The International Federation of Air Line Pilots' Associations
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The Global Voice of Pilots

23 May 2006

To All IFALPA Member Associations

Dear Colleagues:

INDUSTRY GUIDANCE MATERIAL AND REGULATORY OVERSIGHT OF ULTRA LONG-RANGE (ULR) OPERATIONS

Ultra-long-range (ULR) flight operations have become a reality with the recent introduction of new aircraft that are capable of flying non-stop half way around the world, with block times greater than 16 hours and flight-duty periods from 18 to 22 hours. By introducing daily flights between Singapore and New York, which average 18.5 flight hours per leg, Singapore Airlines has shown that ULR operations can be safely flown by following the recommended operational guidelines developed by the Flight Safety Foundation in conjunction with aviation experts from around the world, including representatives from IFALPA.

The increased flight times associated with ULR flights exceed traditional prescriptive flight and duty time limitations used in current long-range operations and present new challenges for maintaining crew alertness and preventing excessive fatigue during ULR flights. Preventing degradation of crew alertness and performance during ULR flights involves issues beyond simply managing fatigue as practiced in current long-range operations.

From the outset it was recognized that these much longer flight operations would present unique challenges to ensure that crew alertness was maintained at adequate levels comparable to current non-ULR flights. Further, maintenance of crew alertness and performance was considered essential to assure that safety standards did not decline as flight times became progressively longer.

Recognizing the challenges involved in ULR operations, the Flight Safety Foundation in conjunction with other industry participants sponsored a series of international workshops designed to develop guidance and recommendations for industry in advance of ULR operations being introduced. The aim was to be proactive in examining issues that were expected to arise, and provide guidance material to address these issues by way of discussion groups of industry stakeholders including regulators, operators, manufacturers, scientists, and pilots.

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IFALPA urges the promotion and adoption of the Flight Safety Foundation ULR Crew Alertness Steering Committee recommendations and guidance material to all regulatory agencies that will be providing the oversight that is necessary to maintain existing standards of safety during these longer range operations. A cautious approach is warranted until such time as a sufficient body of information is available from which to make more specific conclusions. It is essential that ULR operations are carefully monitored from the outset, with appropriate regulatory oversight both initially and over longer periods to ensure safety standards are maintained. IFALPA policy regarding Ultra Long Range (ULR) Operations can be found in Attachment J of the IFALPA Industrial Manual.

On behalf of the International Federation of Airline Pilots' Associations, I attach the guidance material developed by the Flight Safety Foundation ULR Crew Alertness Steering Committee for your consideration and application in ULR operations for those pilots from your Member Association that are engaged in these operations.

Yours sincerely,

Dennis J. Dolan

Captain Dennis J Dolan
President

Attachment 1: Ultra-long-range Crew Alertness Initiative Recommended Guidelines

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Flight Safety Digest
Vol. 24 No. 8–9 August–September 2005
Lessons from the Dawn of Ultra-long-range Flight

Appendix A

Ultra-long-range Crew Alertness Initiative — Recommended Guidelines

The Ultra-long-range (ULR) Crew Alertness Steering Committee's[1] recommended guidelines are based on a fatigue risk management system (FRMS) methodology for addressing crew alertness in planning and conducting commercial flight operations (see "Fatigue Risk Management System Helps Ensure Crew Alertness, Performance," page 16 of the FSF Digest August / September 2005, available on the FSF website).

Operational Best Practices

Assumption: ULR operations consist of out-and-back flights between an approved city pair using a specific aircraft type with a defined departure window.[2]

Crewing

• Flight crew complement:

– For initial operations between a city pair, the number of flight crewmembers required would need to be assessed using the best scientific means available at the time and industry operational experience. Following this assessment, if there is a discrepancy between the two recommendations, adopting the higher crew complement would represent best practice.
– During the initial operations, a validation of the crew complement should be carried out.
This validation should consist of a scientific assessment of crew alertness level, confidential crew reporting and any other evidence-based means available (e.g., flight data monitoring [FDM],[3] line operations safety audit [LOSA],[4] etc.).
–If the validation fails to support the original assessment, a review should be undertaken.

• Flight crew qualifications:

– Best practice suggests that ULR flight crews should have adequate operational experience, including previous long-range flights.
– For ULR operations, the flight crew complement will not be less than four pilots, two of whom should hold pilot-in-command qualifications and four of whom should be qualified for the takeoff and landing phases of flight. The hierarchy should be established at the rostering/scheduling stage and should be promulgated by the flight crew. A crewmember qualified as pilot-in-command should be at the controls at all times. Any assigned pilots who are not takeoff-and-landing qualified should be trained to support the command qualified pilot in conducting landings and emergency procedures, including pilot incapacitation and emergency evacuation.

Education

• Regulatory authorities should require the operator to provide appropriate education to ground staff and flying staff associated with ULR operations. This should include, but not be limited to, management, flight crew, cabin crew, scheduling and rostering staff, dispatchers (as appropriate), operational control staff, and airline medical service providers. Training should be tailored to the job description, using modular content for different audiences, and should be evaluated as ULR experience is gained.

• Curricula should include, but not be limited to, the following topics:

– Consequences of fatigue on aviation safety;
– Confidential feedback from incidents;
– Recognition of signs of fatigue and decreased alertness in self and others;
– Physiology of sleep;
– Circadian rhythms;
– Homeostatic process;
– Sleep and alertness strategies;
– Diet and hydration;
– Prescription and non-prescription medication, plus related regulatory policies;
– In-flight environment;
– Work scheduling; and,
– Crew coordination to address sleep inertia after in-flight rest.

Delays and Disruptions

• The approval for ULR operations should include a maximum departure delay after scheduled time of departure as a limit. The allowable delay time is ULR city-pair-dependent and may be different for the home base and the outstation, and for different city pairs. The proposed departure time window should be designed to cover the approved delay time and to allow for flexibility in the event of rescheduling while ensuring that a crew is rested. Caution is required to avoid the “creeping-delay” effect.

• As part of the ULR city-pair approval, regulatory authorities should require operators to demonstrate plans to cope with delays and disruptions, including diversions.

• A diversion may result in reversion from the flight and duty time limitations of ULR flight to those of long-range flight. The operator should conduct risk assessment on possible alternate airports during initial ULR planning, to include seasonal weather (e.g., snow), air traffic management, local area issues (e.g., terrain, local wind effects, wind shear) and specific training for some diversion airports. Pilots, schedulers, operational managers and non operational managers should receive risk-assessment training for ULR flights to include unusual situations, diversions, change of flight operations (e.g., ULR flight to long-range flight) after an en route technical stop — including support/assistance/advice to pilots from the home base.

• The pilot-in-command has the final authority for any variation from the ULR scheduled duty. After consulting with all operating crewmembers, the pilot-in-command should assess crew fatigue levels to determine whether the flight can be conducted safely.

Standby

• Regulatory authorities should require the operator to demonstrate that its standby activation system will ensure that a crewmember assigned to ULR duty from standby status will have fulfilled the pre-ULR rest requirements.

• ULR operations may require a dedicated standby system with crewmembers aware of the potential ULR assignment.

• Early notification of in-flight rest allocation is desirable.

In-flight Environment

• Rest:
– Regulatory authorities should require the operator to demonstrate that the crew-rest facilities are sufficient to provide adequate rest opportunity in order to ensure that pilot alertness is maintained at an acceptable level. Preferably, these should include both an acceptable sleeping surface and the provision of a comfortable reclining seat for non-sleeping rest. Ideally, each resting pilot should have an individual sleeping compartment with facilities available to enable him or her to have a choice of a comfortable reclining seat or sleeping surface at all times. These facilities should be separated from the flight deck and not be positioned in the passenger cabin.
– Comment: It is assumed that the design requirements for the crew-rest facilities will be covered under a separate document (e.g., advisory circular).

The following factors should be considered, as well as other sleep/rest-related requirements:
• Noise levels;
• Space for changing into and out of uniform/sleep suit;
• Reading lights;
• Ventilation, temperature and humidity controls;
• Alert systems and a communication system to the flight deck and passenger cabin; and,
• In-flight entertainment and other passenger-cabin provisions.
• Lavatories:
– There should be a lavatory dedicated for flight crew use within a secure area and accessible from the flight deck.
• Flight deck environment:
– Due consideration should be given by operators to encourage manufacturers to continue improving flight deck ergonomic design aspects to assist in reducing stress and fatigue levels. Examples could include comfortable seating, suitable lighting, adequate provision of sunshades on all windows (to limit sunlight and heat), noise management, humidification and appropriate alert systems.

Rostering Practices

• ULR operating pattern (including flights and layovers) — The build of a ULR pattern should:
– Provide adequate pre-flight sleep opportunities (preferably, a period of rest that affords two major sleep opportunities) so that it is possible for crewmembers to be fully rested prior to departure;
– Ensure that the layover provides an adequate sleep opportunity (preferably, two sleep opportunities) so the crewmembers are adequately rested for the return flight;
– Provide adequate recovery time after the pattern to allow for physiological recovery from the trip;
– Provide reasonable additional time off for normal social interaction; and,
  – The recovery time should not be used as pre-ULR rest requirements.

• In-flight rest:
– Regulators should ensure that operators have a responsible scheme for in-flight rest planning.
– Operators should provide guidance to crew for in-flight rest planning.
– This information should be tailored for the specific flight pattern.
– Crews should be given adequate prior notification of their allocated in-flight rest period.
– Although pre-programmed rest periods are highly desirable, the crew should have the flexibility to alter the plan, if needed, once aboard the airplane.
– Guidance should be provided on how to manage crew change/handover procedures following a rest period. The implications of sleep inertia should be emphasized.
  – Cockpit napping (or controlled rest on the flight deck) can provide effective short-term recuperation but should be used cautiously and not as a replacement for planned rest in a bunk or to extend approved duty times.

• Scheduling of ULR trips:
– Positioning is considered duty and may not be part of a pre-ULR rest period.
– A ULR flight duty period may not be combined with other duties in a single duty period (e.g., simulator sessions, recovery days, office work or other flights).

Go/No-go

• Operators should provide the crew with suitable go/no-go guidance material affecting crew performance with regard to crew alertness and/or rest facilities on:
– Minimum equipment list (MEL) provisions;
– Delays;
– Disruptions;
– Diversions; and,
– Any other areas that may affect crew alertness.

Operational Validation Programs

Overview of the Validation Process

• Before initiation of ULR operations, a steering committee composed of representatives from the operator, pilots' group and regulators must be established and define the validation plan (Figure 1). The assistance of a subject matter expert (SME) may be required. The steering committee will select an "independent" scientific organization to assist in the data collection, analysis and recommendations. The SME should be from a different organization than the scientific group conducting the validation.

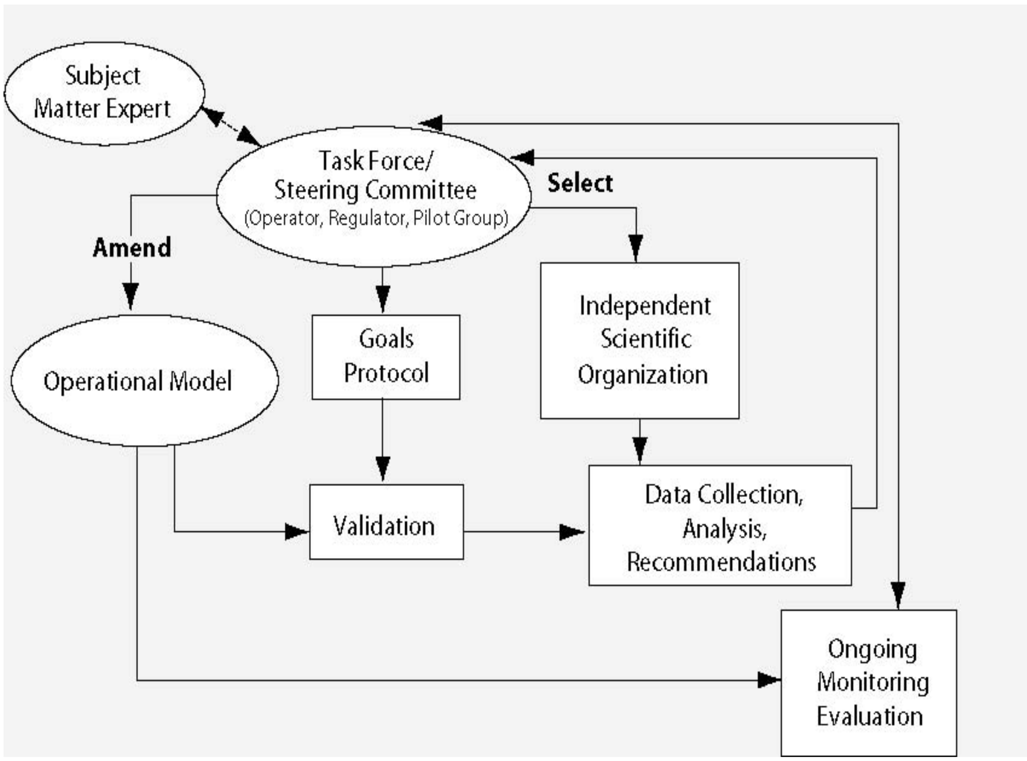

Figure 1

• Validation is required from the commencement of ULR flights and should be conducted in two phases; initial validation and ongoing monitoring.
The initial validation should be sufficiently rigorous to ensure operational safety equivalent to, or better than, that in current long range operations.

• As a result of initial validation, the operational model may then be adjusted as required, and ongoing monitoring will continue to take place.

What Should Be Validated?

• Validate the ULR operational model to include validation of the agreed assumptions upon which the ULR approval is based. For example, this includes variables such as the city pairs, aircraft types, departure windows, routing, pre-ULR rest, post-ULR rest, crew complement, in-flight rest strategy, rest rostering in flight, etc.

• The objective is to determine whether the level of flight crew performance/ alertness and safety is equivalent to or better than that existing in current long-range operations.

When Validation Should Take Place

• Initially, at launch of operations;
• Continuous monitoring is required;
• Specific validation may be required; and,
• Any change to the ULR operational model.
The recommendation is that the steering committee will, in each case, assess any change to the ULR operational model and decide whether some type of validation is needed for that particular change.

Triggers for Reassessment

• The primary triggers requiring reassessment by the steering committee are changes to city pair, departure time window, time zone or aircraft type.
• These secondary triggers also should be considered:
– Crew demographic change (e.g., age distribution, gender distribution, etc.);
– Crew base change; and,
– Same city pairs, but route change.

Validation Metrics

• Initial validation must include both subjective measures and objective measures, using a combination of the following methods:
– Sleep: sleep diaries (subjective), Actiwatches[5] with diaries (objective), polysomnography[6] (objective);
– Alertness: subjective rating scales, electroencephalography (EEG)/electrooculography (EOG) (objective); and,
– Performance: subjective rating scale, reaction time tests (objective), other cognitive tasks (objective).
• Ongoing monitoring may include some of the methods listed above in addition to normal processes as adopted by the operators (e.g., FDM, LOSA, crew reports, air safety reports, etc.), regulatory feedback and/or confidential reporting.

Global Regulatory Approach

Regulatory Requirements:

To be granted approval to conduct ULR operations, an operator must comply with the following minimum requirements:

• Submit to the applicable civil aviation authority an operational plan that has been developed using a scientifically based approach, or equivalent, to achieve an acceptable level of safety, taking into account at least the following:
– Departure-time windows;
– Rostering arrangements for operating flight crew and cabin crew, and standby crewmembers;
– Proposed rest requirements:
• Pre-flight;
• In-flight; and,
• Post flight;
– Crew complement: A minimum of four appropriately qualified flight crewmembers to include a minimum of two pilots who must be pilot-in-command qualified, plus augmented cabin crew to enable adequate rest on board;
– Standby activation;
– Exceptional circumstances/ commander’s discretion: The commander’s discretion should be limited to a maximum extension of three hours to the flight duty period; and,
– Proposed validation program.
Note: It is not the intent of this document to preclude future flight schedules comprising more than two sectors, one of which is a ULR sector. The key issue is sufficient rest before/after each ULR sector with rest times still predicated by ULR requirements. Common license/ mixed-fleet operations allow crews to mix ULR sectors and other sectors. However, any changes to the originally approved and validated city

pair operation will require a revised operational plan. The ability of the industry to address such changes will be improved in the light of actual ULR experience.
The ULR planning process for new routes should be conservative and should include integration of pilot rosters to include existing routes that ensure adequate rest between duties.
• Propose a validation program that covers at least the following:
– Establishment of an operational steering committee comprising representatives of the company, the regulator and the pilots' association to define the validation plan and provide oversight;
– Standardized methodology for initial validation:
• Sample size;
• Sampling intervals;
• Objective measures — operational and/or individual; and,
• Subjective measures;
– Ongoing monitoring — all aspects (i.e., sleep achieved, performance, etc.):
• Sample size;
• Sampling intervals;
• Objective measures — operational and/or individual; and,
• Subjective measures;
– Occasions when revalidation is required; and,
– Feedback reporting system.
• Develop rest requirements that take into account both preparatory and recuperative rest (including sleep) that meets the modeled assumptions, or equivalent, covering:
– Pre-flight;
– In-flight; and,
– Post-flight;
Note: It is intended that before a crew undertakes a ULR operation, both flight and cabin crewmembers will be acclimatized to the initial point of departure both before a ULR operation and, following return from a ULR operation, before undertaking any other flight duty.
Cabin crew scheduling may require special attention because of the ability of cabin crewmembers to crew multiple aircraft types.
• Provide adequate rest facilities that enable horizontal rest for crewmembers resting in flight (e.g., Australian and International Pilots Association facility standard AIPARS 001-1998, toilet requirements, environment, etc.);
• Develop material to provide appropriate training and education for all staff involved in the operation; and,
• Develop material for the operations manual that addresses all of the above.
Note: Regulators may need to review/revise existing regulatory material in the light of ULR operations (e.g., where existing "hard" limits may be exceeded by ULR — 18 hours maximum flight duty period) and "grandfather rights."

Approval Process

The approval process will require at least the following:
• Initial approval:
– Submission of the proposed operational plan;
– Consideration of the proposed operational plan by the civil aviation authority. This should be an iterative process between the civil aviation authority and the operator;
– Submission of operations manual amendments reflecting the proposed operational plan; and,
– Initial approval by the civil aviation authority (e.g., operations specifications/variations/ approval/interim approval).
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• Final approval and ongoing safety oversight by the civil aviation authority, which, based on the validation program, may require modification of the regulatory basis.

• City pairing — once a city pair has been approved, additional destinations in the same "cluster" may be considered, taking into account the following to achieve an equivalent level of safety:
– Time zone;

– Departure-time windows;
– Acceptable increase in flight time;
– Operational variables; and,
– Risk levels.

Recommendations

• The International Civil Aviation Organization (ICAO) should establish an SME group to develop standards and recommended practices (SARPs) for fatigue risk management to be incorporated in *Annex 6 to the Convention on International Civil Aviation: Operation of Aircraf*t that will encompass ULR operations.
• An FRMS is an integral part of a safety management system that provides a means of ensuring that employees' alertness and performance are not degraded to an unacceptable level as a result of fatigue. The purpose of an FRMS is to reduce the errors, incidents and accidents in which fatigue is a contributory factor. An FRMS is expected to lead to improved safety, efficiency, productivity and operational flexibility while satisfying the operator's duty of care to its employees and to the public.

• Because on-board crew sleep is a critical factor in ULR operations, the quality of the crew-rest facility is of paramount importance. Regulatory guidance material should be developed to ensure that crew-rest facilities are adequate for proposed ULR operations.

• The ULR Crew Alertness Steering Committee recognizes that ensuring flight crew proficiency is a critical issue for assuring the safety of ULR operations; however, it was deemed outside the prescribed scope of crew alertness which governed this initiative. Another, more qualified, group should consider flight crew proficiency for ULR operations and define the regulatory requirements necessary to achieve them.

Research and Development

The goal of the ULR Crew Alertness Steering Committee's proposed research and development is to better understand and predict the impact of flight and duty schedules and rosters on crew performance and flight safety. There are some key research questions and issues that need to be addressed.

Research That Needs to Be Done

• What are the relationships between objective and subjective measures of sleep quality/quantity? Use polysomnography, which is the current standard among objective measures and involves analysis of data showing brain-wave activity (electroencephalography), eye movement (electrooculography) and muscle tone (electromyography) to validate other methods that could be equally effective or more effective but cost less to implement than polysomnography.
  – Wherever possible, multiple measures should be used until these relationships are clearly established. This will enable advice to the operational community on which measures to use in which circumstances (could enable a tool kit to be created for validation of ULR operations and possibly other operations, and continuous improvement within an organization).

• Establish the linkages between physiological alertness (electroencephalography), vigilance (psychomotor vigilance task) and flight crew performance (FDM and LOSA).
  – Wherever possible, multiple measures should be used until these relationships are clearly established. This will enable advice to the operational community on which measures to use in which circumstances (could enable a tool kit to be created for validation of ULR operations and possibly other operations, and continuous improvement within an organization).

• Continue the search for practical methods for monitoring circadian phase in field settings. The current standard markers for circadian phase are the evening rise of melatonin and body temperature low point. Melatonin cannot be sampled during sleep and is suppressed by light. Temperature is influenced by levels of physical activity, and monitoring is intrusive. There are several reasons why it would be useful to be able to predict circadian phase:

– To know where the circadian low point is occurring (if in flight);
– To optimize personal sleep strategies; and,
– To determine the rate of readaptation and recovery at the conclusion of a flight pattern.

• Research on the effects of aging on sleep (on-board, during layovers and between trips) and its impact on operational performance.

• Research on the impact of ULR (and other) schedules on family and social life of crew. There are growing indications in shift-work research that life outside of work is an important intervening variable in an individual's ability to cope with work demands. This information can be valuable, for example, in education and training, and work force morale and retention.

• Research on long-term health implications for crew of ULR and other schedules.
Multivariate analyses are recommended to take account of factors such as age, order in the bunk, crew rank, gender and individual variability.

Mathematical Model Application Issues

Mathematical modelling is a tool that is based on known situations and may be used to predict outcomes in the absence of data.

• No mathematical model captures all aspects of a situation.

• The data set used to develop the mathematical model should be relevant to the situation being predicted (e.g., the characteristics of the population, the environment in which the data were collected, etc.).

• Different mathematical models use different inputs and provide different outputs. The inputs need to be able to be measured practically in the work environment (e.g., prior work history is easy, light exposure is more difficult). The outputs have to be tailored to the problem being addressed (e.g., to what degree mathematical model predictions are indicative of overall flight crew performance).

• Mathematical models should not be used in isolation. They are one tool that can be used to develop and assess ULR operations and are a support, but they are not a substitute for operational knowledge and standard regulatory processes.

Improving Mathematical Models

Mathematical modelling is an iterative process of data collection and model re- finement. The following are suggestions for improving the process:

• Every effort should be made to share existing data for mathematical model validation. This could be facilitated by a central research advisory panel.

• Create and improve dialog between the operational community and mathematical modelers (integrate operational personnel into mathematical-modeling teams).

• Encourage mathematical modelers to communicate and publish their efforts.

Mathematical models need to be strengthened in the following areas:

• Progressively address individual variability.

• Predictive mathematical models should be expanded to include measures of reliability/variability/confidence.

Application of Research and Mathematical Modeling to Operational Validation Programs

• Develop an integrated approach to research, mathematical modeling and operational validation for continuous improvement of ULR operations (the iterative process).
• Build tools for the regulators and operators by standardizing:
– Questionnaires and diaries/logs;
– Data-collection protocols (e.g., duration of preflight and postflight recording periods); and,
– Actigraphy methodology (e.g., epoch length, sensitivity settings and event markers).

• Address the comparability of different performance and vigilance testing devices.
• Provide feedback to the research community of data collected for operational validation, as part of the continuous improvement process.

General Principles

• Funding:
– Availability of funds — who should fund?
– Those that will benefit should fund — the stakeholders (e.g., manufacturers, operators, regulators, crew associations).
• Conditions of funding:
– Minimize proprietary information and maximize public availability.
– Define incentives:
• Worldwide improvement in safety;
• More efficient and accurate tools for ULR route planning and validation;
• Reduce duplication of effort; and,
• Recognition that the public interest could benefit the company (customer loyalty).
– Address disincentives to making information available:
• Shareholder interests/ profits; and,
• Perceived loss of competitive advantage.
• Visibility and accessibility of data and results: All research projects should include a full report to all stakeholders, peer-reviewed publications and feedback to the research advisory panel (for quality assurance).
• Standardized methodology should be employed as much as possible because it allows for comparability/ sharing of data for research and operational validation purposes (e.g., subjective and objective measures of sleep and alertness).

Recommendations

A research advisory panel should be created underthe auspices of Flight Safety Foundation, ICAO,etc. The aim is to provide a focal point for research in ULR operations. Membership of this body should include specialists from the following types of organizations:
• Manufacturers;
• Operators;
• Regulators;
• Scientific researchers; and,
• Crew associations.
The objectives of this body are to:
• Provide a source of information/advice on ULR operations;
• Develop a register for past, present and proposed research projects, including data collection for operational validation;
• Develop a register of qualified and competent research teams; and,
• Develop standard data collection and analysis methods for operational validation. The registration of research teams and projects, although voluntary, would be strongly encouraged. The research advisory panel will develop information templates for submitting details about mathematical model specification and use, research teams and projects.
• An example of a template for model specification appears on pages 18 and 19 of the May– June 2003 edition of *Flight Safety Digest*. With regard to the research projects, the intention is that the research advisory panel will provide high-level descriptions of objectives, methods, datasets available and personnel to contact. Any more detailed exchange of information would be negotiated directly between the parties.

Notes

1. Beginning in late 2000, the Ultra-long-range (ULR) Crew Alertness Steering Committee has conducted four workshops through co-sponsorship of Airbus, Boeing Commercial Airplanes and Flight Safety Foundation. The Air Line Pilots Association, International and the International Association of Air Line Pilots' Associations participated in cosponsoring the fourth workshop in May 2005.

2. The ULR Crew Alertness Steering Committee defines a ULR flight as "an operation involving any sector between a specific city pair (A-B-A) in which the planned flight time exceeds 16 hours, taking into account mean wind conditions and seasonal changes."

3. The U.K. Civil Aviation Authority, in Civil Aviation Publication 739, *Flight Data Monitoring,* first issued Aug. 29, 2003, defines *flight data monitoring* (FDM) as "the systematic, proactive and nonpunitive use of digital flight data from routine operations to improve aviation safety." Another term for FDM is *flight operational quality assurance* (FOQA).

4. A line operations safety audit (LOSA) involves the collection of data by trained observers during routine flights to determine how flight crews detect, manage and mismanage threats and errors. The International Civil Aviation Organization (ICAO) has endorsed LOSA as a tool for monitoring normal flight operations and developing countermeasures against human error. ICAO Document 9803, Line Operations Safety Audit (LOSA), contains detailed information on planning and conducting a LOSA, including guidelines for airlines on using LOSA data to gauge operational strengths and weaknesses. LOSA also enables airlines to compare data among de-identified data gathered by other airlines.

5. The Actiwatch — a small, lightweight device approximately the size of a wristwatch — measures and records motions of the body; this research method is called actigraphy. Actigraphy devices have proven to be highly sensitive to sleep, and they are a useful means of objectively monitoring sleep over extended periods of time.

6. Polysomnography, a method of recording in-flight sleep data, involves recording brain activity (by electroencephalography), eye movement and muscle tone using small electrodes that are attached to the head and the face of the pilot.