adaptation to shift work and reduce fatigue.[28] As of November 2006, the FAA had not initiated such evaluations.

All four controllers involved in the above-described incidents were working rapidly rotating counterclockwise shift schedules and had received scheduled rest periods of 9 hours or less before coming to work. In view of the high percentage of controllers who work such schedules and the CAMI research, the probability is very high that controllers are sometimes working when they are significantly fatigued and are committing fundamental errors directly as a result of being fatigued. However, little progress has been made to revise controller-scheduling policies and practices in light of the latest research findings on controller fatigue. The Safety Board is concerned that because of the lack of FAA action on this issue, controllers frequently operate in a fatigued state and that action needed now must go beyond simple evaluations. Because controller scheduling is accomplished in accordance with the collective bargaining agreement between the FAA and NATCA, progress in this area would likely benefit from the cooperative efforts of both parties. Therefore, the Board believes that the FAA should work with NATCA to reduce the potential for controller fatigue by revising controller work-scheduling policies and practices to provide rest periods that are long enough for controllers to obtain sufficient restorative sleep and by modifying shift rotations to minimize disrupted sleep patterns, accumulation of sleep debt, and decreased cognitive performance.

Awareness of Fatigue-Related Issues in the Air Traffic Organization

Two other recommendations presented by the FAA's administrative advisory group urged the FAA to disseminate the results of the controller survey and to educate the controller workforce on shift work, its effects on performance, and management of fatigue. In response to these internal recommendations, the FAA mailed the results of CAMI's controller shift-work and fatigue survey and an educational multimedia CD-ROM, titled "Shift Work Coping Strategies," to all FAA employees classified as ATC specialists in 2002.[29] Despite this effort, evidence obtained during recent investigations of air traffic incidents suggests that many personnel in the FAA's air traffic organization still lack awareness of fatigue-related issues. Many controllers interviewed by Safety Board investigators since 2004 did not recall receiving the materials disseminated in 2002, and few who did could recall their contents in detail. Poor recall of this information was not limited to controllers. In September 2006, the FAA's vice president for terminal services told Board investigators that he was not aware of FAA guidance for improving controller awareness of fatigue issues.[30] These statements suggest that the FAA's previous effort to educate the controller workforce on shift work and fatigue may have had little lasting impact.

[28] As described in Della Rocco and Nesthus (2005), such principles include minimizing exposure to midnight shifts, providing rest the day after midnight shifts, rotating shift start times in a clockwise rotation, providing long intervals between cycles (at least 2 days off), avoiding quick turnarounds with short rest periods, avoiding early morning start times, providing weekend days off, scheduling 8-hour shifts instead of longer 12-hour shifts, and providing predictability in scheduling for the employee.

[29] Della Rocco and Nesthus (2005).

[30] Interview with FAA vice president of terminal services was conducted on September 7, 2006.

This impression was corroborated during interviews with controllers and operational supervisors who were on duty during two additional 2006 runway incursions at ORD that are not described in detail in this letter.[31] Although these incidents were not attributed to fatigue, controllers were asked about fatigue because of the Safety Board's ongoing concern in this area. Their comments suggest that some air traffic personnel who are assigned to shift work may not view fatigue as a challenge that must be actively managed and may lack knowledge of fatigue-related issues.

One controller who committed an error that led to the first of the 2006 runway incursion events at ORD (on March 21, 2006) reported that, although he had been diagnosed with a sleep disorder 7 years before the incursion, he had discontinued the treatment prescribed by his doctor within 2 years because of side effects and had not sought further medical evaluation. When asked about controller awareness of fatigue-related issues, a supervisor on duty during the incident involving this controller said she did not know the extent to which controllers were aware of fatigue-related issues, that controllers did not discuss fatigue among themselves, and that they were "just used to being tired." A controller who was on duty during the second runway incursion at ORD (on July 23, 2006) was also asked about controller awareness of fatigue-related issues. He stated, "Recently, they mentioned something to us about [fatigue], but it's never been an issue." When queried about whether he felt fatigued during midnight shifts, the controller stated, "Yes, but not so where I can't do my job." A supervisor on duty during the same incursion incident commented, "controllers here don't think [fatigue] is a problem."

When faced with circadian disruption and short rest periods, it is essential that controllers use personal strategies to maximize restorative sleep and minimize fatigue.[32] However, some controllers may have personal habits that exacerbate the fatigue caused by shift work. For example, the controller involved in the March 23, 2006, runway incursion had only 9 hours off duty before reporting for the incident shift. He arrived home from his previous shift about 2200,[33] engaged in routine activities at home, fell asleep while watching television between 0100 and 0130, and slept only 4 hours before getting up to prepare for his next shift, which began at 0630. That he obtained only 4 hours of sleep before his next shift suggests that this controller may not have been using effective personal strategies to obtain adequate sleep. This practice may not be unusual. In fact, few controllers interviewed by the Safety Board during the investigation of recent runway incursions have reported using comprehensive personal strategies for maximizing restorative sleep between shifts.

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[31] Descriptions of these incidents, OPS06IA006 and OPS06IA008, can be found on the Safety Board's Web site at <http://www.ntsb.gov>.

[32] J.L. Caldwell, "Managing Sleep for Night Shifts Requires Personal Strategies," *Flight Safety Foundation: Human Factors & Aviation Medicine*, Vol. 46, No. 2 (1999): 1-11. Strategies commonly advocated by sleep and fatigue researchers include explaining to family and friends the importance of obtaining adequate sleep; scheduling adequate time for sleep; minimizing exposure to daytime circadian cues during rest periods; timing sleep onset to increase sleep duration; preparing a sleep environment that is well designed for sleep; taking measures to prevent sleep interruptions; using personal rituals as psychological cues to prepare the body for sleep; napping to supplement shortened sleep periods; timing the use of caffeine; and consulting with health professionals about medical or psychological conditions that interfere with sleep.

[33] This was the second shift of his workweek and the second consecutive evening shift.

The findings that controllers have minimal recollection of the FAA's previously disseminated fatigue-related information and poor awareness of fatigue-related issues and that they inconsistently apply personal strategies for maximizing restorative sleep suggest that safety could be improved by providing more intensive training to controllers on shift-work and fatigue-related issues. It is likely that involving NATCA in the development of such training would increase controller acceptance of the material. Therefore, the Safety Board believes that the FAA should develop a fatigue awareness and countermeasures training program for controllers and for personnel who are involved in the scheduling of controllers for operational duty that will address the incidence of fatigue in the controller workforce, causes of fatigue, effects of fatigue on controller performance and safety, and the importance of using personal strategies to minimize fatigue. This training should be provided in a format that promotes retention, and recurrent training should be provided at regular intervals.

In summary, the Safety Board remains concerned about the impact of fatigue on the performance of shift-working controllers and its impact on the safety of the NAS. Controller fatigue decreases aviation safety. FAA policies and controllers' off-duty habits can contribute to the problem. Although the FAA and other organizations have conducted a great deal of research on this issue resulting in an improved scientific understanding of the causes of fatigue, its effects on controller performance, and strategies for reducing controller fatigue, the FAA has been slow to change controller-scheduling practices. In addition, some personnel in the FAA's air traffic organization may lack knowledge and awareness of fatigue-related issues and may not realize the importance of using personal strategies for minimizing fatigue when assigned to shift work.

Therefore, the National Transportation Board makes the following recommendations:

—To the Federal Aviation Administration:

Work with the National Air Traffic Controllers Association to reduce the potential for controller fatigue by revising controller work-scheduling policies and practices to provide rest periods that are long enough for controllers to obtain sufficient restorative sleep and by modifying shift rotations to minimize disrupted sleep patterns, accumulation of sleep debt, and decreased cognitive performance. (A-07-30)

Develop a fatigue awareness and countermeasures training program for controllers and for personnel who are involved in the scheduling of controllers for operational duty that will address the incidence of fatigue in the controller workforce, causes of fatigue, effects of fatigue on controller performance and safety, and the importance of using personal strategies to minimize fatigue. This training should be provided in a format that promotes retention, and recurrent training should be provided at regular intervals. (A-07-31)

—To the National Air Traffic Controllers Association:

Work with the Federal Aviation Administration to reduce the potential for controller fatigue by revising controller work-scheduling policies and practices to provide rest periods that are long enough for controllers to obtain sufficient restorative sleep and by modifying shift rotations to minimize disrupted sleep patterns, accumulation of sleep debt, and decreased cognitive performance. (A-07-32)

Please refer to Safety Recommendations A-07-30 through -32 in your reply. If you need additional information, you may call (202) 314-6177.

Chairman ROSENKER, Vice Chairman SUMWALT, and Members HERSMAN, HIGGINS, and CHEALANDER concurred with these recommendations.

[*Original Signed*]

By: Mark V. Rosenker
Chairman