

Slowly but surely, operators and regulators are implementing programs to prevent fatigue among aviation maintenance personnel.

BY LINDA WERFELMAN

WORKING to the Limit

Although aviation maintenance personnel typically work long hours, often at night, they rarely are included in aviation industry programs to fight fatigue. Duty time limits and other efforts to address fatigue typically are intended for flight crews — not maintenance personnel.

Nevertheless, in recent years, some civil aviation authorities and operators have taken steps to ensure that maintenance personnel are not pushed beyond their limits.

The International Civil Aviation Organization (ICAO), in its 2003 manual for maintenance human factors, said that fatigue among aviation maintenance personnel has resulted from “excessive hours of work, poor planning, insufficient staff, bad shift scheduling and a working environment with no proper control of temperature, humidity or noise.”¹

Although fatigue among maintenance personnel has not specifically been cited as a cause of a major accident, on several occasions, maintenance work “performed at night by staff who may have been affected by fatigue or lack of sleep” has been identified as a causal factor, ICAO said.

For example, ICAO cited a June 10, 1990, incident in which the left windshield of a British Airways BAC 1-11 blew out as the airplane was climbing through 17,300 ft after departure from Birmingham International Airport in England. The commander was drawn halfway out of the opening and held there by cabin crewmembers until the first officer landed the airplane in Southampton. Investigators said that maintenance personnel who had replaced the windshield the night before had used bolts that were not the size specified. The U.K. Air Accidents Investigation Branch (AAIB) said in its final report that several human factors issues had contributed to the incident, including “circadian effects” — biological patterns that influence the time of day when the body is programmed to sleep — on maintenance personnel.

Fatigue also contributes to non-reportable incidents, and ICAO cited the case of one unidentified operator of a fleet of 12 aircraft that experienced extensive structural damage to one aircraft because of incorrect jacking procedures, extensive structural damage to two aircraft because of a towing collision, and serious injuries to three maintenance technicians because of a traffic accident that occurred as they drove home after a



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long shift at work (see “Fighting Fatigue-Related Errors,” p. 17).

Studies conducted for several civil aviation authorities and accident investigation bureaus have identified fatigue as a significant problem for aviation maintenance personnel.

One study, a U.S. Federal Aviation Administration (FAA) survey of maintenance human factors programs worldwide, found that of 414 survey respondents, 82 percent said that fatigue is a safety issue in aviation maintenance. Only 36 percent said that fatigue was

addressed in their training programs, however, and only 25 percent said they had a fatigue management system.²

“The discontinuity between recognizing the fatigue threat and establishing barriers is alarming,” two of the study’s authors said. (ASW, 3/08, p. 34–40).

Half of the 1,209 AMEs responding to questionnaires believed that overtime worked during night shifts “had a strong negative effect on their work.”

Another study, conducted in 2002 for Transport Canada (TC), found that aviation maintenance engineers (AMEs) were working an average of more than 50 hours a week, often in 12-hour shifts “with very few days off for recovery.” A significant number of AMEs worked during their days off, either putting in overtime or working extra shifts for another employer, the study said. In addition, the study found that half of the 1,209 AMEs responding to questionnaires believed that overtime worked during night shifts “had a strong negative effect on their work.”³

The U.K. Civil Aviation Authority (CAA) also recognized the adverse effects of tiredness and fatigue. In an airworthiness notice discussing “personal responsibility when medically unfit,” the CAA said that individual maintenance personnel “should be fully aware of the dangers of impaired performance due to these factors and of their personal responsibilities.”⁴

ICAO, citing various human factors guides, said that although individuals are responsible for “sensible” sleep habits, “management and local supervision ... have a responsibility to control shifts, breaks, duty periods and overtime to minimize fatigue.”

The most straightforward approach is a strict limit on the number of hours worked, said Darol V. Holsman, FSF manager of aviation safety audits. During evaluations of corporate operations, he always recommends a fatigue management policy and always says the best policy is a 12-hour duty-time limit.

“This is one of the human factors issues that should be considered by every operator,” Holsman said.

Nevertheless, his estimate is that less than 10 percent of corporate operators have duty-time limits — the limit most often is 12 hours, but some operators establish 14-hour limits — or fatigue management programs. These limits have been implemented within the last three or four years, Holsman said, noting that when he began auditing in 2000, he never found a corporate operation that limited duty time for its maintenance personnel.

The reason for the low percentage is tradition, he said.

“It’s always been this way,” he said. “If there’s work that needs doing, the expectation — of managers and the technicians themselves — is that they’ll be out doing it. The technicians are sometimes their own worst enemy; they willingly do what’s expected.”

Often, the problem is complicated by sporadic work hours; many operators tell mechanics that when there’s no flying activity, there’s no reason for them to report to work. “The thinking is that if they work only a few hours one week, then the next week they should be able to work long hours if necessary,” Holsman said. “But this still doesn’t relieve the responsibility of management to limit duty hours.”

Despite the willingness of most maintenance personnel to work long hours to meet those expectations, some also tell stories of falling asleep while working on an airplane, he said.



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A few operators and regulatory authorities have rejected duty-time limits in favor of a fatigue risk management system (FRMS), designed to detect behavior related to fatigue and, by doing so, to prevent fatigue-related incidents.

Drew Dawson, director of the Centre for Sleep Research at the University of South Australia, said that FRMS requires consideration of five major levels: “sleep opportunity or average sleep obtained across the organization, actual sleep obtained by individual employees, presence of fatigue-related behavior, occurrence of fatigue-related errors and occurrence of a fatigue-related accident or incident.” In an effective FRMS, all five levels are addressed with organized defense systems.⁵

In most cases, FRMS has thus far been applied only to flight crews, but a Canadian initiative aims to incorporate FRMS for both flight crews and maintenance personnel as a mandatory portion of an operator’s safety management system (SMS). At press time, the FRMS notice of proposed amendments to the Canadian Aviation Regulations was being reviewed by the Department of Justice; the requirements were expected to take effect for aviation maintenance organizations (AMOs) in March 2009, said Jacqueline Booth-Bourdeau, chief of technical and national programs for TC.

“The implementation of an FRMS is an extension to this [SMS] approach in that it requires operators to implement robust management systems for identifying fatigue-related hazards and managing the related risks,” Booth-Bourdeau said. “The FRMS approach clearly establishes the accountabilities at the management and employee levels for fatigue-related issues.”

To aid the industry, TC developed an FRMS toolbox, a collection of policy

Fighting Fatigue-Related Errors

Human factors guides recommend a variety of actions to prevent aviation maintenance errors that stem from fatigue. For example, the International Civil Aviation Organization, in its *Human Factors Guide for Aircraft Maintenance Manual*, recommends the following:

- Because tools and parts can obstruct flight controls if they are left in an aircraft after maintenance, a box or shadow board for wrenches, screwdrivers and other hand tools should bear contrasting-color outlines of each tool to provide a cue if it is not replaced;
- Hand tools that are the personal property of a maintenance technician should be marked, and checklists should be used for each technician’s toolbox before an aircraft is released for return to service;
- When maintenance personnel take possession of company-owned tools, a loan system using personal “tool checks” or electronic card controls should be used to identify the person who has possession;
- “Loose-object” inspections should be conducted before final panel closures;
- To limit interruptions, people not involved with maintenance on a specific aircraft should be excluded from the area, unless they have the permission of a supervisor, and only those not working on the aircraft should answer telephone calls; and,
- To avert cross-connections of wiring or plumbing, parts should be color-coded as they are disassembled; to identify cross-connections, functional testing should be conducted any time wiring or plumbing is disturbed. Any instances of cross-connection should be reported to the regulatory body and the type certificate holder.

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templates, training materials and other approved methodologies for FRMS implementation. The topics covered in the toolbox’s training information for employees include how to obtain sufficient rest, manage fatigue and recognize fatigue symptoms in themselves and others. Management materials discuss the implementation process and how to provide sufficient rest; investigate fatigue-related errors, incidents and accidents; and conduct FRMS audits.⁶

A planned implementation trial, using the toolbox, was canceled because of a change in management at the participating airline, Booth-Bourdeau said.

In Australia, the Civil Aviation Safety Authority (CASA) also is moving

toward implementation of FRMS in aviation maintenance.

The CASA maintenance regulations project team said that, although FRMS is not mandatory for aviation maintenance personnel, “CASA is convinced that [it] is necessary and is initiating its design and formulating requirements for implementation.

“Safety outcome-based legislation being developed will place the onus on an employing organization to ensure that there are systems in place to ‘preclude an employee from fulfilling any maintenance action where the employee’s capability to do it is impaired.’”

The regulation will be accompanied by an Acceptable Means of Compliance,

“which will describe how an organization may meet the requirements of the regulation, with a range of options dependent on the size of the organization and the nature of the maintenance to be conducted,” the project team said. Maintenance organizations will be required to submit written plans explaining how they will comply with FRMS requirements.

The team said that CASA plans to establish a group including representatives of CASA, AMOs and employee associations to “formulate a way forward” in development of detailed FRMS policies.

Some operators and AMOs have implemented fatigue management programs — sometimes through labor agreements — even without a regulatory requirement to do so.

In Canada, for example, provincial governments limit hours for workers of all types, although they also establish provisions that allow the limits to be exceeded. In addition, some operators, usually smaller organizations, limit work hours to a single eight-hour daytime shift in what is essentially a form of FRMS, Booth-Bourdeau said.

In the United States, the National Transportation Safety Board (NTSB) has for years urged the FAA to limit work hours for maintenance personnel and others in the aviation industry “based on fatigue research, circadian rhythms, and sleep and rest requirements.” A recommendation was added in 1999 to the NTSB’s annual “most wanted” list of safety improvements, specifically calling for a review of fatigue in aviation maintenance and the subsequent establishment of duty time limitations “consistent with the current state of scientific knowledge for personnel who perform maintenance on air carrier aircraft.”⁷

The NTSB said that it disagrees with the FAA’s position that regulatory

action is not appropriate, and said that Advisory Circular 120–72, *Maintenance Resource Management (MRM) Training* — characterized by the FAA as a focus of its fatigue education and training efforts for aviation maintenance personnel — in fact contains “little ... guidance on human fatigue in maintenance crews other than generalized warnings that attention to fatigue is important and should be considered in MRM training.”

However, the FAA has emphasized, as Deputy Associate Administrator for Aviation Safety Peggy Gilligan told a congressional subcommittee in June 2007, that fatigue research by the FAA and others has shown that fatigue “does not easily lend itself to a set of prescriptive rules.” As a result, she said that, in the future, fatigue risk management will become increasingly important.⁸

The FAA and other proponents of FRMS say that rules to limit work hours are not enough to combat fatigue.

The University of South Australia’s Dawson said that, increasingly, sleep specialists believe that traditional duty-time limits “may not be the most appropriate or only way to manage fatigue-related risk.”⁹

“The assumption is that compliance with the limits on working hours is evidence that an individual is adequately rested and fit for work and will not make any fatigue-related errors,” Dawson said. Nevertheless, “any hazard has multiple causes and should thus be managed using multiple overlapping defenses.” ●

Notes

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