National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: August 7, 2009

In reply refer to: A-09-61 through -66

The Honorable J. Randolph Babbitt
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On February 13, 2008, a Bombardier CL-600-2B19, N651BR, operated by Mesa Airlines as *go!* flight 1002, flew past the destination airport, General Lyman Field, Hilo, Hawaii, after both the captain and first officer fell asleep during the flight. The pilots awoke and returned to General Lyman Field, where all 3 crew members and 40 passengers onboard deplaned safely. The airplane was not damaged. Visual meteorological conditions prevailed for the regularly scheduled commercial passenger flight, which was operating under the provisions of 14 *Code of Federal Regulations* (CFR) Part 121 on an instrument rules flight plan.[1]

The National Transportation Safety Board (NTSB) determined that the probable cause of this incident was the captain and first officer inadvertently falling asleep during the cruise phase of flight. Contributing to the incident were the captain's undiagnosed obstructive sleep apnea (OSA) and the flight crew’s recent work schedules, which included several consecutive days of early-morning start times.

Background

The flight departed Honolulu International Airport, Honolulu, Hawaii, about 0916 Hawaii standard time. About 0940, approximately halfway through the scheduled flight, the two pilots stopped responding to air traffic control (ATC) communications. For about the next 18 minutes, ATC attempted repeatedly to contact the pilots as the airplane continued on autopilot on a constant heading at cruising altitude. The airplane traveled 26 miles past the destination airport and continued southeast of the Hawaiian island chain before the flight crew resumed communications with ATC about 0958.

The captain and first officer both reported to their company that they had unintentionally fallen asleep in flight. The fact that both pilots fell asleep during the midmorning hours, a time of

[1] More information about this incident, SEA08IA080, is available on the National Transportation Safety Board’s website at <http://www.ntsb.gov/ntsb/query.asp>.

day normally associated with wakefulness and rising alertness, indicates that both pilots were fatigued.

While the pilots of flight 1002 were asleep, they were unable to monitor airplane systems, communicate with ATC, scan for potential traffic conflicts, or perform other routine flight-crew duties. This reduced the safety of the flight. Furthermore, although the incident ended without damage or injury, this outcome was dependent on two chance factors. First, the airplane was carrying a substantial amount of excess fuel: in addition to the fuel for the 51-minute flight to Hilo and the required 45-minute fuel reserve,[2] the airplane was loaded with fuel for a return flight to Honolulu, so that more than 1.5 hours of fuel remained when the pilots woke. If the airplane had not been carrying fuel for the return flight, it could have continued for only 22.5 minutes beyond the destination airport before risking fuel exhaustion during its return to land. Second, the flight crew fell asleep halfway through the 51-minute flight rather than later in the flight, and they slept 18 to 25 minutes; thus, they flew only 3 minutes beyond their destination and added just 8 minutes to the total duration of the flight. If the flight crew had fallen asleep later in the flight or remained asleep longer, that situation, too, may have led to the exhaustion of available fuel.

This incident is not an isolated occurrence. Researchers have found and pilots have reported other instances of professional pilots falling asleep on commercial flights. In 2005, for example, researchers measuring pilot brain activity on commercial flights documented 10 episodes of "unplanned sleep or reduced alertness" in 400 person hours of flight.[3] In addition, a search of the National Aeronautics and Space Administration's (NASA) Aviation Safety Reporting System (ASRS) database for the years 1995 to 2007 found reports of at least 17 crew-reported incidents of one or more flight crewmembers inadvertently falling asleep.[4] In five of these incidents, both pilots fell asleep.[5] Further, in a 1999 NASA survey of pilots at 26 regional airlines, 80 percent of respondents acknowledged having actually "nodded off" during a flight.[6] Survey respondents identified multiple flight segments and scheduling considerations as factors that contributed to fatigue.

Below are discussions and recommendations related to the fatiguing elements present in this incident: undiagnosed OSA in pilots and the uniquely fatiguing effects of short-haul operations on pilots.

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[2] According to 14 CFR 91.167, "Fuel requirements for flight in IFR [instrument flight rules] conditions," IFR flights are required to carry 45 minutes of minimum reserve fuel when good weather conditions are forecast for the destination airport.

[3] N. Wright and others, "Avoiding involuntary sleep during civil air operations: Validation of a wrist-worn alertness device," *Aviation, Space, and Environmental Medicine*, vol. 76, no. 9, (2005), pp. 847-56.

[4] The database was searched for the terms "fell asleep" and "dozed off." Only cases involving scheduled commercial flights conducted under 14 CFR Part 121 were included. Cases were reviewed individually to determine if they described a relevant episode.

[5] These incidents are described in ASRS report numbers 477544, 611329, 706956, 716338, and 738306.

[6] E.L. Co and others, *Crew Factors in Flight Operations XI: A Survey of Fatigue Factors in Regional Airline Operations*, NASA/TM Report no. 1999–208799. (Moffett Field, California: Ames Research Center, NASA 1999).

Screening for Sleep Disorders During Pilot Medical Certification

Three months after the incident involving flight 1002, the incident captain was diagnosed with severe OSA, a disorder in which an individual's airway is repeatedly blocked during sleep, usually by soft tissue collapsing at the back of the throat. Interruptions in breathing can last for many seconds and these, in turn, cause hypoxia, disturbed sleep architecture, and decrements in cognitive and psychomotor functioning. In addition to these problems, OSA is associated with an increased risk of aeromedically relevant medical conditions including stroke, heart failure, coronary artery disease, and diabetes. It is also associated with an increased risk of automobile accidents.[7] The most common symptoms reported by patients with OSA are excessive daytime sleepiness, memory impairment, and lack of concentration.[8] Another nearly universal symptom is loud nighttime snoring. Common physical findings associated with OSA include obesity and poorly controlled hypertension.

Before the flight 1002 incident, the captain was unaware of his OSA, but he did have several symptoms and conditions that could have identified him as at high risk for OSA during at least two medical examinations before the incident. The captain was experiencing excessive daytime sleepiness and loud nighttime snoring, was obese, with a body mass index[9] (BMI) of 32.1, and had hypertension that was not optimally controlled despite the use of two different blood pressure medications. As noted above, obesity and hypertension are strongly correlated with OSA. In one study, for example, more than 50 percent of a group of obese patients had OSA.[10] Another study found that 96 percent of male patients with resistant hypertension[11] had unsuspected OSA.[12]

In December 2007, the captain discussed his snoring with his primary care physician. The captain recalled that, apart from recommending appropriate sleep hygiene and weight loss, his physician did not suggest any further evaluation or treatment. The captain's risk for OSA was also not identified during an aviation medical examination he received on December 18, 2007.

If diagnosed, OSA can be effectively treated. The most effective approach involves the use of a continuous positive airway pressure (CPAP) device that is worn at night. The CPAP device delivers air pressure that forces the airway open when a person is sleeping. In some cases,

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[7] J. Teran-Santos, A. Jimenez-Gomez, and J. Cordero-Guevara, "The Association Between Sleep Apnea and the Risk of Traffic Accidents, Cooperative Group Burgos-Santander, *New England Journal of Medicine*, vol. 340, no. 11 (1999), pp. 847-51.

[8] L. Ferini-Strambi and others, "Cognitive Dysfunction in Patients with Obstructive Sleep Apnea (OSA): Partial Reversibility after Continuous Positive Airway Pressure (CPAP)," *Brain Research Bulletin*, vol. 61, no. 1 (2003), pp. 87-92.

[9] BMI is a person's weight in kilograms divided by their height in meters squared. An index of 30 or more is defined as obese by the National Institutes of Health.

[10] O. Resta and others, "Sleep-Related Breathing Disorders, Loud Snoring and Excessive Daytime Sleepiness in Obese Subjects," *International Journal of Obesity and Related Metabolic Disorders*, vol. 25, no. 5 (2001), pp. 669-75.

[11] Resistant hypertension was defined as high blood pressure that was poorly controlled despite the use of three or more antihypertensive agents.

[12] A.G. Logan and others, "High Prevalence of Unrecognized Sleep Apnea in Drug-Resistant Hypertension," *Journal of Hypertension*, vol. 19 (2001), pp. 2271–2277

surgery modifying an individual's anatomy to allow the airway to remain unobstructed during sleep might also be recommended. With treatment, sleep can be improved, and OSA symptoms reduced. Even cognitive effects associated with severe OSA can be at least partially reversed.[13] With treatment, it is likely that most civilian pilots with OSA could return to normal duty. Almost all U.S. Air Force pilots who have been diagnosed with OSA have received waivers for the disorder based on documentation of effective treatment.[14]

If a commercial pilot is diagnosed with OSA, the Federal Aviation Administration (FAA) *2006 Guide for Aviation Medical Examiners* states that an aviation medical examiner (AME) must "submit all pertinent medical information and current status report" and "include sleep study with a polysomnogram, use of medications and titration study [in which the optimal pressure for CPAP is identified] results." The guidance further notes that an initial special issuance[15] of a medical certificate for the disorder requires an FAA decision. Subsequent issuance of a medical certificate may be authorized through the AME if the applicant provides a report performed in the last 90 days from the treating physician that describes the present treatment and its effectiveness in eliminating or reducing symptoms, including daytime sleepiness. A maintenance of wakefulness test[16] is required if there is any question about compliance with or response to treatment, and the AME must defer the certification decision if the individual demonstrates sleep deficiency on a maintenance of wakefulness test, has developed an illness associated with OSA, or if there is doubt about compliance with or effectiveness of therapy.

Treatment can only begin, however, after diagnosis, and there is evidence that certificated commercial pilots are significantly underdiagnosed. Scientists have estimated that 7 percent of adults suffer from at least moderate OSA.[17] By contrast, records maintained by the FAA of certificated pilots document reported OSA in only 0.5 percent, 0.6 percent, and 0.3 percent for 1st, 2nd, and 3rd class medical certificate applicants, respectively.[18] The U.S. Air Force, by comparison, has diagnosed approximately 1 percent of its active pilot population with OSA,[19] about double the rate reported by civilian commercial pilots to the FAA. This difference is even

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[13] L. Ferini-Strambi L, pp. 87-92.

[14] Personal communication, Jeb S. Pickard, MD, U.S. Air Force School of Aerospace Medicine, with NTSB investigator, April 7, 2008.

[15] Under 14 CFR 67.401, an authorization for a special issuance of a medical certificate may be granted to a person who does not meet the medical standards if the person shows to the satisfaction of the federal air surgeon that the duties authorized by the class of medical certificate applied for can be performed without endangering public safety. The regulation notes that the federal air surgeon may limit the duration of an authorization; condition the granting of a new authorization on the results of subsequent medical tests, examinations, or evaluations; and include any operational limitation needed for safety.

[16] The maintenance of wakefulness test requires an individual to stay awake for a specified time (typically 20 or 40 minutes) in a dark quiet room.

[17] T. Young, P.E. Peppard, and D.J. Gottlieb, "Epidemiology of Obstructive Sleep Apnea: A Population Health Perspective," *American Journal of Respiratory and Critical Care Medicine*, vol. 165, no. 9 (2002), pp. 1217-39.

[18] Personal communication, Jerrod Epple, FAA Aerospace Medical Certification, AAM-300, with NTSB investigator, January 17, 2008.

[19] Personal communication, Jeb S. Pickard, MD, U.S. Air Force School of Aerospace Medicine, with NTSB investigator, April 7, 2008.

more significant when one considers that civilian pilots are more likely to have risk factors, such as obesity and hypertension than military pilots are, given military physical fitness requirements. Furthermore, a recent article in *Aviation, Space, and Environmental Medicine*, found that 15 to 24 percent of civilian pilots with a valid medical certificate can be classified as obese, a major risk factor for OSA.[20] All of these data suggest that the number of civil pilots reporting a history of OSA may not reflect the actual prevalence of OSA in the civil pilot population.

The FAA does not provide guidance to AMEs describing risk factors for OSA, nor does the FAA routinely use medical information (such as height, weight, and blood pressure) collected during certification examinations to screen for the possible presence of the disorder. Furthermore, the Application for Airman Medical Certificate asks applicants about their history of over 20 specific conditions or symptoms but does not specifically ask about a history of OSA or the presence of symptoms, such as snoring or excessive daytime sleepiness, related to OSA.

The NTSB has investigated accidents in all modes of passenger transportation involving operators with sleep disorders,[21] but the problem has usually received more attention in other modes than it has in aviation. A recent consensus statement on screening for OSA in commercial drivers, for example, recommended that drivers with a BMI of 35 or higher and hypertension that cannot be controlled with fewer than two medications should not be certified for longer than 3 months without a formal evaluation for OSA.[22] Furthermore, the Federal Motor Carrier Safety Administration (FMCSA) Medical Review Board recently recommended that the FMCSA require OSA screening for all drivers with a BMI over 30.

Except for the FAA, every U.S. Federal agency that oversees passenger transportation either gathers or plans to gather subjective information specific to OSA from transportation operators. FMCSA, for example, asks specifically about sleep disorders, apneas, daytime sleepiness, and snoring on its required forms. The U.S. Coast Guard is currently revising forms and guidance regarding medical certification, and its most recent draft of the medical examination form includes a specific question regarding OSA and questions on other sleep disorders. The Federal Railroad Administration is also working on new forms and guidance regarding medical certification, drafts of which include a specific question regarding sleep disorders, apneas, and snoring. Though the Federal Transit Administration does not set physical standards for transit operators, at least one transit agency, the Southeastern Pennsylvania Transportation Agency, has begun a test project to help screen operators for sleep disorders.

By contrast, the FAA is not yet formally considering such changes. Objective medical data already gathered by the FAA could be used to measure risk for OSA using existing

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[20] D.A. Bryman and W. Mills, "Co-morbid conditions in overweight and obese airmen: trends and aeromedical implications." *Aviation, Space, and Environmental Medicine*. vol. 78, no. 7 (2007), pp. 702-5.

[21] See, for instance, reports of NTSB investigations DCA95MM045 (marine), DCA02MR001 (rail), HWY00IH046 (highway), HWY04MH038 (highway), and CHI00LA076 (aviation).

[22] N. Hartenbaum and others, "Sleep Apnea and Commercial Motor Vehicle Operators: Statement from the Joint Task Force of the American College of Chest Physicians, American College of Occupational and Environmental Medicine, and the National Sleep Foundation," *Journal of Occupational and Environmental Medicine*, vol. 48, no. 9 (supplement) (2006), pp. S4-37.

consensus guidance on screening, but the most effective screening would require the FAA to gather additional information and develop additional guidance.

Because OSA is associated with excessive daytime fatigue, leads to an increased risk of accidents and cognitive impairment, substantially increases the likelihood of critical errors and of actually falling asleep during flight, and because many individuals who have the disorder do not know they have it, the NTSB concludes that efforts to identify and treat the disorder in commercial pilots could improve the safety of the traveling public. Therefore, the NTSB recommends that the FAA modify the Application for Airman Medical Certificate to elicit specific information about any previous diagnosis of OSA and about the presence of specific risk factors for that disorder. The NTSB further recommends that the FAA implement a program to identify pilots at high risk for OSA and require that those pilots provide evidence through the medical certification process of having been appropriately evaluated and, if treatment is needed, effectively treated for that disorder before being granted unrestricted medical certification. In addition, the NTSB recommends that the FAA develop and disseminate guidance for pilots, employers, and physicians regarding the identification and treatment of individuals at high risk of OSA, emphasizing that pilots who have OSA that is effectively treated are routinely approved for continued medical certification.

Research on Fatigue in Short-Haul Flight Operations

Pilots engaged in short-haul flight operations, such as those involved in this incident, face unique working conditions compared to pilots in other segments of the airline industry. These conditions can involve many legs flown in a single duty period, few breaks, and multiple consecutive days with early morning start times. Adequate consideration of the unique demands imposed on short-haul flight crews will be essential if the FAA is to develop effective strategies for reducing pilot fatigue in the U.S. airline industry.

One factor that contributes to self-reported pilot fatigue, especially in short-haul flight operations, is the number of legs flown in a duty period. According to a 2007 study of fatigue in short-haul operations, pilots who flew one leg in a duty period reported feeling "okay" near the end of a shift, whereas those who flew five legs reported minor to moderate fatigue.[23] Pilots who fly many short legs in a single duty period are exposed to more takeoffs and landings. Takeoffs and landings are high workload phases of flight, as evidenced by rapid heart rate and other measures.[24] Greater exposure to these high workload phases of flight, such as takeoff and landing, may explain why pilots who fly more legs in a single duty period feel more fatigued than those who fly fewer legs.

The NTSB was unable to identify any research documenting the effect of flying more than five legs in a single duty period on the fatigue and performance of airline pilots. The incident pilots, by comparison, routinely flew 8 legs in a duty period of slightly more than

[23] D.M.C. Powell and others, "Pilot fatigue in short-haul operations: Effects of number of sectors, duty length, and time of day," *Aviation, Space, and Environmental Medicine*, vol. 78, no. 7 (2007), pp. 698-701.

[24] H.P. Ruffell-Smith, "Heart rate of pilots flying aircraft on scheduled airline routes," *Aerospace Medicine*, vol. 38, no. 11 (1967), pp. 1117-9.

9 hours, with turnaround times averaging 17 minutes between flights.[25] Their schedule maximized time spent in high workload phases of flight, such as takeoffs and landings. In addition, a lack of breaks limited their opportunities to eat and attend to physiological needs, which could have interfered with their ability to obtain proper nutrition and avoid dehydration.

Adequate rest is another critical factor. The captain said he needed about 8 hours of sleep per night to feel rested. The first officer said he needed about 7.5 to 8 hours. The captain was not getting restful sleep due to OSA. Although the first officer did not report any health-related conditions or symptoms, when he was interviewed a week after the incident, he estimated that he had spent about 7 hours 25 minutes in bed the night before the incident, and about 6 hours 55 minutes in bed during each of the previous two nights. Thus, the first officer's self-reported sleep history indicated an accumulated sleep debt of between 1 hour 15 minutes and 2 hours 45 minutes in the 72 hours before the incident. The first officer's reduced sleep probably resulted from the flight crew's recent work schedule. For several days before the flight 1002 incident, the pilots' schedules required them to wake between 0400 and 0600, and the day of the incident was the third consecutive 0540 start time for both pilots.[26] Research evidence suggests that, based on his schedule, the first officer may have slept even less than he estimated.

It is well established that early-morning start times are associated with decreased sleep duration and increased fatigue. A 1998 North Atlantic Treaty Organization study found that pilots who were required to report for duty before 0600 slept less than 6 hours and had poorer quality sleep.[27] A 1998 NASA study found that short-haul pilots slept less, woke earlier, and had more difficulty falling asleep on trip days. Physiological monitoring devices indicated that the pilots slept an average of just 6.68 hours per night on trip days, significantly less than they obtained in the days before a trip and also less than the 8 hours that people need, on average, to sustain optimal alertness. Flight crews in the NASA study had difficulty compensating for early-morning start times by going to sleep earlier, probably because circadian rhythms tend to promote alertness within 2 hours of a person's habitual bedtime. A similar pattern has been observed for air traffic controllers. FAA researchers found that controllers assigned shifts starting before 0800 typically sleep 5 or 6 hours the night before. Even controllers who worked five consecutive early morning shifts slept an average of just 6 hours per night.[28] Reducing sleep to 6 or 7 hours per night for several consecutive nights can cause measurable decrements in cognitive performance.[29,30] It also reduces the time that is required to fall asleep during midmorning

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[25] This figure was calculated using flight data for the incident crew in the 72 hours before the incident.

[26] The incident occurred on the captain's fifth consecutive day of work, with start times ranging from 0540 to 0740 on those days. The incident occurred on the first officer's third consecutive day of work with a start time of 0540 that day. It was his fourth early morning in 5 days.

[27] M. Simons and P.J.L. Valk, "Early starts: Effects on sleep, alertness, and vigilance," Report *AGARD-CP-599*; (Neuilly-sur-Seine, France: NATO-AGARD, 1998), pp. 6/1-6/5.

[28] 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 D. Schaefer (Eds.), *Human Factors Impacts In Air Traffic Management*. (Aldershot, United Kingdon: Ashgate, 2005).

[29] H.P.A. Van Dongen and others, "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) pp. 117-126.

hours.[31] Because of evidence linking early morning start times with reduced sleep and fatigue, NASA and FAA researchers have recommended that schedulers minimize workers' exposure to early morning shifts.[32, 33]

According to the incident operator's managers, two types of shifts were commonly worked by pilots stationed in Kahului, Hawaii. One began at 0540 and ended about 1440. The other began at 1400 and ended about 2300. Pilot schedules were not arranged to minimize individual pilots' exposure to morning shifts, as recommended by researchers. Rather, schedules were arranged so that some weeks included mostly morning shifts and some included mostly afternoon shifts. As a result, some pilots were required to work five consecutive early morning shifts. These schedules are permitted under federal regulations because they provide a rest period of more than 14 hours between each shift and a daily flight time of less than 8 hours.

Federal regulations do not impose maximum daily limits on duty time in the scheduling of commercial pilots. Rather, they impose daily limits on flight hours, allowing two-person flight crews to be scheduled for up to 8 hours of flying per day, as detailed in 14 CFR 121.471, "Flight time limitations and rest requirements: All flight crewmembers." These flight-hour limits do not account for number of legs flown or duty start time, two characteristics of schedules that affect pilot fatigue. The regulations also do not specify maximum duty times, but they do specify that operators should provide flight crews a minimum rest period of 9 hours between duty periods, while allowing rest periods as short as 8 hours under some circumstances.

In 2004, the United Kingdom adopted new work limits for commercial pilots designed to account for fatigue-related scheduling characteristics. These new work limits imposed maximum daily duty times as a function of duty start time and the number of legs flown in a duty period. The maximum allowable duty period was reduced if a pilot began work before 0800, and it was reduced further if a pilot began work before 0600. Maximum duty time also varied according to the number of legs flown. A two-person crew that began work between 2200 and 0559, was assigned to fly one leg, and was acclimatized to the local time zone could be assigned a duty period as long as 11 hours, but a flight crew operating four or more legs could only be assigned a duty period of 9 hours. Furthermore, flight crews assigned several consecutive early morning shifts were limited to duty periods of 9 hours per day, regardless of the number of legs flown.[34] These work limits were designed with consideration for the unique and interacting effects on fatigue of duty start time, continuous hours of duty, and the number of legs flown.

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[30] G. Belenky and others, "Patterns of performance degradation and restoration during sleep restriction and subsequent recovery: a sleep dose-response study," *Journal of Sleep Research*, vol. 12 no. 1 (2003) pp. 1-12.

[31] Personal communication with George Belenky on October 9, 2008, with NTSB investigator regarding the research described in "Patterns of performance degradation and restoration during sleep restriction and subsequent recovery: a sleep dose-response study."

[32] P.H. Gander and others. "Flight crew fatigue II: Short-haul fixed-wing air transport operations," *Aviation, Space, and Environmental Medicine*, vol. 69, no. 9 (supplement) (1998) pp. B8-15.

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

[34] Civil Aviation Publication (CAP) 371, *The Avoidance of Fatigue in Aircrews: Guide to Requirements*, Section B (West Sussex, United Kingdom: United Kingdom Civil Aviation Authority, 2004).

It is unclear whether the incident crew's schedule would have been permitted under the United Kingdom's new regulations. Flight crews at *go!* Airlines working the morning shift were assigned 9-hour duty periods, which was the maximum duty period that would have been permitted under the United Kingdom regulations. However, the incident flight crewmembers' recent work history suggests that their actual duty times were typically longer than 9 hours.

The NTSB has had longstanding concerns about human fatigue causing or contributing to aviation accidents and/or incidents. Since 1972, the NTSB has issued 115 human fatigue-related safety recommendations in all modes of transportation, including 32 recommendations addressing fatigue in aviation and 4 intermodal recommendations. The NTSB has included safety recommendations related to human fatigue in transport operations on its annual Most Wanted List of Transportation Safety Improvements since the list's inception in 1990. The Most Wanted List currently has seven aviation fatigue-related recommendations: three concerning flight crews, three concerning air traffic controllers, and one concerning maintenance personnel.[35]

Since 1989, the NTSB has highlighted the need to change flight and duty time regulations to reduce fatigue in commercial flight operations. The NTSB's most recent recommendation in this area was issued after a 2004 accident involving Corporate Airlines flight 5966, when a BAE Systems BAE-J3201 struck trees on final approach to Kirksville Regional Airport. In Safety Recommendation A-06-10, the NTSB recommended that the FAA modify and simplify flight crew hours-of-service regulations.[36] The FAA has not yet committed to changing existing hours-of-service regulations, and this recommendation is currently classified "Open—Unacceptable Response."

In 2007, the FAA stated that it is working with the International Civil Aviation Organization to develop standards for fatigue risk management systems, under which operators use a tailored approach to reduce fatigue.[37] The FAA has not yet published specific guidance regarding the development, implementation, and evaluation of fatigue management systems, but several U.S. operators have suggested that they are developing such systems, and at least one operator has voluntarily implemented such a system on a trial basis. These systems would not replace the need for duty-time limits; rather, together with such limits, fatigue management systems would further reduce the risk of fatigue-related accidents.

On June 12, 2008, the NTSB issued Safety Recommendation A-08-44 to the FAA, asking it to develop guidance based on empirical and scientific evidence for operators regarding the establishment of fatigue management systems. As of February 2009, the FAA had collected data on ultra-long-haul range flight operations to support the development of guidance for fatigue management, but it had not yet collected similar data for short-haul flight operations. Although flight crew fatigue is common in long-haul flights, especially those that are operated at night or

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[35] For more about these fatigue-related recommendations, see the Most Wanted Transportation Safety Improvements fact sheet on "Reduce Accidents and Incidents Caused by Human Fatigue in the Aviation Industry," online at <http://www.ntsb.gov/Recs/mostwanted/aviation_reduce_acc_inc_humanfatig.htm>.

[36] *Crash Short of the Runway, Corporate Airlines Flight 5966, British Aerospace BAE-J3201, Kirksville, Missouri, October 19, 2004*, Aircraft Accident Report NTSB/AAR-06/01 (Washington, DC: NTSB, 2006).

[37] For more about the status of this recommendation, see the NTSB Safety Recommendation database, online at <http://www.ntsb.gov/safetyrecs/private/QueryPage.aspx>.

that cross multiple time zones, the incident involving flight 1002 demonstrates that fatigue can also affect flight crews engaged in daytime short-haul flying and that this fatigue can affect safety. The NTSB's investigation of this incident suggests that short-haul pilots can face unique schedule-related challenges, including a high number of flights in a single duty period and multiple consecutive early-morning starts. Although research suggests that duty start time, the number of legs flown in a duty period, and continuous hours of duty are related to fatigue, the effects of these scheduling characteristics are not well understood. In fact, the NTSB was unable to identify any published research examining the independent and interactive effects of these three scheduling variables for commercial pilots who operate transport-category, fixed-wing airplanes for more than five flights in a single duty period like the pilots at *go!* Airlines did.

Adequate research is essential to identify needed revisions to existing scheduling regulations and guidance for short-haul operations. Therefore, the NTSB recommends that the FAA conduct research examining how pilot fatigue is affected by the unique characteristics of short-haul operations and identify methods for reducing those effects; include research into the interactive effects of shift timing, consecutive days of work, number of legs flown, and the availability of rest breaks. The NTSB further recommends that the FAA issue interim guidance, such as an advisory circular, that provides operators of multisegment, short-haul flights with the relevant safety information as it becomes available during the research requested in Safety Recommendation A-09-64. When the research is completed, the NTSB recommends that the FAA require operators of short-haul, multisegment flights to incorporate the guidance requested in Safety Recommendation A-9-65 into their operating specifications to reflect the unique crew fatigue characteristics of these operators.

Recommendations

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Modify the Application for Airman Medical Certificate to elicit specific information about any previous diagnosis of obstructive sleep apnea and about the presence of specific risk factors for that disorder. (A-09-61)
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> Implement a program to identify pilots at high risk for obstructive sleep apnea and require that those pilots provide evidence through the medical certification process of having been appropriately evaluated and, if treatment is needed, effectively treated for that disorder before being granted unrestricted medical certification. (A-09-62)
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> Develop and disseminate guidance for pilots, employers, and physicians regarding the identification and treatment of individuals at high risk of obstructive sleep apnea, emphasizing that pilots who have obstructive sleep apnea that is effectively treated are routinely approved for continued medical certification. (A-09-63)
>
> Conduct research examining how pilot fatigue is affected by the unique characteristics of short-haul operations and identify methods for reducing those effects; include research into the interactive effects of shift timing, consecutive days of work, number of legs flown, and the availability of rest breaks. (A-09-64)

> Issue interim guidance, such as an advisory circular, that provides operators of multisegment, short-haul flights with the relevant safety information as it becomes available during the research requested in Safety Recommendation A-09-64. (A-09-65)
>
> When the research requested in Safety Recommendation A-09-64 is completed, require operators of short-haul, multisegment flights to incorporate the guidance requested in Safety Recommendation A-09-65 into their operating specifications to reflect the unique crew fatigue characteristics of these operators. (A-09-66)

In response to the recommendations in this letter, please refer to Safety Recommendations A-09-61 through A-09-66. If you would like to submit your response electronically rather than in hard copy, you may send it to the following e-mail address: correspondence@ntsb.gov. If your response includes attachments that exceed 5 megabytes, please e-mail us asking for instructions on how to use our Tumbleweed secure mailbox procedures. To avoid confusion, please use only one method of submission (that is, do not submit both an electronic copy and a hard copy of the same response letter).

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

[Original Signed]

By: Deborah A.P. Hersman
Chairman