SPECIAL INSERT: TRIBUTES TO AN AVIATION LEADER

ICAO JOURNAL

VOLUME 61 NUMBER 4, 2006

TAILORED APPROACHES
Tangible Economic Benefits

HYBRID NAV SYSTEM
Performance Enhancement

ATNS knows Africa

Whichever way you look at it

Responsible for approximately **10% of the world's airspace**, ATNS proudly manages more than **half a million** arrival and departure movements every year and is making **Cape to Cairo satellite communications** a reality. ATNS trains international aviation professionals, maintains **ISO 9001** accreditation and subscribes to **ICAO Standards and Recommended Practices.**

ICAO Journal

The magazine of the International Civil Aviation Organization

VOL. 61, NO. 4 **JULY/AUGUST 2006**

FEATURES

6 Industry initiative promises fuel savings and environmental benefits
The "tailored arrivals" ATM concept has been designed to take advantage of the capabilities widely available on today's air transports …

9 Nav system ensures RNP 0.1 approaches are possible under any conditions
The latest hybrid navigation system demonstrates notable performance improvements over standalone GPS or traditional integrated GPS/IRS navigation …

14 Web-based service available from ICAO will facilitate air navigation planning
New GIS portal will allow authorized users anywhere in the world to view and amend information and follow links to other web-based resources useful for air navigation planning …

16 New training programme targets world's airport managers
A series of courses being developed by ICAO and ACI is designed to provide managers with the knowledge and skills needed to improve the efficiency and cost effectiveness of their airport operations …

19 Hurdles to wide acceptance of AMOS will eventually be surmounted
Before automatic meteorological observing systems can enter common operational use, sensor and system manufacturers will need to work with meteorological service providers to improve their performance …

22 Ground icing remains a safety issue that warrants further research
The effect of a very thin layer of wing ice or frost on an aircraft's aerodynamic performance has been known for years, but accidents still occur despite introduction of the "clean aircraft" concept …

SPECIAL INSERT

S1 ICAO bids farewell to its long serving Council President
A tireless worker on behalf of international civil aviation, many praise Assad Kotaite's accomplishments as a consensus builder and leader

UPDATE

26 Bombardment of Beirut's airport brings operations to a standstill
- Ballistic missile launches spark aviation safety concerns
- World's air carriers see profit grow in 2005 despite fuel cost increase
- ICAO convenes safety management system training courses

COVER PHOTO *(courtesy of Airbus S.A.S.)*
An Airbus A380 overflies the Airbus factory in Filton, England, in mid-May during a visit to the United Kingdom that included airport compatibility tests at London Heathrow Airport. By mid-June, the world's largest airliner had accumulated more than 1,400 flight hours, including 950 take-offs, with type certification and delivery of the first aircraft anticipated by year's end. Airbus recently announced production delays that will impact the aircraft delivery schedule until 2009, and the company is taking steps to address the related industrial issues.

WWW.ICAO.INT

Promoting the Development of International Civil Aviation

The International Civil Aviation Organization, created in 1944 to promote the safe and orderly development of civil aviation worldwide, is a specialized agency of the United Nations. Headquartered in Montreal, ICAO develops international air transport standards and regulations and serves as the medium for cooperation in all fields of civil aviation among its 189 Contracting States.

ICAO CONTRACTING STATES

Afghanistan
Albania
Algeria
Andorra
Angola
Antigua and Barbuda
Argentina
Armenia
Australia
Austria
Azerbaijan
Bahamas
Bahrain
Bangladesh
Barbados
Belarus
Belgium
Belize
Benin
Bhutan
Bolivia
Bosnia and Herzegovina
Botswana
Brazil
Brunei Darussalam
Bulgaria
Burkina Faso
Burundi
Cambodia
Cameroon
Canada
Cape Verde
Central African Republic
Chad
Chile
China
Colombia
Comoros
Congo
Cook Islands
Costa Rica
Côte d'Ivoire
Croatia
Cuba
Cyprus
Czech Republic
Democratic People's Republic of Korea
Democratic Republic of the Congo
Denmark
Djibouti
Dominican Republic
Ecuador
Egypt
El Salvador
Equatorial Guinea
Eritrea
Estonia
Ethiopia
Fiji
Finland
France
Gabon
Gambia
Georgia
Germany
Ghana
Greece
Grenada
Guatemala
Guinea
Guinea-Bissau
Guyana
Haiti
Honduras
Hungary
Iceland
India
Indonesia
Iran (Islamic Republic of)
Iraq
Ireland
Israel
Italy
Jamaica
Japan
Jordan
Kazakhstan
Kenya
Kiribati
Kuwait
Kyrgyzstan
Lao People's Democratic Republic
Latvia
Lebanon
Lesotho
Liberia
Libyan Arab Jamahiriya
Lithuania
Luxembourg
Madagascar
Malawi
Malaysia
Maldives
Mali
Malta
Marshall Islands
Mauritania
Mauritius
Mexico
Micronesia (Federated States of)
Monaco
Mongolia
Morocco
Mozambique
Myanmar
Namibia
Nauru
Nepal
Netherlands
New Zealand
Nicaragua
Niger
Nigeria
Norway
Oman
Pakistan
Palau
Panama
Papua New Guinea
Paraguay
Peru
Philippines
Poland
Portugal
Qatar
Republic of Korea
Republic of Moldova
Republic of Serbia
Romania
Russian Federation
Rwanda
Saint Kitts and Nevis
Saint Lucia
Saint Vincent and the Grenadines
Samoa
San Marino
Sao Tome and Principe
Saudi Arabia
Senegal
Seychelles
Sierra Leone
Singapore
Slovakia
Slovenia
Solomon Islands
Somalia
South Africa
Spain
Sri Lanka
Sudan
Suriname
Swaziland
Sweden
Switzerland
Syrian Arab Republic
Tajikistan
Thailand
The former Yugoslav Republic of Macedonia
Timor-Leste
Togo
Tonga
Trinidad and Tobago
Tunisia
Turkey
Turkmenistan
Uganda
Ukraine
United Arab Emirates
United Kingdom
United Republic of Tanzania
United States
Uruguay
Uzbekistan
Vanuatu
Venezuela
Viet Nam
Yemen
Zambia
Zimbabwe

ICAO Headquarters

999 University Street
Montreal, Quebec
Canada H3C 5H7
Telephone: 514-954-8219
Facsimile: 514-954-6077
E-mail: icaohq@icao.int
Website: www.icao.int

REGIONAL OFFICES

Asia and Pacific Office
Bangkok, Thailand
Telephone: + 662-537-8189
Facsimile: + 662-537-8199
E-mail:
icao_apac@bangkok.icao.int

Eastern and Southern African Office
Nairobi, Kenya
Telephone: + 254-20-7622-395
Facsimile: + 254-20-7623-028
E-mail: icao@icao.unon.org

European and North Atlantic Office
Paris, France
Telephone: + 33-1-46-41-85-85
Facsimile: + 33-1-46-41-85-00
E-mail: icaoeurnat@paris.icao.int

Middle East Office
Cairo, Egypt
Telephone: + 202-267-4841
Facsimile: + 202-267-4843
E-mail: icaomid@cairo.icao.int
Website: www.icao.int/mid

North American, Central American and Caribbean Office
Mexico City, Mexico
Telephone: + 52-55-52-50-32-11
Facsimile: + 52-55-52-03-27-57
E-mail: icao_nacc@mexico.icao.int

South American Office
Lima, Peru
Telephone: + 51-1-575-1646
Facsimile: + 51-1-575-0974
E-mail: mail@lima.icao.int
Website: www.lima.icao.int

Western and Central African Office
Dakar, Senegal
Telephone: + 221-839-93-93
Facsimile: + 221-823-69-26
E-mail: icaodkr@icao.sn

ICAO Journal

Editor: Eric MacBurnie
Editorial Assistant: Regina Zorman
Production Clerk: Arlene Barnes
Design Consultant: François-B. Tremblay

The objectives of the Journal are to provide a concise account of the activities of the International Civil Aviation Organization and to feature additional information of interest to ICAO Contracting States and the international aeronautical world.

Opinions expressed in signed articles or in advertisements appearing in the ICAO Journal represent the author's or advertiser's opinion and do not necessarily reflect the views of ICAO. The mention of specific companies or products in articles or advertisements does not imply that they are endorsed or recommended by ICAO in preference to others of a similar nature which are not mentioned or advertised.

Published in Montreal, Canada. Second class mail registration No. 1610. ISSN 1014-8876. Date of publication of Issue 4/2006: 10 August 2006. Published six times annually in English, French and Spanish.

Subscriptions: $25 (by surface) and $35 (by air) per year. Single copies available for $10. Prices in U.S. funds. ***For subscription and circulation inquiries***, please contact ICAO Document Sales Unit. Telephone: +1 (514) 954-8022; Facsimile: +1 (514) 954-6769; E-mail: sales@icao.int. ***Important Note:*** Readers are advised that surface delivery may take as long as six months, depending on location. Air mail is strongly recommended. The current issue may be viewed in PDF format without delay at ICAO's website (http://icao.int/icao/en/jr/jr.cfm). Issues dated 2005 or earlier are viewable using the downloadable DjVu reader. Planned publication dates for 2006 are 15 February, 13 April, 9 June, 7 August, 8 September and 11 December.

Advertising representative: Yves Allard, FCM Communications Inc., 835 Montarville St., Longueuil, Quebec, Canada J4H 2M5. Telephone: +1 (450) 677-3535; Facsimile: +1 (450) 677-4445; e-mail: fcmcommunications@ videotron.ca.

Editorial Office: International Civil Aviation Organization, 999 University St., Room 1205, Montreal, Quebec, Canada H3C 5H7. Telephone: +1 (514) 954-8222; Facsimile: +1 (514) 954-6376; e-mail: emacburnie@icao.int.

Graphic Art/Design: Bang Marketing (www.bang-marketing.com). **Printing:** Transcontinental-O'Keefe Montreal (www.transcontinental-printing.com).

ICAO Headquarters: 999 University St., Montreal, Quebec, Canada H3C 5H7. Telephone +1 (514) 954-8219; Facsimile +1 (514) 954-6077; e-mail: icaohq@icao.int.

www.icao.int VISIT ICAO's website for a wealth of information including past issues of the ICAO Journal, information on advertising in ICAO's magazine, the latest news releases, a complete listing of ICAO publications and audio visual training aids, the ICAO aviation training directory, Secretariat job vacancies, technical cooperation project postings, and much more.

ICAO Publications: *The Catalogue of ICAO Publications and Audio-Visual Training Aids* contains a list of all document titles as well as abstracts and indicates the availability of language versions. The catalogue is issued annually in hard copy. Monthly supplements list new publications and audio-visual training aids as they become available, as well as amendments and supplements. Most ICAO publications are issued in English, French, Russian and Spanish; Arabic and Chinese are being introduced on a gradual basis. (The most efficient way to order an ICAO publication is online at http://www.icao.int using VISA or Mastercard. All transactions conducted on this server are encrypted and secure.)

ICAO eSHOP (www.icao.int/eshop): eSHOP is a commercial website offering online access to ICAO documentation for an annual fee. A subscription gives access to the full texts of international conventions and protocols, all annexes to the *Convention on International Civil Aviation* (the Chicago Convention), publications pertaining to air traffic management, and the annual reports of the ICAO Council.

DGCA Directory: ICAO has developed an electronic database of information on national civil aviation administrations from around the world. The *Directory of National Civil Aviation Administrations* (Document 7604) is continuously updated, based on information received from ICAO's 189 Contracting States. The online directory is available through ICAO's website at an annual subscription fee of U.S. $150. For further information, please contact the Database Administrator (dgca@icao.int).

ICAO

Electronic publications

Man in Flight by Hans Erni *

Air Traffic Management, 2006 Edition

This CD-ROM contains a number of complete documents, including the following:

- Convention on International Civil Aviation
- Annex 2 – Rules of the Air
- Annex 11 – Air Traffic Services
- Annex 12 – Search and Rescue
- PANS – Air Traffic Management
- Air Traffic Services Planning Manual
- Global Air Navigation Plan for CNS/ATM Systems
- International Aeronautical and Maritime Search and Rescue (IAMSAR) Manual
- Manual Concerning Interception of Civil Aircraft
- Manual Concerning Safety Measures Relating to Military Activities Potentially Hazardous to Civil Aircraft Operations
- Manual on Air Traffic Services Data Link Applications
- Manual on Airspace Planning Methodology for the Determination of Separation Minima
- Global ATM Operational Concept
- Manual on Implementation of a 300 m (1,000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive

English text only

U.S. $950 for the purchase of a single copy
(Order No. 4444-CD)

U.S. $1,200 for the purchase of a single copy with a two-year amendment service
(Order No. 4444-CD1)

The publication is also accessible through ICAO eSHOP, a web-based information service offering online access to various sets of ICAO documentation for an annual subscription fee. A free preview is available at www.icao.int by clicking on ICAO Publications, ICAO eCommerce, ICAO eSHOP and entering access code: GUESTguest

U.S. $650 for an annual subscription for online web access, via ICAO eSHOP
(Order No. 4444-E)

For more information or to place an order, contact:

International Civil Aviation Organization
Attention: Document Sales Unit
999 University Street, Montreal
Quebec, Canada H3C 5H7
Telephone: +1 (514) 954-8022
Fax: +1 (514) 954-6769
E-mail: sales@icao.int

* Detail of a mural on display at the ICAO headquarters building, Montreal.

Industry initiative promises fuel savings, environmental benefits and greater safety

The "tailored arrivals" concept has been designed to take advantage of the capabilities widely available on today's air transports, among them flight management computers and integrated data link systems

ROB MEAD
THE BOEING COMPANY
(UNITED STATES)

A new air traffic management (ATM) concept known as "tailored arrivals" emerged in early 2004 when Boeing, Airservices Australia, Qantas Airways and the Air Traffic Alliance — a partnership of Airbus and Thales — joined forces to develop a safer and more efficient way of handling flight arrivals around the world.


Jim Jorgenson

Current ATM procedures often lead to fuel penalties and excessive aircraft noise. The tailored approach is designed to address this, while improving safety.

The new concept represents a significant improvement over today's operations, in which adjustments to an aircraft's arrival trajectory required for separation and sequencing are provided as tactical instructions by Air Traffic Control (ATC). Such instructions almost invariably occur subsequent to the aircraft arriving at its top-of-descent (TOD) point, and include re-routing, speed control, radar vectoring and intermediate level assignments, all of which invalidate the optimal arrival trajectory calculated by the aircraft's flight management computer (FMC) prior to the commencement of descent.

These inefficiencies result in obvious penalties in fuel burn and noise level; estimates are as high as 400 kilograms of fuel and 12 decibels of noise per flight, with a commensurate penalty in emissions and other environmental impacts. Moreover, the late application of tactical instructions means that operations are far from optimal in terms of their predictiveness, with increasing controller workload as aircrew react to the tactical instructions in a variety of ways, using different aircraft flight modes and guidance.

In addition to tangible economic benefits, tailored arrivals enhance safety by greatly improving communications between pilots and controllers. One tailored arrival uplink received prior to top-of-descent can take the place of as many as 15 discreet voice exchanges. This will help to reduce voice frequency congestion at any major airport, especially at airports where a high percentage of controllers and pilots use English as a second language.

Key enablers. The tailored arrivals concept counters these inefficiencies by using the aircraft's on-board capabilities, in conjunction with ground-based automation, to calculate a descent trajectory based on awareness of all known ATC constraints likely to be encountered during the descent phase. ATC coordinates and uplinks a route clearance prior to the aircraft's TOD that includes any speed and altitude requirements and any path adjustments required to substitute for low-level radar vectoring. The route clearance is intended to provide the aircraft's FMC with the means to meet timing and separation needs for a particular flight while allowing the aircraft to follow the optimum descent trajectory.

Ground automation, such as the ATM system supplied by Thales or the en-route descent advisor (EDA) developed by the U.S. National Aeronautics and Space Administration (NASA), computes fuel-efficient descent solutions in light of complex traffic constraints and airspace restrictions. It constructs a tailored arrival that accommodates aircraft performance limits, standard instrument arrival (STAR) restrictions, scheduling and sequencing requirements, intermediate crossing restrictions, and strategic separation requirements. Where air traffic demands or other constraints do not allow the ideal continuous idle descent, ground automation optimizes the profile as far as possible within the constraints at the time.

By striking a balance between traffic demand, environmental impact and flight efficiency, the ground automation provides the optimum arrival profile for the given situation. This maximizes the benefits for each flight in terms of reduced fuel burn, noise and exhaust emissions, as well as enhanced predictability for the aircrew, aircraft operator and controllers handling the flight. Other benefits include strategic separation assistance through trajectory probing and planning, and maximum throughput by meeting sequencing and scheduling constraints and by avoiding conflicts as well as avoiding terrain and restricted airspace. Delivery of information by data link decreases workload and improves flexibility, at the same time bolstering safety by reducing the possibility of retyping errors. Moreover, aircraft navigational database storage and pilot interface needs are reduced, as well as the lead times required for the publication and distribution of the definition, safety assessment, and deployment of new arrival paths for an airport.

The tailored arrivals operational concept was designed to take advantage of capabilities widely available on the majority of transport aircraft in service today, including modern flight management computers and other navigational and guidance capability, and integrated data link systems (*Figure 1*).

A mature tailored arrival implementation requires a system capable of exchanging data between aircraft flight management systems and ATM ground systems. Such integrated solutions are essential to ensure low workload and error-free exchange of trajectory clearances, and to extract and downlink on-board data such as automatic dependent surveillance-contract (ADS-C) parameters to ensure the detection of aircraft deviations from predicted times and constraints during the descent path to the runway. Tailored arrival activities are being undertaken with the FANS-1/A system currently deployed on some aircraft, while incorporation of the aeronautical telecommunication network (ATN) will be included as soon as an integrated solution becomes available, as is expected within the next five years.

Tailored arrival mechanisms. Coordination of the uplinked constraints conveyed in an ATC clearance that normally concerns multiple ATC centres and sectors is a critical aspect of tailored arrivals, allowing on-board capabilities to provide an efficient and predictable descent profile that can be flown repeatedly. Without these coordinated procedures and supportive automation, constraints and profile clearances cannot be provided to aircraft prior to TOD. When this is the case, reduced efficiency and predictability will result as more and more human intervention is required both in the aircraft and on the ground to compensate for the lessened predictability.

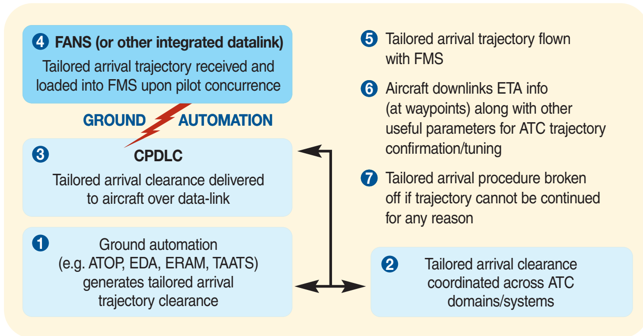


Figure 1. Flow chart illustrates the basic tailored arrivals process

A tailored arrival clearance using integrated data link systems is a procedure that applies between the end of the cruise phase and commencement of a published arrival routing or approach procedure. A tailored arrival should make it possible to shorten the flight path and the aircraft database capacity required for the arrival procedure, and the demands these impose on aircraft navigational databases.

Key tools employed within the overall tailored arrivals concept are path extension or shortening, speed and altitude constraints over specified waypoints, and speed schedules giving the speed the aircraft will adhere to during the descent and between constraints. These tailored

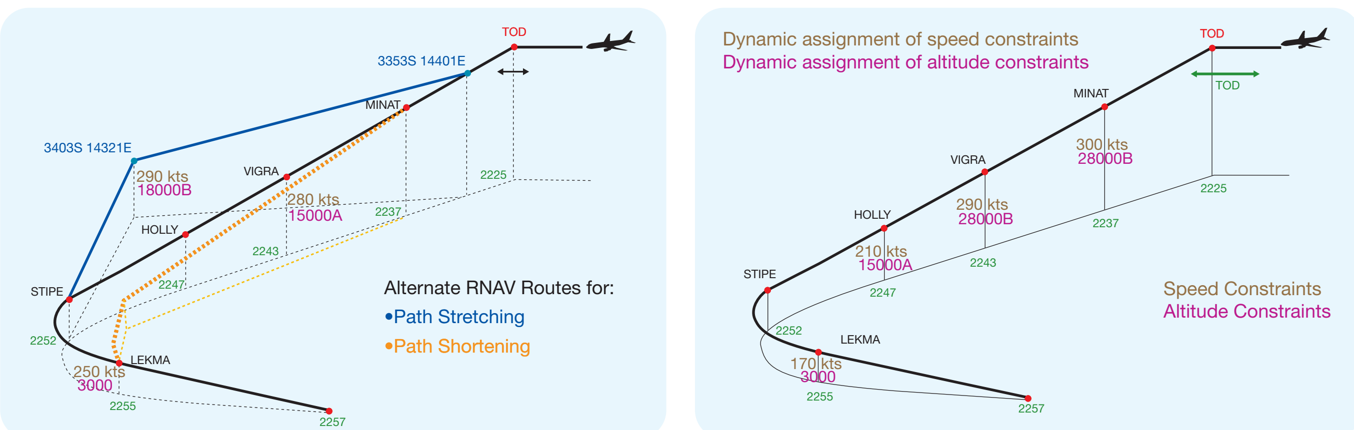
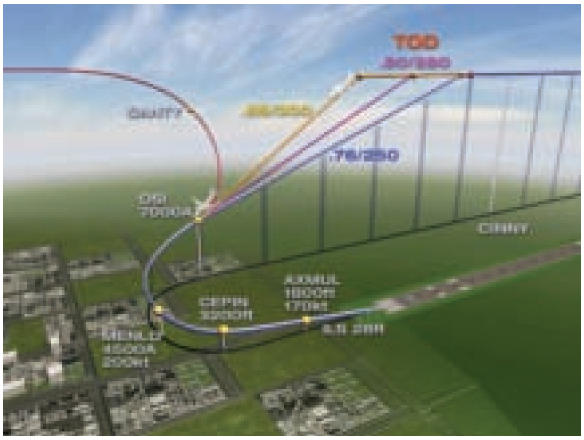


Figure 2 (left). With tailored arrivals in place, traffic conflicts are addressed by extending or shortening the distance flown and duration of descent by two minutes or more. Speed and altitude constraints (Figure 3) are also adjusted for the same purpose.

arrival mechanisms are illustrated in *Figures 2, 3* and *4*.

Tailored arrivals development. Tailored arrivals are being developed and harmonized globally through three projects under way in Europe (Amsterdam), North America (the San Francisco Bay Area) and Australia (Melbourne).

The tailored arrivals initiative was launched with Phase 1 of the Australian project. The main purpose of the Australian trials was to prove the concept of uplinking a controller-pilot data link communications (CPDLC) route clearance that took the aircraft from a position prior to the TOD point onto the existing STAR clearance while encountering a number of speed and altitude constraints during the descent. The results show that with the capability of future automation on the ground, the concept is not only viable but practical, since flight crew already operating FANS-equipped aircraft require no additional training to be able to accept and follow the tailored arrival route clearance.



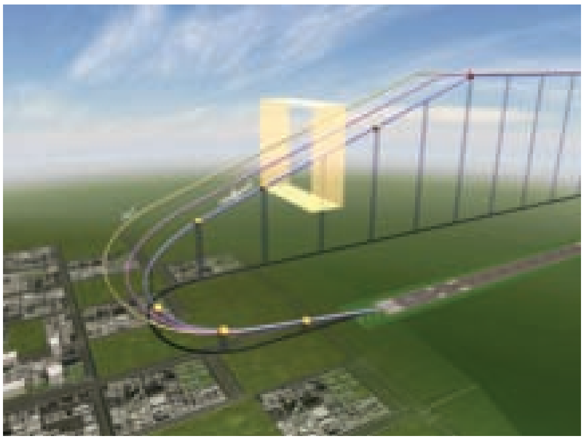


Figure 4 (top). Adjustment of the descent speed schedule can alter timing by two minutes or less when traffic conflicts require. Figure 5 depicts the use of a descent profile "window" for managing adjacent traffic streams.

Data collected during Phase 1 trials show that the original FMC estimates for specified ATC waypoints, obtained from the flight crew at distances up to 250 nautical miles (NM) from the waypoints, proved to be remarkably accurate. Changes in FMC estimates that result whenever an aircraft deviates from the optimum path could be detected in the ADS-C intermediate intent information being downlinked from the aircraft's avionics.

Phase 2 of the trials in Australian airspace is expected to begin in July 2006 and is intended to cover several activities, with highlight being a demonstration of automatic detection in real time of aircraft that fail to meet a negotiated estimated time of arrival (ETA), providing "closed loop" monitoring. Quickly detecting aircraft "off plan" is essential to maintaining controller situational awareness during the transition to strategic control. Once initial FMC estimates have been obtained via ADS-C, these will be re-checked at a high rate throughout the descent phase. Pilots will be instructed via radio to deselect FMC automation, simulating a pilot error or aircraft automation failure.

Meanwhile, in the Netherlands, trials involving more than 190 flights took place every night between 2300 and 0500 local time during the period from 9 January to 15 March 2006. The trials were conducted at Amsterdam's Schiphol Airport and involved Boeing and Luchtverkeersleiding Nederland (LVNL), the ATC organization of the Netherlands, as well as the Eurocontrol Maastricht Upper Area Control Centre and Schiphol-based airlines Transavia Airlines and Martinair.

The activity at Schiphol Airport supported the Advanced Arrivals and Departures Techniques (AADT) project, which is part of a 27-month joint research and development programme between Boeing and the LVNL. While data link was not available during this early trial, the basic concept of tailored arrivals was exercised through delivery of predefined arrival clearances from cruise level to the runway in use at Amsterdam Airport. The primary objective was to identify key areas of air-to-ground data sharing that can improve predictions for arrival times and arrival paths. This information is critical for the design of new ground systems and procedures which would allow the fuel efficient and quieter continuous descent approaches to be flown in more congested periods, when frequent ATC intervention is customary.

During the AADT trials, data downlinked from aircraft (e.g. route and wind predictions loaded into the FMC, time and altitude predictions over waypoints in the descent) and derived from radar ground systems were used and compared to identify the factors that most influence aircraft profile predictability. In addition to the impact of these factors on arrival times over metering fixes, the factors were sorted to identify those that had the most impact on predicted flight levels and speeds. The aim of this analysis was to identify whether it is feasible to provide delivery "altitude windows" at key points along the descent path. An altitude window can accommodate a wide range of aircraft types, allowing controllers to manage arrivals with confidence that aircraft will pass through the window without interfering with the streams of arriving or departing aircraft in adjacent airspace (see *Figure 5*).

In North America, Boeing has joined with NASA, the U.S. Federal Aviation Administration (FAA) and United Airlines

continued on page 31

Rob Mead (rob.mead@boeing.com) is Lead Engineer for air/ground communications in the Advanced Air Traffic Management unit at The Boeing Company, and is based in Seattle, WA.

Hybrid nav system ensures RNP 0.1 approaches can be completed under any conditions

Integrated GPS/IRS navigation exploits the best characteristics of each technology, while the latest hybrid system demonstrates notable performance improvements over standalone GPS or traditional integrated GPS/IRS navigation

MIKE IBIS • CURT CALL
JIM MACDONALD • KEVIN VANDERWERF
HONEYWELL AEROSPACE
(UNITED STATES)

PERFORMANCE-BASED navigation (PBN) operations, including the newly developed required navigation performance (RNP) 0.1 approaches,* offer substantial cost savings and airspace efficiency improvements for aircraft operators. The PBN concept, which encompasses both area navigation (RNAV) and RNP, allows aircraft to operate in a defined airspace and to execute non-precision approaches as well as approaches with vertical guidance based on the navigation performance of their equipment (see "Performance-based navigation seen as key to global harmonization," Issue 3/2006, pp 5-7).

Today's operating environment places increased demands on navigation performance. The aviation community has long recognized that navigation can be improved by exploiting the synergistic benefits of the global navigation satellite system (GNSS) and an inertial reference system (IRS). The widely used global positioning system (GPS) developed by the United States offers excellent accuracy, but its performance is also vulnerable to adverse satellite geometry, signal masking, interference, and errors from satellite signals. IRS, on the other hand, is very accurate over the short term, but faced with errors that grow over time. IRS is self-contained, so its performance is immune to external interference or satellite failures. An integrated GPS/IRS navigation system exploits the best characteristics of each system.

Several navigation systems are currently available for RNP operations, and they perform well down to RNP 0.3. The performance requirements for RNP 0.1 approaches are considerably more stringent however, and these traditional navigation systems too frequently are incapable of executing an RNP 0.1 approach, especially into mountainous terrain. The landing must be delayed until the satellite geometry improves or a decision is made to divert to an alternate airport.

The most recent implementation of the Honeywell inertial GPS hybrid (HIGH) navigation system, known as HIGH Step II, features an upgraded algorithm for a new air data inertial reference unit (ADIRU) that is currently undergoing final certification testing. HIGH Step II more effectively blends GPS, IRS and barometric-based altitude data. It enhances navigation performance well beyond what is possible with standalone (unaugmented) GPS systems, or even with traditional integrated GPS/IRS/barometric navigation systems. It provides 100 percent worldwide availability for RNP 0.1 approaches.

Airbus S.A.S.

A hybrid inertial/GPS navigation system has been implemented in a variety of aircraft platforms. A system developed by Honeywell will be standard on the ADIRU to be certified on the Airbus A380 as well as several other aircraft types.

A modern flight management system (FMS) primarily uses two inputs from the navigation system to determine whether it can perform an RNP operation. These inputs are called the horizontal protection level (HPL) and the horizontal figure of merit (HFOM). HPL provides a limit on the horizontal position error with a probability derived from the integrity requirement, and is used as an indication of navigation integrity. HFOM is a measure of navigation accuracy, to a 95 percent confidence level. The lower the values of HPL and HFOM, the better the navigation performance. HPL and HFOM are checked by the FMS prior to, and during, an RNP operation to ensure they are low enough to safely complete the operation.

The primary benefit of the hybrid system is that it calculates substantially lower values for both HPL and HFOM than standalone GPS receivers or traditional integrated GPS/IRS/barometric navigation systems. It reduces HPL and HFOM values under all conditions, but the improvement is most dramatic for the conditions where it is needed most — that is, when satellite geometry is poor, or when GPS signals become unavailable. The HIGH Step II navigation system ensures that an RNP 0.1 approach can be successfully completed under virtually any condition that might be encountered.

RNP benefits

RNP approaches offer many benefits over traditional non-precision approaches (see "Implementation of performance-based navigation making notable progress," Issue 3/2006, pp 9-12). The obstacle clearance volume for traditional approaches is angular in nature, such that the lateral protected airspace grows as the distance from the runway increases. In contrast, the clearance volume for RNP approaches is linear, such that the protected crosstrack airspace remains constant with respect to distance from the runway. In addition, RNP approaches can follow complex paths to avoid obstacles. The net result is that RNP approaches are able to achieve much lower minima, especially when the controlling obstacle is some distance from the runway threshold yet close to the extended runway centreline. In fact, RNP approaches enjoy minima as low as 250 feet, which is very close to the 200-foot decision altitude (DA) limit of a typical Category I precision approach.

Operators that receive approval to perform RNP procedures benefit in many ways. Among them:

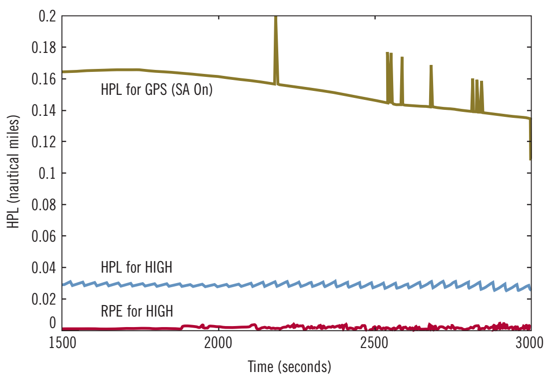
- RNP approaches have lower minima compared to traditional approaches, resulting in fewer weather-related diversions. On average, aircraft can carry less fuel for alternate airports, allowing for greater payloads.
- RNP approaches have a constant rate of descent, which eliminates the stepped non-precision approach paths. This reduces fuel burn, decreases crew workload, and lowers the risk of controlled flight into terrain (CFIT).
- RNP allows for better missed approach guidance, increasing operational safety.
- RNP capability enables more efficient routing resulting in shorter paths, fewer delays, and lower fuel consumption. In the future, RNP approaches are expected to increase capacity for closely spaced parallel runways.
- RNP provides access to more runways, eliminating the need to install landing aids to work around terrain and obstacle challenges. This is particularly important in many areas outside of North America and Europe, where instrument landing system (ILS) facilities are less common.

Aircraft can benefit from RNP without being equipped with a satellite-based augmentation system (SBAS), which is currently required to achieve lateral precision with vertical guidance (LPV) approach capability. According to the U.S. Federal Aviation Administration (FAA), RNP 0.1 capability can be achieved if an aircraft is equipped with IRS, dual FMS, dual GPS, dual air data systems and dual autopilots (a special aircraft and aircrew authorization is required). Also, RNP procedures, where available, can be flown anywhere in the world and are not subject to the availability of external augmentation systems such as WAAS, which can become unavailable during ionospheric storms.

Several RNP approach procedures exist today. Some of the higher profile airports in the United States with established RNP approaches include Juneau, Aspen, Palm Springs, and Reagan/Washington National. Outside the United States, airports with RNP approaches include Innsbruck, Austria; Queenstown, New Zealand; and Kelowna, Canada. Many others exist, with hundreds scheduled for development in the next few years.

Implementing RNP capability allows operators to reap cost savings by avoiding diversions and operating on more efficient routings. Airlines can complete flights as planned when the weather is below the minima of traditional approaches, and have shown dozens of "saved" flights per year at a single airport. With the cost of one diversion estimated at U.S. $20,000 to $50,000, this benefit alone can significantly improve an operator's bottom line. Moreover, complex RNP routes can shorten flight times by 15 minutes or more for each flight leg. Airlines have been shown to save over $1 million per year when new RNP approaches are established at a single airport.

Performance improvements. The primary benefit provided by the HIGH Step II system is the improvement to the accuracy and integrity parameters over standalone GPS systems or traditional integrated GPS/IRS navigation systems. With standalone GPS systems, these values are typically based on "snapshot" algorithms. The geometry of the satellites in the solution and the assumed error



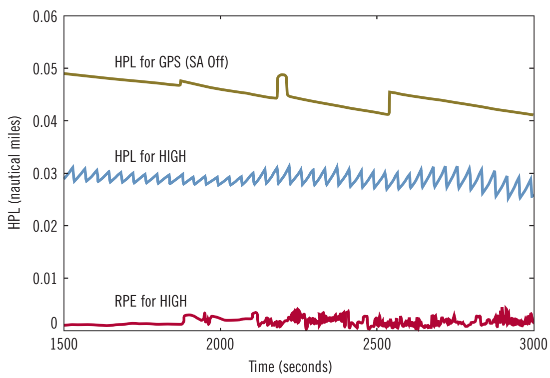


Figure 1 (left). Horizontal protection level (HPL) for the HIGH Step II navigation system and for a GPS receiver (SA-on) during flight test. Figure 2 (right). HPL for HIGH Step II system and GPS receiver (SA off).

in each pseudorange drive these values. As GPS satellites move throughout the day, the effect that the geometry has on the horizontal position solution continues to change. The mask angle used by the system, satellite selection methods, and the loss of satellites because of terrain masking, aircraft manoeuvres or signal interference, all influence the geometry.

Accuracy and integrity as computed by snapshot algorithms used in standalone GPS systems exhibit jumps as a result of abrupt changes in satellite geometry as satellites are gained or lost. Parameters computed by snapshot algorithms used in receiver autonomous integrity monitoring (RAIM) operations require five or more measurements (one may be calibrated pressure altitude) to detect satellite failures and calculate HPL. The snapshot RAIM algorithms require six or more measurements to isolate and exclude satellites. When the computed HPL of the system exceeds the threshold for the RNP operation (called the alert limit), the system is said to be in a "RAIM hole" since the procedure cannot be performed based on the standalone GPS RAIM computation. RAIM holes over the world increase in size and duration for lower RNP levels, and availability of the corresponding RNP operation decreases accordingly.

The HIGH Step II navigation system utilizes multiple Kalman filters to establish the HPL level. Since the Kalman filters provide an optimal estimate of the GPS and inertial error states, HPL generated by HIGH Step II will inherently be a lower value than HPL from a standalone GPS snapshot-based HPL. The Kalman filters utilize the GPS measurements to calibrate the inertial errors as well as slowly changing pseudorange errors and in this way reduce their uncertainties. The HIGH Step II-based HPL does not, therefore, experience the abrupt increases of the snapshot-based HPL after loss of a satellite signal or other change in geometry. In situations where an autonomous-based HPL increases dramatically, as in a RAIM hole, the HIGH Step II-based HPL tends to "coast" through them with only a gradual increase. However, when a new satellite comes into view, the HPL instantly decreases to reflect the new information. Thus, the HIGH Step II-based HPLs are not only lower, but tend to stay low and are less noisy when compared to an autonomous-based HPL.

The characteristics of the HIGH Step II system result in significantly higher availability and continuity for more precise RNP operations than can be achieved with standalone GPS. While RNP 0.1 operations are being performed at challenging airports with standalone GPS systems, it has been reported that the actual availability achieved for some approaches can be as low as 80 percent. With HIGH Step II, 100 percent availability for RNP 0.1 eliminates the need for time-consuming pre-flight procedures that predict RNP availability. Importantly, this capability is worldwide and does not rely on augmentations such as SBAS that may be available only regionally or locally.

HIGH Step II provides better accuracy and integrity signals than standalone GPS systems under all conditions. This is especially so for the vast majority of GPS receivers incorporated within current multi-mode receivers (MMRs), which do not take advantage of the selective availability (SA) security feature being turned off. HPL and HFOM signals from multi-mode receivers are unnecessarily inflated given their conservative assumptions about GPS accuracy. Since HIGH Step II utilizes raw pseudorange measurements from the MMR, the transmitted assessments of accuracy and integrity do not depend on SA assumptions within the MMR. Therefore HIGH Step II achieves full performance benefits even when used with MMRs designed for operations with SA turned on. With HIGH Step II, it is not necessary to upgrade MMRs for operations with SA turned off in order to improve their performance.

Test results

To demonstrate typical performance improvements, flight tests were conducted using an MMR to provide GPS pseudorange data to a HIGH Step II air data inertial reference unit. Like most receivers in the field today, the flight test GPS receiver providing satellite measurements to the HIGH Step II system assumed that SA was turned on. HIGH Step II operated in the SA-off mode during all flight tests. Data from a second GPS receiver, tuned for SA-off, were also collected during the flight test. A differential GPS system was included as a truth system. The radial position error (RPE) in the accompanying figures represents the difference between the horizontal position from the HIGH Step II navigation solution and the horizontal position from the truth data.

Figures 1 and *2* show how HIGH Step II dramatically reduces HPL during nominal flight conditions. The flight was performed under conditions with 10 or more satellites in view. Figure 1 shows the HPL for HIGH Step II, the HPL for an MMR GPS receiver tuned for SA, and the radial position error for the HIGH Step II navi-

Table 1. Accuracy coasting for HIGH Step II system (SA off)

Coasting Time (minutes)	95% Radial Position Error (NM)
0	0.0113
10	0.0829
20	0.2630
30	0.4963
60	0.9694

Table 2. System availability performance with 2 degree mask angle and 24 satellite constellation

Nav system	Horizontal Alert Limit			
	0.1 NM	0.2 NM	0.3 NM	1.0 NM
HIGH Step II	100%	100%	100%	100%
Standalone GPS*	98.862%	99.981%	99.997%	100%

*with calibrated pressure altitude

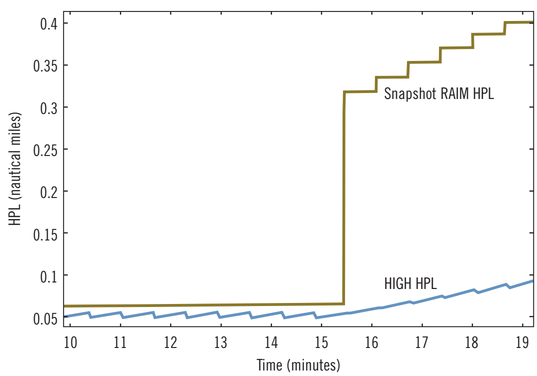
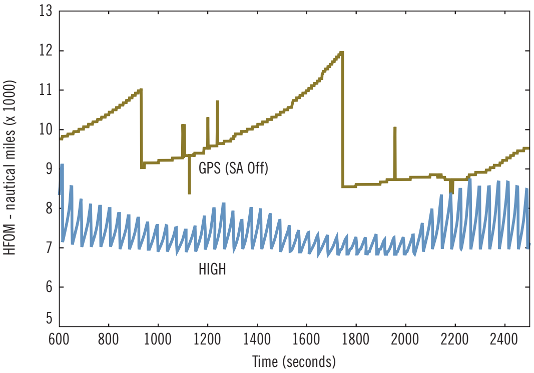


Figure 3. Simulation comparison of the horizontal position error in a RAIM hole

gation solution. This dramatic improvement in HPL, which translates to a significant increase in system availability, can



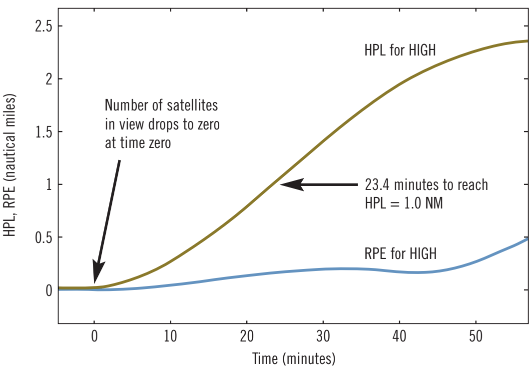


Figure 4 (top). Horizontal figure of merit (HFOM) for High Step II and GPS receiver. Figure 5. Integrity coasting demonstration illustrates HPL and RPE during simulated coasting conditions.

be achieved by adding HIGH Step II to the ADIRU.

Figure 2 shows the HPL for HIGH Step II, the HPL for a GPS receiver in the SA-off mode, and RPE for the HIGH Step II navigation solution. The data shows that HIGH Step II provides a lower HPL and increased availability even over a standalone GPS in SA-off mode with good satellite geometry. On average, the HPLs from the standalone GPS system tuned for SA off are at least 50 percent worse than HIGH Step II HPLs during these good satellite geometries. The HPL value provided by HIGH Step II is consistently lower than RAIM-based HPL and eliminates the intermittent steps and spikes exhibited on standalone GPS systems.

While Figures 1 and 2 illustrate how HIGH Step II performs in nominal geometry conditions, even more impressive improvements are achieved during adverse satellite geometry conditions. As described above, the HPLs for standalone GPS systems can increase suddenly as a result of geometric changes such as RAIM holes. Sudden changes in HPL can impact system availability during an RNP approach. HIGH Step II HPLs react more slowly to geometric changes that would increase HPLs for snapshot RAIM systems. *Figure 3* demonstrates the ability of HIGH Step II to coast through a RAIM hole. This RAIM hole was generated during a simulation using the 24 satellite almanac defined by the RTCA (Appendix B of DO-229). For an alert limit of 0.1 nautical mile, HIGH Step II would allow an aeroplane to complete the RNP operation while the standalone GPS system would not even be available for an alert limit of 0.3 nautical miles. From Figure 3, one can easily visualize the increased availability that can be achieved with HIGH Step II.

In addition to the HPL, GPS systems typically provide a 95 percent accuracy value for the navigation solution called the horizontal figure of merit. *Figure 4* compares HFOM from HIGH Step II and a GPS receiver (SA-off) during a flight test. These data were taken during nominal conditions with good satellite geometry. HIGH Step II HFOM is lower than HFOM provided by a GPS receiver in the SA-off mode. If a GPS receiver provides an HFOM using SA-on assumptions, HIGH Step II would provide even more dramatic improvements similar to the HPL results.

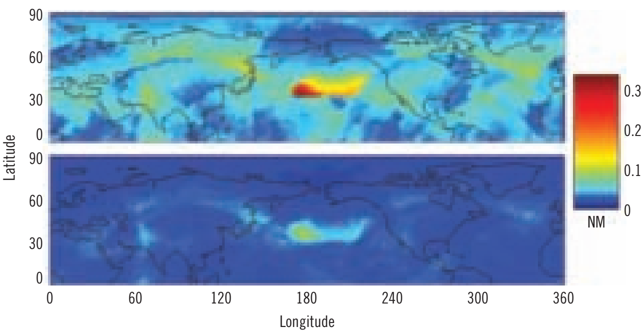


Figure 6. HIGH Step II HPL distribution (bottom) compared to HPL distribution from snapshot RAIM system.

The sawtooth characteristics exhibited by the HIGH Step II HPL and HFOM signals are the result of timed updates of the Kalman filters. A smoothing function is implemented within HIGH Step II in order to gradually incorporate Kalman corrections into the actual navigation solution, ensuring that the navigation solution itself does not possess any sawtooth behaviour.

Another important feature of HIGH Step II is that it provides both accuracy and integrity capabilities even when satellite signals are not being received (i.e. when the system must "coast"). With accuracy coasting, the navigation solution continues to be valid even when there are less than four measurements. With integrity coasting, the navigation solution and the HPL continue to be valid with less than five measurements.

The ability to detect and isolate latent satellite failures when measurements are no longer being received is key to providing integrity coasting. Even if GPS measurements cease entirely, integrity coasting can continue indefinitely. GPS outages that initiate coasting may occur with intentional or unintentional signal interference as well as satellite masking from the terrain or buildings such as the passenger terminal. This coasting capability greatly enhances system availability and continuity.

GPS vulnerability to interference has been extensively documented. RNP 0.1 operations are particularly susceptible to

continued on page 30

*RNP 0.1 operations require specific aircraft and aircrew authorization similar to that required for instrument landing system (ILS) Category II and III operations. The international specification for these operations, known as RNP authorization required (RNP/AR), is currently under development in ICAO.

Mike Ibis is a Technical Manager at Honeywell Aerospace – Guidance and Navigation, and along with his co-authors, is based in Minneapolis. Curt Call and Jim MacDonald are System Engineers, and Kevin Vanderwerf is a Staff Engineer.

New web-based service available from ICAO will facilitate air navigation planning

GIS portal will allow authorized users anywhere in the world to view and amend information and follow links to other web-based resources useful for air navigation planning

ALEKSANDER PAVLOVIC
ICAO SECRETARIAT

ICAO is in the final stages of developing its global air navigation planning database, a centralized aeronautical database accessible through a web-based user interface via a geographic information system (GIS) portal. The new portal will give access to air navigation plan (ANP) data, aeronautical numerical planning data and forecast information, and will provide charting services and air navigation planning tools — all linked to geographically referenced information. The database was designed to allow for future requirements, such as initiatives in support of the *Global Air Navigation Plan* (Document 9750) and associated implementation tools and guidance material, to be included and accessible through the GIS portal. (See "Global Plan stresses initiatives that lead to direct performance enhancements," Issue 2/2006, p. 13).

The database will integrate current air navigation planning information from all ICAO regions. The availability of this information online — and through a single portal — will greatly facilitate updating and access to the latest information for States, ICAO regional offices and various other users. The database will support, in particular, the work of regional planning and implementation groups that plan, monitor and analyse the implementation status of planned facilities and services for inclusion in the regional air navigation plans, and recommend ways to expedite these plans in accordance with ICAO priorities.

Amendments to the air navigation plans will essentially follow the same paper-based process that occurs today when amendments are submitted for inclusion in hard-copy ANP publications, except that the whole amendment process will be performed in an electronic, web-based environment through the GIS portal. ANP material will be updated by authorized staff in State administrations around the world, as well as at ICAO headquarters and regional offices, who will input amendments directly to the database. User-friendly interfaces will assist in entering data, and data filters will reduce erroneous entries. Following a detailed technical review and verification of submitted ANP amendments at ICAO headquarters, ANP amendments will be stored in the database and, after formal approval, posted on the website.

GIS software and associated tools are used for capturing, storing, updating, manipulating, analysing and displaying geographically referenced information. The GIS portal provides remote desktop users with a single point of access to geographically referenced information and applications, regardless of the underlying database structure or format. The web functionality of the GIS has been ensured by placing the system on the ICAO server, which allows remote users to access and use the system without requiring special software to be installed locally at their workstations.

The ICAO GIS portal is intended to centralize Global ANP content and associated services such as aeronautical geographic data directories, planning and search tools, flow and traffic forecast information, planning support resources and associated applications. The portal will make it possible to query metadata records for relevant planning and other data and services, and will link users directly to the ICAO online site that hosts the air navigation planning services. At the

Overview of the GIS portal's various elements

portal, Global Air Navigation Plan content may be presented as selectable information layers, overlaid with information from other sources such as air navigation geographic-based data.

Development of the ICAO GIS portal began in 2005 as a way to support the updated Global ANP through the provision of GIS services and a set of interactive planning tools. When complete, the portal will contain information on flight information regions, aerodromes, routes, communications, navigation and surveillance, meteorology, search and rescue, aeronautical information services, air traffic flows, and so on. The portal will allow viewing, editing, reporting, development of amendment proposals and selection and allocation of codes, and will provide links to ICAO and other web-based resources and services (e.g. GEO Network) associated with, and useful for, air navigation planning.

The GIS software used by ICAO has extensive drafting tools which have allowed the creation of applications that permit authorized users to develop and propose changes to their respective ANPs directly through the portal. Besides planning data, global operational air navigation data will also be made available, allowing users to analyse and update the implementation status of the ANPs. It is envisaged that this facility will also aid regional coordination through web-based conferencing.

The GIS features include interactive dynamic charts from which the user will be able to select what is to be displayed. Other uses include identification of information, extraction of data, and geographic query and analysis, to mention just a few. A variety of products and outputs will be available, among them customized charts with selectable information and coverage, and a GIS-specialized CD-ROM and electronic files in various data formats. Integration of ANP data with a geographic information system provides graphical presentation of the geospatial data and hence facilitates validation of the planning data, since data discrepancies are easily detected visually and corrected.

In addition to air navigation planning material and tools, ICAO has incorporated the five-letter name code (5LNC) system and associated global database. The 5LNC system is intended for use by authorized air navigation planners in States to reserve codes. This system will significantly reduce the current workload in ICAO regional offices related to the maintenance and assigning of these codes. Since the system is fully integrated with the GIS, it will also be used to help resolve the duplicate, and sometimes triplicate, assignment of five-letter codes that exists at present.

ICAO has also developed a tool for searching, viewing and updating the aerodrome operations (AOP) data for all ICAO regions. This allows users to view aerodrome locations on a map and to interact with the system. Once linked to the GIS, users will have access to detailed aerodrome information and will be able to link this to additional sources of information, such as the Google Earth Service. An important function of the AOP tool for air navigation planning will be the ability of authorized users to edit and update AOP information and produce reports in the form of amended AOP tables.

Once linked to the GIS, users have access to detailed aerodrome operations data combined with additional sources of information such as the Google Earth Service. The screen shots illustrated here feature Bloemfontein Airport (FABL) in South Africa.

Progress is continuing on development of similar planning tools and applications to be used for the other ANP GIS services outlined above. These new tools will be

continued on page 32

Aleksander Pavlovic is Chief of the Aeronautical Information and Charts Section in the Air Navigation Bureau at ICAO headquarters, Montreal.

New training programme targets the world's airport managers

A series of courses being developed by ICAO and ACI is designed to provide managers with the knowledge and skills needed to improve the efficiency and cost effectiveness of their airport operations

ÖSTEN MAGNUSSON
BERNARD M. PÉGUILLAN
ICAO SECRETARIAT

A training course on international policies and practices for the establishment of airport user charges was delivered in May this year in the Balsberg Conference Centre in Zurich, Switzerland. This event represented the first in a series of courses that ICAO and the Airports Council International (ACI) have agreed to offer to airport managers around the world (see Issue 3/2006, p. 29).

The course on airport user charges — a pilot project for the launching of the training programme — includes two main components: an e-learning segment and a face-to-face workshop. Participants first receive a CD-ROM that they study prior to attending the workshop. The CD contains three modules addressing basic subjects such as an introduction to ICAO policies on airport user charges, essentials of airport financial management, and the basics of the consultation and negotiation process involving providers and users. Two additional modules contain a series of questions that allow participants to check their level of knowledge of the course subject matters.

The purpose of the user charges training course is to increase awareness and knowledge of ICAO's policies on airport charges. Although initially available only in English, the announcement of the first course attracted strong interest from airport managers all over the globe, and participation had to be limited to 30 managers from diverse areas including the Caribbean, North America, Africa, Europe, Asia and the Pacific.

The workshop component includes a review of the essential elements of ICAO's policies on charges and airport financial management, such as the identification of the appropriate cost basis for charges, cost allocation, economic regulation, and performance measuring. Emphasis is placed on practical cases and exercises, including the calculation of charges levels and the application of ICAO's policies and guidance for the establishment of user charges. Policies on consultations between airports and users are explained through the use of case studies.

An ICAO instructor explains the organization's policies on charges to participants at a workshop held at Zurich Airport during May 2006. The workshop is part of a new training programme launched jointly by ICAO and ACI.

With the establishment of a more privatized and commercialized environment in which airports operate, ICAO has experienced greater difficulty in communicating its policies to the appropriate entities that actually operate airports, since many of them are now separated from governments. To help promote a common international approach to user charges in a commercialized environment, ICAO recently made its policy document, *Policies on Charges for Airports and Air Navigation Services* (Document 9082), as well as its guidance material in the *Airport Economics Manual* (Document 9562) available free of charge on the ICAO website (www.icao.int).

ICAO's policies on airport user charges have been developed over a long period of time. They are based on recommendations by major economic conferences, the latest one held in June 2000, where the policies were adjusted to reflect the new environment. The current policies include several recommendations directly related to the operation of commercialized and privatized airports. These include the establishment of an independent mechanism for economic regulation, the application of best commercial practices, performance measuring, revenues from non-aeronautical activities, the use of return on assets for future investment needs or remuneration to shareholders, application of other economic principles (e.g. peak-hour or congestion pricing), and the pre-funding of large-scale investment projects.

Now that many airports operate in a commercial environment, international

Östen Magnusson is Chief of the Economic Policy and Infrastructure Management (EPM) Section in the Air Transport Bureau at ICAO headquarters, Montreal. Bernard M. Péguillan is an Economist in the EPM Section, and serves as Secretary of the Airport Economics Panel.

policies are needed to ensure that charges are applied in a transparent and harmonized fashion. Absent such policies, different regions or individual airports would develop and apply their own principles and invent their own charging schemes, which would probably result in overall higher charges in various locales. In such a policy vacuum, States would probably also find reasons to increase the taxation of international aviation.

The primary goal for participants in the course on user charges, as well as future ICAO-ACI course offerings, is to acquire the knowledge and skills that will enable them to contribute to improved airport operations by increasing efficiency and cost effectiveness. An analysis of evaluation forms filled out by participants at the end of the pilot workshop in Zurich in May revealed that the majority felt that the information taught would be useful in their daily work. Moreover, an examination carried out at the end of the workshop as part of ICAO's quality assurance process was successfully passed by 80 percent of the candidates.

The ICAO-ACI joint training programme will cover a variety of subjects in the fields of airport operations, airport financial management, safety management systems, airport certification and security. The courses to be offered will be determined by a market study that will be conducted by ACI.

The next training courses on user charges (i.e. the workshop part), to be offered in English, will convene in Zurich, Switzerland, in October 2006, and in Kuala Lumpur, Malaysia, in November or December 2006. Courses on the same subject are to be offered in Spanish and French in early 2007, at locations still to be determined.

For those who are only interested in the theoretical part of the airport user charges training programme, it will soon be possible to acquire the CD-ROM, "An Introduction to Setting Airport Charges," separately. For more information, contact ICAO's Document Sales Unit (sales@icao.int). □

REVISED MANUAL REFLECTS NEW TRENDS AND PRACTICES

The *ICAO Airport Economics Manual* (Document 9562), an important resource for the recently launched ICAO-ACI joint training programme, has been significantly revised through the combined efforts of the Airport Economics Panel (AEP) and the ICAO Secretariat during two panel meetings held recently for this purpose. The new edition of the manual has been released and disseminated to member States.

The updating and revisions of the manual were made necessary by the recommendations of a global economics conference held at ICAO headquarters in mid-2000, and new trends and practices that now govern the management of airports around the world.

Rand K. Peck

The *Airport Economics Manual* has been updated to reflect new trends and practices that govern the management of airports.

Composed of members from 16 States representing various regions of the world as well as five international organizations, the AEP agreed to update, improve and expand guidance on a number of airport economics issues. The major changes reflected in the second edition of Document 9562 are summarized below.

Chapter 1, dealing with ICAO policy on airport charges, has been slightly revised and expanded to cover the modifications already brought to Document 9082 as a result of recommendations emerging from an ICAO conference on the economics of airports and air navigation services in June 2000 (ANSConf 2000), and to incorporate the latest ICAO Assembly resolutions, including a reference to the resolution on environmental protection. This chapter presents a summary of ICAO's policies on airport charges, focusing on the main features described in detail in the following chapters in view of their implementation by States.

The second chapter of the revised manual discusses the organizational structures of airports and has been substantially expanded to include further guidance on privatization and commercialization, as well as to address the issue of airport networks. It now includes a new part on the economic oversight of airports that States may wish to implement in the context of airport privatization and commercialization. In terms of both airport privatization and commercialization and economic oversight, the manual indicates the different options available to States and the steps to follow in proceeding with the most relevant option.

Chapter 3, devoted to airport financial management, has been extensively redrafted in order to focus more on the principal elements needed by airport management, such as the application of best commercial practices, the establishment of business plans, and the introduction of the concepts of cost centres and service lines in the accounting and cost

continued on page 34

ICAO bids farewell to its long serving Council President

A tireless worker on behalf of international civil aviation, many praise Assad Kotaite's accomplishments as an effective consensus builder and leader

HALF a century ago, a young lawyer from Lebanon arrived in Montreal to assume a post at ICAO headquarters as the representative of his country. Dr. Assad Kotaite travelled to his new assignment in a piston-engined airliner, sea vessels positioned strategically on the ocean below to observe the weather and provide emergency assistance to transoceanic aircraft if called upon. The more reliable jet age had yet to dawn.

The international organization that Dr. Kotaite joined that October, founded in 1944 by the signing of the *Convention on International Civil Aviation* in Chicago, had 69 member States (it has since grown to 189 Contracting States, a testament to its relevancy). ICAO's work then, as now, focused chiefly on air navigation matters, with safety as a high priority, as well as activities in the field of air transport and development. While safety continues to be its raison d'être, related priorities have emerged: in 1956, the organization whose work became Assad Kotaite's preoccupation had not yet perceived a need for aviation security measures or for environmental policies. The requirement for mandatory audits of the safety oversight systems of Contracting States, as well as audits of aviation security systems — crucial roles the future Council President would champion — had not yet been recognized.

Dr. Assad Kotaite addresses the 35th Session of the ICAO Assembly held in Montreal in 2004, the last assembly in which the veteran Council President played a role.

At the start of his career in aviation, fewer than 100 million passengers travelled each year by air. As he steps down as head of the organization created to promote the safe and orderly development of civil aviation, more than 2 billion passengers travel by air annually. The growth of the industry has been spectacular, and Dr. Kotaite — first as Secretary General and then as President of the Council, the governing body of ICAO — played a pivotal role in making possible the technological and regulatory changes that ensured such growth could occur in a safe manner.

The Council President's illustrious career was the focus of attention on 16 June 2006, the date of the last Council meeting to be presided over by Dr. Kotaite, who first took up the gavel in 1976. There were many tributes, including a message from Kofi Annan, UN Secretary General, which was read out by ICAO Secretary General Taïeb Chérif before a gathering in the Assembly Hall.

"Assad Kotaite has worked tirelessly for half a century to advance the principles and objectives of the *Convention on International Civil Aviation*. He has devoted his life to promoting the safety and security of all who travel by air. He has furthered the understanding that a healthy and sustainable global air transport system helps build better lives for the citizens of our planet, and stimulates cooperation between peoples and nations. Throughout his mission, he has been guided by a profound belief in the power of dialogue and consensus-building in overcoming any obstacle that stood in the way of progress for the common good.

"As Dr. Kotaite retires as President of the Council of the International Civil Aviation Organization, I pay tribute to his exceptional contribution. He leaves a precious and far-reaching legacy," Mr. Annan wrote.

Wishing Dr. Kotaite all the best in the years ahead, Mr. Annan concluded his message by expressing appreciation for the departing Council President's well known vitality. "You may be stepping down," he observed, "but I very much doubt you will be slowing down — and that is good news for the rest of us."

On behalf of the ICAO Secretariat, Dr. Chérif presented the Council President with a platinum pin, symbolizing more than 50 years of service to the organization, and remarked on its uniqueness, "a distinction which has never been given in the whole history of ICAO, and which will undoubtedly never be given again." Before now, the most distinctive award for service to the organization was the gold pin, presented for 25 years of public service.

The Secretary General unveiled an official portrait of the long-serving President, to be placed at the entrance to the Council Chamber alongside the portraits of Edward Warner and Walter Binaghi, Dr. Kotaite's predecessors as Council President. And Canada, as host country to ICAO, commemorated the occasion by sponsoring a gala dinner and a warm celebration in honour of Dr. Kotaite. The special tribute in the ICAO Assembly Hall, organized together with the Secretariat, was attended by ICAO staff and Council members.

Dr. Kotaite later expressed his appreciation to the ICAO Secretariat and Council members by thanking them for their "constant support and cooperation throughout the years, without which this organization … would not be able to achieve its objectives.

"I leave ICAO in good hands, confident that the spirit of global consensus upon which it is built will always guide international civil aviation in helping to create and preserve friendship and understanding among nations and peoples of the world," he stated.

At his final meeting as President of the Council, which normally gives its full attention to diverse aviation matters, the spotlight was fully on Dr. Kotaite, with a number of Council members reminiscing about his long and remarkable career. Those taking the floor were representative of all regions of the world, and paid tribute in the six working languages of the organization. They thanked the outgoing President for his dedication and hard work, and spoke of his many abilities.

An effective mediator, Dr. Kotaite celebrates an agreement reached between the civil aviation administrations of China and Viet Nam during a meeting at ICAO headquarters on 7 December 2000. The two countries agreed to introduce a revised route structure and airspace organization in the South China Sea area on a trial basis and recently agreed on an amendment to the Regional Air Navigation Plan which was implemented on 8 June 2006. Flanking Dr. Kotaite in 2000 are Bao Peide, the Vice-Minister of the Civil Aviation Administration of China, at left, and Pham Vu Hien, Deputy Director General of the Civil Aviation Administration of Viet Nam (CAAV).

Donald Bliss, of the United States, remarked on the "extraordinary capacity of our President to build consensus and to negotiate the successful resolution of disputes in a way that not only serves the interest of all parties, but most importantly serves the public interest."

Mr. Bliss recalled Dr. Kotaite's decisive influence on a recent conference of directors general of civil aviation (DGCAs) that succeeded in creating a global strategy for aviation safety whose cornerstone is full transparency and sharing of safety information (see "Global safety conference heralds new era of openness," Issue 2/2006, pp 5-7). When it appeared that widely divergent views might prevent agreement to disclose safety audit results to the public, a step considered by many to be crucial to safety enhancement, Dr. Kotaite "miraculously" persuaded delegates to act in the public's best interest.

"The skies are far safer, more secure and quieter due to his efforts," Mr. Bliss also said of Dr. Kotaite.

Many of the tributes presented at his last Council meeting underscored Dr. Kotaite's impressive memory and his capacity to effectively summarize meetings even when they concerned sensitive and controversial issues. Yafeng Zhang, of China, cited this as one reason why Dr. Kotaite had been re-elected so many times as Council President. During his leadership of the Council, remarked Gonzalo Miranda Aguirre (Chile), Dr. Kotaite had been "a tireless worker for aviation, who gave wings to diplomacy," and had played a crucial role in finding solutions to crises that were fair to all parties.

Jean-Christophe Chouvet, of France, described the outgoing Council President as "an international civil servant who is truly a citizen of the world," citing his fluency in six languages, including five of the working languages used by ICAO.

Silvia Gehrer (Austria) commented on the President's remarkable communication skills, describing them as the "key to his success as negotiator, mediator and consensus builder," while Soo-taek Rhee (Republic of Korea), highlighted his role in expanding the ICAO Council's membership to represent every corner of the world. Saud Hashem (Saudi Arabia) praised his diplomacy and his profound knowledge of aviation issues. Mr. Hashem noted that Dr. Kotaite had done so much for aviation safety that "it is very difficult for any one of us to enumerate the achievements of Assad Kotaite."

Olumuyiwa Aliu, of Nigeria, stated that Dr. Kotaite's participation in Council meetings, ICAO assemblies and in diplomatic conferences had "led the way to finding solutions to very delicate and controversial issues, to the great appreciation of ICAO member States and the international aviation community." One of his unique characteristics, added Mr. Aliu, was the ability to earn the trust and confidence of others.

Igor Lysenko, of the Russian Federation, spoke of the President's impressive work ethic and dedication, noting that Dr. Kotaite had made a point of being accessible to Council members, in this way promoting highly effective relations. He expressed appreciation for the President's dedication to international cooperation and the development of civil aviation around the world.

"Throughout his long career, Dr. Kotaite has provided unfailing leadership in promoting optimum cooperation between ICAO Contracting States and members of the world aviation community," said Lionel Dupuis, of Canada, in summarizing the Council President's career. "Most noteworthy on the diplomatic front has been his success in maintaining open the airspace in many strategic parts of the world …. Dr. Kotaite's immense contribution to the orderly evolution of global air transport has earned him worldwide respect and admiration."

Saying that he was deeply touched and honoured by the Council's farewell, Dr. Kotaite pointed out that his accomplishments were only possible with the support of the Council and the Contracting States of the organization. Although he was retiring as President of the ICAO Council, he assured the Council members he would never be far away from the world of aviation. He noted that it had been a privilege to be associated with the extraordinary development of air transport over a period of 53 years, from the time of the Douglas DC-3 to the launch of the Airbus A380.

"In my view," Dr. Kotaite told the Council, "there is no problem without a solution, but you must have a spirit of acceptance and tolerance. International affairs ... requires that we look at problems not just through our own eyes but through the eyes of others as well."

Q&A

In late 1956, an announcement appeared in the pages of the *ICAO Bulletin* to the effect that Dr. Assad A. Kotaite had been named Representative of Lebanon on the Council of ICAO, the governing body of the organization. "He was officially welcomed by the Council on 2 October 1956," the *Bulletin* declared.

On 31 July 2006, Dr. Kotaite departs the Council, and ICAO, after having served as Council President for the last 30 years. In a symbolic gesture at his last Council meeting, he passed the gavel to his successor, Roberto Kobeh González, of Mexico.

Dr. Kotaite's career in aviation actually precedes his 1956 appointment. In 1953, the Government of Lebanon placed Dr. Kotaite in charge of legal matters, international agreements and external relations at the country's Civil Aviation Department, a post he held until he was assigned to ICAO. He was also made a member of the ICAO Legal Committee in 1953, and the young lawyer represented Lebanon at several ICAO conferences before arriving at headquarters in 1956. He served on the Legal Committee until 1970.

Dr. Kotaite received a degree in law from the French University in Beirut in 1948. He continued his studies in Paris, where he obtained a doctorate of law in 1952, having submitted a thesis on "the termination of the mandate in Lebanon." The future Council President also studied at the Institut des Hautes Études Internationales in Paris, and later specialized in international law and air law at The Hague Academy of International Law.

Dr. Kotaite represented Lebanon on the Council of ICAO more than once, initially until 1962, when he returned to his native country to serve as Chief of Administrative Services in the Directorate General of Transport. He was reappointed as a member of the ICAO Council in 1965, and remained in the post until July 1970. As a Council member, Dr. Kotaite served as Chairman of the Air Transport Committee during 1959-62, and again during 1965-68. He was also involved in the work of the ICAO Finance Committee and, externally, was a member of the UN Transport and Communications Commission from 1957 to 1959.

Assad Kotaite was appointed as the fifth Secretary General of ICAO in 1970, and remained as head of the Secretariat until 1976, when he became President of the Council. He was re-elected to this office 11 consecutive times, most recently in 2004 following the 35th Session of the ICAO Assembly. Although the term for which Dr. Kotaite was elected in 2004 would normally comprise three years, prior to the election he indicated that his 11th term in office would be of a transitional nature.

During the three decades in which he presided as ICAO Council President, Assad Kotaite provided the organization with leadership and continuity throughout a period of dramatic and long-term sustained growth for international civil aviation. As Council President, he championed a number of important initiatives, among them the creation of safety oversight and aviation security audit programmes. The *ICAO Journal* interviewed Dr. Kotaite in his office on the eve of his retirement.

Q: You must be very concerned about the recent conflict that has broken out in the Middle East, both as a Lebanese and as President of the ICAO Council? **A:** The air transport sector is very vulnerable to international or national crises, and of course it has been deeply affected by the current crisis in the Middle East. All three runways of the Rafic Hariri International Airport in Beirut have been bombed, although it is a civil airport and Lebanon has no air force. I don't see any justification for the bombing of the airport, which has been shelled repeatedly and is now out of operation.

A letter was sent immediately to the Vice Prime Minister of Israel, who is also the Minister of Transport, with copies directed to the Minister of Foreign Affairs of Israel, the Director General of Civil Aviation and others. I reminded Israel of its commitment to protect civil aviation under the *Convention on International Civil Aviation*, and I requested that it exercise restraint and take all necessary measures to allow Beirut airport to return to normal operations.

Your predecessor as ICAO Council President, Walter Binaghi, died only a few days ago. The passing away of Mr. Binaghi is a big loss. It affected me more than others because I worked closely with him. I worked with him when I was the Representative of Lebanon and also during my period as Secretary General.

ICAO's current headquarters building was officially inaugurated at a ceremony in December 1996. Dr. Kotaite and then ICAO Secretary General Dr. Philippe Rochat (at right) are pictured on the special occasion with (l-r): Walter Binaghi, former President of the ICAO Council (1957-76); Montreal Mayor Pierre Bourque; Quebec Premier Lucien Bouchard; and Canadian Prime Minister Jean Chrétien.

He was a man truly dedicated to civil aviation safety, and he had an extraordinary capacity for work. Before he became Council President, he was Chairman of the Air Navigation Commission for nine years, which is a record. During this period, from 1948 to 1957, a number of annexes were developed, and he took a big part in drafting them. ICAO was still a new organization then, and he was a visionary in a way, recognizing that without safety there can be no growth. I have the greatest respect for Mr. Binaghi, and I learned a great deal from him.

In 1948, after acquiring a degree in law at the French University in Beirut, did you have any inkling that you would embark on a lifelong career dedicated to the development of civil aviation? Really, no, absolutely. It is amazing to think that when I was appointed Representative of Lebanon, it was for only one year.

I was a bit reluctant to come to Montreal, but the government had a problem finding a representative. So I came for one year, and you see where I am now. But I never thought, when studying in Beirut and in Paris, that one day my career would be in aviation and that I would reach the summit of aviation, to be President of the ICAO Council. Of course I am happy with how it turned out. It has been a wonderful time, and if I could do it over, I would do the same thing.

With your long-range perspective, would you describe the challenges of today as more complex or more urgent than those of the past? Definitely. I can say without hesitation that the challenges of today are much more demanding. For one, the Chicago Convention has no reference to security or the environment, and these areas now present major problems.

The greatest challenge is related to growth. Last year the airlines carried 2 billion passengers, and this year the average growth should be around 5 percent. If this continues, in 2015 we will have to manage some 2.8 billion passengers. But such growth has a negative impact on the environment, so we must work hard to minimize the environmental impact of civil aviation. Although aviation pollutes much less than other industries, the problem with aviation is that it is so conspicuous. Aircraft fly over your house and you hear the noise. You do not hear the noise of the industries that are producing a lot more pollution, and a lot of carbon dioxide.

ICAO, together with the aviation industry, has made a lot of advances regarding the environment, establishing a special annex to the Chicago Convention. We now have a policy for noise, the balanced approach, which is reducing the effect of noise in populated areas near airports. The other environmental issue, engine emissions, is a very delicate and complex one, but ICAO is working hard on this matter. We should be able to count on the development of technology and at the same time on enhancements in air traffic management. ICAO is working with very good experts.

Security is another area of concern that calls for a global solution. Following the events of 9/11, we moved quickly to introduce more stringent security measures. Our goal is to establish an effective global security system, with the support of all States.

The ICAO flag is proudly displayed by Dr. Kotaite on the occasion of the organization's 50th anniversary. Then Secretary General Dr. Philippe Rochat looks on.

The DGCA Conference held last March gave shape to an action-oriented global aviation strategy. It was a great achievement. We should always struggle for safer skies, because safety does not happen by itself. It is a process. The recent conference provided a vision for the next century, and decided that it was important to have transparency. ICAO had already established a safety oversight audit programme, but the findings were known only to ICAO and the State concerned. The conference said no to the status quo, and declared that safety information should not only be communicated to States, but to the public. This was a very important breakthrough.

At a certain point it appeared we would not achieve what we set out to achieve. But with the cooperation of States, along with my proposal that States be allowed up to two years to update safety information before it must be released to the public, the achievement was made possible.

States agreed that if no authorization is given by the 2008 deadline, ICAO is completely free to release the information. ICAO will publish a press release and post the safety information at its public website. No attempt will be made to categorize findings, but when we make them known to the outside world, the public can draw its own conclusions about whether to fly with a particular airline.

You have often returned to the theme of global cooperation over the years. Is the spirit of cooperation alive and well today? I think it is for aviation, yes. You began by asking me about the Middle East. It is unfortunate that aviation is a victim of a political problem in the Middle East. When you speak to aviation people, you find that the spirit of cooperation transcends borders. They are focused on safety and security.

Cooperation among States remains good, but we have to try to make it better. From time to time we are disappointed with developments, but we should not let our disappointment distract us from the essence of our work, which is to ensure the safety and security of air transport.

As the longest serving Council President, what would you consider to be the greatest challenge facing the organization? There are always challenges, but I am leaving a strong organization, an organization that is highly respected and efficient. We still have work to do to make it more efficient, but I am not really concerned because I know the organization will continue on a solid basis. My successor, Roberto Kobeh, is a man of experience. I knew him before he joined the Council, where he has served his country for eight years. He is very capable and I am confident that he will lead the organization well.

Speaking of challenges, there is an emerging issue that I would like to highlight here, and that is related to all aviation developments and — particularly in the 21st century — to market liberalization, traffic growth and new technology. I am concerned that one day we will find our growth not restrained by flight saturation, but by the lack of qualified pilots. By 2015, as I noted earlier, traffic will reach some 2.8 billion passengers, but at the same time, we estimate that by 2015 we will have about 30 million departures. Even now, in certain areas we do not have enough pilots, and this is a matter that calls for attention.

Over the years you have acquired a reputation as a mediator and consensus builder. To what do you attribute your success in this area? When you act as a conciliator for two parties, it is essential first of all to have their trust. Trust is much more important than knowledge in such negotiations. Number two, a negotiator or conciliator should listen carefully to different points of view. Number three, a negotiator should not start by eliminating any argument by assuming that it is invalid. Number four, the negotiator has to be able to summarize the views of the parties and then test the water to see to what extent the parties are ready to negotiate. At this stage he should gradually put his knowledge to use, discussing with the parties which comments are valid or which part cannot be accepted, always with objectivity and integrity. All of this requires a lot of patience.

I negotiated between the European Union and the United States during the debate over the use of hushkits, a process that required years. The negotiations to open the airspace between South and North Korea required 16 years, from 1981 to 1997. And regarding the provisions of air navigation services above the South China Sea between China and Viet Nam, we started to deal with this matter in 1975. We reached an agreement that was implemented in June of this year, after I approved the amendment of the Air Navigation Plan.

The recipient of many awards over the years, Dr. Kotaite is shown on 5 June 2006 with a sculpture representing the evolution of transport, presented by IATA in recognition of his 53 years of service to the international civil aviation community. Pictured are (l-r): Jean-Cyril Spinetta (Air France-KLM Group), President of the 62nd IATA Annual General Meeting; Dr. Kotaite; IATA Director General and CEO Giovanni Bisignani; and Robert Milton (Air Canada), Chairman of the IATA Board of Governors for 2005-06.

At a certain moment you may find that the door is locked, you cannot go further than that. It is my view we should never lock the door so the dialogue can continue. I have been following this approach throughout my career, relying on the cooperation of States. Without this, what can an international civil servant do?

I have exercised this approach in case of conflict within the Council, at various conferences, ICAO assemblies, and so on. In 30 years, it was very, very seldom that I asked the Council to vote on a problem. Usually, the Council would engage in a lot of discussion, but finally it would accept a proposed solution.

So as a mediator, you must be trustworthy obviously, but you must also show great patience. Absolutely, absolutely. Trust and patience. These are the two key words. Of course what I have accomplished here was not, frankly speaking, an individual effort. I was always surrounded by good experts and advisers from ICAO. They travelled with me, and we would discuss the matter among ourselves before devising a strategy. And then we would start to implement the strategy step by step. In policy matters you should not take the elevator, but rather the stairs.

Tributes

ICAO COUNCIL

Luis Adrover, *Representative of Spain on the Council of ICAO (Dean of the Council)*

During an extended period of time in which Dr. Assad Kotaite served as ICAO Council President, and before that as the Secretary General, ICAO has been able to identify rapid and effective solutions to the various challenges affecting international civil aviation. These solutions have always been appropriate, thanks in large part to the untiring efforts of Dr. Kotaite.

When we review ICAO's achievements during these past 30 years, we can see Dr. Kotaite's mark on all of them. His ability to achieve results, both in the Council of ICAO as well as in the capitals of the countries that constitute the organization, has always been remarkable.

Dr. Kotaite has always worked towards coherent decision-making that has been instrumental in achieving the current levels of aviation safety and security, with the unwavering objective of achieving ever better results. This in turn has inspired a high level of confidence amongst civil aviation users.

He has been able to convince all stakeholders of the importance of addressing the problem of aircraft noise near airports, so much so that he was able to persuade both the emerging countries as well as the developed countries of the necessity to accept ICAO proposals and regulations in this area.

During his mandate, the world has accepted ICAO rules that substantially reduce aeroplane engine emissions; the environmental benefits of this policy are undisputed. He continues to work untiringly to convince the aviation industry to respond adequately to the over-riding requirement of the preservation of the global environment.

He spearheaded the initiative that made it possible to establish and maintain a comprehensive system of universal audits that is fair and effective, initially for safety oversight, but later also for reinforcing the highest levels of aviation security while maintaining the highest possible level of air transport efficiency.

Finally, he has ensured the full transparency of safety oversight audits, a requirement accepted by the conference of DGCAs held last March in Montreal. Swayed by Dr. Kotaite's efforts, the conference recognized the need for public disclosure of accurate safety information in each member State of ICAO.

During these past 30 years, there have been conflicts and controversies that created confrontations between some member States of the organization. In these situations, Dr. Kotaite has always managed, despite all odds and without any apparent effort, to bring about a satisfactory result for all parties involved, even when initially the parties departed from seemingly irreconcilable positions. This ability to obtain results, even in seemingly impossible situations, is one of the characteristics that has impressed me the most during the years that I have been a member of the ICAO Council.

For all that, where his leadership qualities, as well as his unwavering dedication to the organization, have been the most remarkable is in the steps he has taken to ensure that the ever continuous improvements to ICAO's efficiency do not suffer from his departure.

In a time of global change, there is a great need for a stable balance between those who seek radical change and those who are reluctant to promote change. To successfully achieve this equilibrium requires guidance from an individual of exceptional ability and intelligence.

The Council of ICAO, with its President at the forefront, is modernizing the working procedures of the organization, a delicate task that requires great diplomacy, understanding and wisdom. Assad Kotaite has set the stage for this debate, and thanks to him we can look to the future with optimism. However, where Dr. Kotaite excels with exceptional brilliance is in his human qualities. His proven intelligence and honesty have assured him the respect of all who know him. His simple modesty ensures that he is always much appreciated as a friend and ally. In addition, his sharp sense of humour, never acid, is always pleasant and entertaining.

We give our thanks to Dr. Kotaite, to whom we are indebted for all the years he has dedicated to the betterment of civil aviation.

INTERNATIONAL AIR TRANSPORT ASSOCIATION

Giovanni Bisignani, *Director General and CEO*

Dr. Assad Kotaite's achievements have been extraordinary, given the widely differing points of view and different interests he has had to reconcile across the globe over the years. Most people would have been defeated by these conflicting demands. Dr. Kotaite is no normal person. He leaves behind an unsurpassed legacy of real achievements in our industry and has built a strong edifice that will last for many generations to come.

I have had the privilege of knowing and working with Dr. Kotaite for many years, beginning when I was CEO of Alitalia, and now at IATA. This spans a decade and a half — only a small portion of Dr. Kotaite's decades of industry leadership. Nonetheless, I would like to use this opportunity to share some reflections on our work together.

There can be no doubt that ICAO is among the most effective of the many international organizations. There can also be no doubt of the role of Dr. Kotaite in keeping ICAO relevant and respected throughout the world of civil aviation.

Some international organizations face a state of conflict with their stakeholders, and this can lead to a level of paralysis where it becomes impossible to move forward. The air transport industry is potentially ripe for this sort of paralysis, but Dr. Kotaite had the vision to see the pitfalls and to bring together the stakeholders, to increase understanding of everyone else's point of view and to reach consensus. Sometimes we would have liked to move faster, we are a fast moving industry where we want everything yesterday. Dr. Kotaite had the courage and good sense to resist our impatience and to put in place solid, well-considered proposals that would stand the test of time. He has thus been instrumental in forming policies and standards that have shaped a thriving industry that flies over 2 billion passengers annually, generates 29 million jobs, and contributes U.S. $3 trillion in economic activity, 8 percent of global GDP.

This has been achieved thanks to Dr. Kotaite's efforts to focus on four industry pillars – safety, security, environmental responsibility, and liberalization. These are four issues that are at the forefront of our industry.

Safety is our industry's number one priority and our greatest achievement. Throughout his career, Dr. Kotaite has been tireless and relentless — not in just talking about safety, but in delivering results. ICAO's Universal Safety Oversight Audit Programme (USOAP) is a cornerstone of civil aviation safety, anchoring numerous industry safety initiatives. Transparency is critical to our efforts on safety, but not necessarily intuitive to our approach. Only a few months ago, I was left admiring Dr. Kotaite's tremendous ability to achieve consensus on difficult issues when he brought stakeholders together to agree on greater transparency in USOAP's audit results. And it was a privilege to sign a landmark agreement between ICAO and IATA to work even more closely on safety issues, particularly by sharing audit data from our operational safety audit programme that is now a condition for IATA membership.

As I was first considering joining IATA in the fall of 2001, the entire world was focused on the impact of the tragic events in the United States. Aviation security had suddenly shot to the top of everyone's agenda — both politically and technically. Dr. Kotaite stepped up to the mark. While many panicked, he drew us back to the obvious solution that is at the very heart of ICAO's existence: global standards and harmonization. The world backed the ICAO aviation security plan of action. And many were drawn to conclusions that ICAO, under Dr. Kotaite's leadership, had already planned for — biometric identification in passport documentation among them. We still have a long way to go, but the vision is clear.

Dr. Kotaite also placed ICAO at the forefront of industry efforts on the environment. Those who drafted the Kyoto protocol had the confidence to entrust ICAO with finding a solution for global aviation. I watched at the 35th Assembly [in Montreal in 2004] as Dr. Kotaite skilfully reminded delegates to resist the temptation for regional solutions on carbon emissions that may deliver more political points than benefit our efforts on the environment. In April of this year we sat next to each other at the 2nd Aviation and the Environment Summit in Geneva, and agreed to work together with all industry stakeholders to ensure that we achieve agreement at the 2007 ICAO Assembly. The task will not be easy, but the foundation for a solid agreement has been carefully put in place.

Finally, Dr. Kotaite also clearly understands that air transport is a business in need of commercial freedoms. I witnessed his leadership at the 5th Air Transport Conference, when we moved from debating the merits of liberalization to planning for it to happen. The conclusion was for a staged approach to progressive liberalization. All the industry may not be moving at the same speed. But it is the job of leaders to define the direction and set the course. Now it is up to the next generation of leaders to follow through and deliver results.

Dr. Kotaite's vision, dedication and accomplishments truly make him one of the most outstanding figures of the first century of aviation. He has earned the gratitude of the aviation industry past, present and future. The mark he has made will be felt for many years to come. On behalf of both our membership and our employees, I wish him all the very best in his well-earned retirement.

AIRPORTS COUNCIL INTERNATIONAL

Robert J. Aaronson, *Director General*

The ability to provide true leadership is a rare quality, but one that Dr. Assad Kotaite has clearly demonstrated during his successive mandates as President of the ICAO Council. The airport community highly values his decisiveness and diplomacy in promoting the standards and industry harmonization that sustain the exponential growth we have witnessed during his tenure at ICAO.

Dr. Kotaite has always made clear the importance he attaches to airports in the aviation sector, saying on several occasions that the three pillars of aviation are ICAO, ACI and IATA, and using the following metaphor to describe their roles: “ICAO writes the script for States and their civil aviation authorities; ACI airports provide the stage where it all happens; IATA airline members are the international players on that stage.”

He has always recognized that airports represent the biggest single investment in a country’s civil aviation infrastructure, and are perhaps its most demanding component administratively, technically and financially.

In a recent interview given to *ACI World Report*, Dr. Kotaite mentioned that he had been a supporter of ACI since it came into existence. He considered it a very important step for the airports to create a body mandated to speak on behalf of airports worldwide. He foresaw that in practical terms, the formation of ACI has allowed airports to table their positions on a very wide range of issues and thereby take part in the shaping of global standards that are meaningful for the industry.

Foresight has been a hallmark of Dr. Kotaite’s tenure, and he has pushed ICAO member States to carry forward new ideas and solutions of critical importance to airports. To continually improve our industry’s safety record, he has actively urged States to support the ICAO Universal Safety Oversight Audit Programme (USOAP) and promoted efforts to increase sharing aviation safety information. At ACI, this has given further impetus for the introduction of a new ACI Global Safety Network, which airports worldwide will support.

In the operational area, we see many outstanding examples of his visionary approach. Dr. Kotaite raised the issue of introducing new larger aircraft, anticipating the impact on airport facilities and services and working closely with ACI throughout the preparatory period.

Environmental considerations present a challenge that Dr. Kotaite evoked many years before it became a leading issue in aviation. He stated, “Perhaps the most contentious and difficult subject dealt with by the ICAO Assembly in September 1986 was that of aircraft noise.” He predicted that environmental considerations would remain a crucial factor to be weighed in all future developments, and his prediction was borne out at the 33rd Assembly [in 2001], where over a long night of negotiations he hammered out an agreement on a balanced approach to aircraft noise management. Environmental matters again took centre stage at the 35th Assembly in 2004.

Dr. Kotaite’s leadership and ability to work under pressure were perhaps never more tested than in the wake of the events of 9/11. After these incidents he moved quickly to convene a ministerial meeting on security. Building on the momentum of that meeting, Dr. Kotaite then led the Secretariat, in concert with States, ACI, IATA and other observers, to draft and obtain fast-track approval for some 20 new standards to strengthen Annex 17. Indeed, thanks largely to his efforts, the toughened version of the annex entered into force at the early date of July 2002.

Assad Kotaite is not only a man of vision, but someone who sees cooperation as an optimum factor in achieving progress in the aviation sector. At the first ACI World Assembly in October 1991, Dr. Kotaite’s keynote speech set out this full support for a cooperative strategy, observing that airports are part of a single transport and communications system whose unfailing characteristic over nearly five decades has been the ability to find commonality and develop harmonized viewpoints and integrated approaches to mutual problems. “As we look to the future,” he said, “the best hope we have of conquering the many challenges that face us is to continue to pursue our compatible objectives with integrated approaches and a harmonization of viewpoints.”

Dr. Kotaite has the intellect, drive and energy to recognize the practical challenges that airports face in the near-to-medium future. In January 2006, during a number of meetings with the Director General of ACI World and the heads of the regional organizations, he took on board the airports’ concerns about the need for planning for infrastructure investments in the light of the dramatic foreseen growth in air transport movements up to 2020. He recognized that not only the world of aviation but political leaders must face up to these requirements in a practical and well-planned manner. He is now playing his part by highlighting this issue in the many public forums that he speaks to, and in individual meetings with political and aviation leaders. At the ICAO/ACI Conference at the end of June, he not only raised the necessity for infrastructure planning, but took some practical steps to ensure that the focus on the capacity issue remains at the forefront of ICAO policy and planning.

During his extensive travels to member States, Dr. Kotaite often visited aviation facilities and construction projects, such as the site of the new Hong Kong International Airport (Chek Lap Kok) in mid-1997. With the future terminal in the background, Dr. Kotaite is given a briefing by Richard Siegel, the Director of Civil Aviation at the Hong Kong Civil Aviation Department.

It is a great pleasure for me to be given the opportunity not only to reflect on Dr. Kotaite’s contribution to the development of airport policy, but at the same time to say a heartfelt thank you on behalf of ACI, our members and staff for his steadfast support over the years. I greatly value our frequent contacts over the last number of years, and I can add that the experience has given me a deep appreciation of his intellect, vision, patience, energy and especially his great sense of humour. From the airports, we say goodbye and wish him well in the future.

THE ICAO COUNCIL AT THE CLOSE OF ITS 178TH SESSION IN JUNE 2006

1 Dr. Assad Kotaite, President of the Council; **2** Taïeb Chérif, ICAO Secretary General and Secretary of the Council; **3** Lionel Alain Dupuis (Canada); **4** Gonzalo Miranda Aguirre (Chile); **5** Simon Clegg (Australia); **6** Luis Adrover (Spain); **7** Adan Suazo Morazán (Honduras); **8** Soo-taek Rhee (Republic of Korea); **9** Thomas Tekou (Cameroon) **10** Yafeng Zhang (China); **11** Nicholas Denton (United Kingdom); **12** Delfim de Deus (Mozambique); **13** Haruhito Kono (Japan); **14** Lars Carl Erik Lövkvist (Finland); **15** Dr. Nasim Zaidi (India); **16** Herald Alexander Wilson (Saint Lucia); **17** Bong Kim Pin (Singapore); **18** Dr. Attila Sipos (Hungary); **19** Pedro Bittencourt de Almeida (Brazil); **20** Mankopano Daniel Tshepo Peege (South Africa); **21** Fabio Cristiani (Italy); **22** Meshesha Belayneh (Ethiopia); **23** Silvia Gehrer (Austria); **24** Julio Muñoz-Deacon (Peru); **25** Donald Bliss (United States); **26** Julio Enrique Ortiz Cuenca (Colombia); **27** Souleiman Eid (Lebanon); **28** Nabil Ezzat Kamel (Egypt); **29** Saud A.R. Hashem (Saudi Arabia) **30** Igor Lysenko (Russian Federation); **31** Dr. Horst Mürl (Germany); **32** Jean-Christophe Chouvet (France); **33** Roberto Kobeh González (Mexico), the President-elect of the Council; **34** Daniel Oscar Valente (Argentina); **35** Dr. Olumuyiwa Benard Aliu (Nigeria); **36** Kofi Kwakwa (Ghana). Missing from photo: Hamdi Chaouk of Lebanon (pictured is the Alternate Representative); Mohamed Chérif (Tunisia).

PASSING THE GAVEL

In a symbolic gesture at the sunset of his career, Dr. Kotaite passes the Council Chamber gavel to his successor, Roberto Kobeh González, of Mexico, whose term in office commenced on 1 August 2006.

Photos by Gerry Ercolani (with exception of photographs on S5 and S7)

Hurdles to wide acceptance of AMOS will eventually be surmounted

Before automatic meteorological observing systems can enter common operational use, sensor and system manufacturers will need to work with meteorological service providers to improve their performance

PEKKA UTELA
VAISALA OYJ
(FINLAND)

ALTHOUGH the potential for cost savings is driving the development of automatic meteorological observing systems (AMOS), fully automatic observations have not yet come into widespread use. ICAO has taken the position that current requirements, as stated in ICAO Annex 3,* cannot be fully met with automatic systems. A 2004 amendment to Annex 3 introduced provisions which allow for automatic observations during non-operational hours, but human input or quality control is still required during active operations. It is anticipated that future ICAO Annex 3 amendments will allow the use of fully automatic systems during an aerodrome's operational hours, subject to local agreements between weather providers, regulators and aircraft operators.

Pioneering efforts to replace human observations with completely automatic systems were poorly received by user communities, causing delays in implementation and modifications to the original goals. Complete replacement of human observations has rarely been successful, and early systems have often had to be modified to allow for human review and modification of the meteorological reports.

Such systems have been better accepted once users have become more experienced with automatic observations, and after they have been trained to better understand their limitations. One of the lessons learned by the pioneers is that automatic observations should not be seen as a direct replacement of human observation. They have different characteristics, but without education, users tend to expect equivalent data that cannot be provided.

Part of the resistance to the implementation of AMOS has been the limitations, and the fact that some meteorological phenomena are currently not well observed. Errors made by automatic systems may appear ridiculous to users familiar with human observations and the types of errors humans make. Sensors used in the fully automatic systems must also be more reliable than at present. Inaccurate measurements or failures in difficult meteorological conditions are not acceptable.

Despite fundamental limitations, automatic meteorological observing systems are generally better accepted once users have gained some experience with using them.

It is generally accepted that temperature and barometric pressure can be reliably measured with automatic systems. Possible problems with these measurements are related to other factors, such as poor siting of the measuring equipment, and would apply equally to instruments read by human observers. The main deficiencies lie in the reports of weather parameters which are based on visual observations, i.e. visibility, present weather and clouds.

Reports of visibility. The theory of visibility measurement is reasonably well developed, and the relationships between subjective observations and measurable physical quantities have been long established. ICAO, in cooperation with the World Meteorological Organization (WMO), has defined the methods to be used for measuring and calculating visibility and runway visual range (RVR). The remaining problems are related to the accuracy and spatial coverage of measurement.

The essential factor determining visibility and runway visual range is the attenuation of light in the atmosphere, which can be measured with sensors. The reported visibility variables are derived from this basic measurement, in combination with other information (e.g. ambient light, runway light setting). The accuracy of visibility measurements is mainly determined by the accuracy of the visibility sensor.

Currently there are two different sensor technologies being used for visibility measurement: transmissometers and (forward) scatter sensors. Transmissometers measure attenuation directly by projecting a beam through the atmosphere and measuring the light arriving at a separate receiver unit. This method provides correct results independent of the type of weather. However, traditionally transmissometers have had very limited measurement ranges, and their accuracy is significantly affected by any contamination of the optical surfaces.

Scatter sensors project a beam of light into the atmosphere and attempt to measure the amount of light scattered away from the beam. Because scattering is the dominant cause of attenuation, in theory this method should provide accurate results. Scatter sensors can have wide measurement ranges and are typically compact in construction. Moreover, they are less sensitive to contamination of lenses, permitting longer intervals between cleaning.

Unfortunately, practical scatter sensors cannot capture and measure all scattered light; they can only sample a selected portion. Moreover, the distribution of the scattered light varies significantly depending on the agent causing the scattering. Thus scatter sensors may have widely varying responses depending on the type of weather.

Careful development and testing against reference transmissometers is required to produce scatter sensors which remain accurate in a range of weather. The best sensors available today have been shown to measure visibility quite accurately in fog, rain, snow and haze. Performance in other types of weather, such as sandstorms or smoke, has not been fully established, and the use of scatter sensors is not advisable if these phenomena are expected to occur regularly.

Both types of visibility sensors sample only a limited volume of air. The measurement volume of a transmissometer is significantly larger, but is still only a small fraction of the total volume within the line of sight of a pilot. Measured results and observed visibility may have large discrepancies in non-homogenous conditions, for example, in fog patches or when a bank of fog approaches from one side of an aerodrome. Such situations probably give rise to the main complaints against automatic visibility measurement.

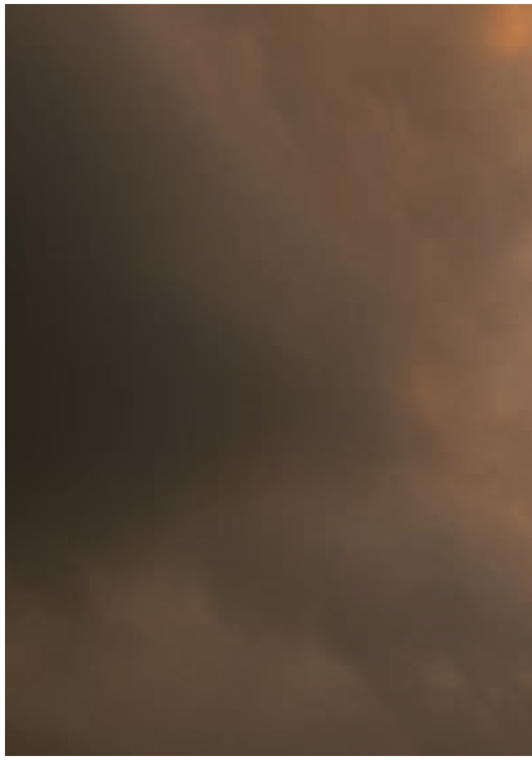
Unfortunately there are no simple ways of improving the spatial representativeness of visibility measurement. Some experiments have been carried out with new types of instruments scanning a wide area, but no new technical breakthroughs have been introduced commercially.

Currently the use of multiple sensors seems to offer the best approach. The recently introduced concept of prevailing visibility was specifically formulated to allow the use of many measurement points. Siting extra sensors based on the local climatology may improve the results significantly, if, for example, fog-prone areas can be suitably covered.

Modern RVR sensors can also be used to provide information for prevailing visibility. Typically they already span major runways, the most critical areas of the aerodrome. With a few well-placed additional sensors, the whole aerodrome area can be monitored to a high degree of accuracy. The total number of sensors may be varied depending on local meteorological conditions and the level of representativeness required.

Latest developments in the technology of visibility sensors have concentrated on improving the reliability and accuracy of measurement. Vaisala, a manufacturer of such sensors, has recently introduced a new transmissometer which includes a forward scatter sensor in the same instrument. The new sensor combines the advantages of both measurement technologies, offering a wide measurement range and stable measurement performance in all meteorological conditions.

Reports of present weather. Probably the most difficult parameter to assess automatically is present weather. The current table of METAR/SPECI present weather codes includes a number of different physical phenomena (precipitation, obscurations such as smoke, etc.) as well as different spatial characteristics of these phenomena (shallow, patches, partial, etc.). The definition of present weather clearly has its roots in human observations, and consequently an automatic present weather observing system must attempt to emulate human observations.



This task is complex because of the lack of exact physical definitions for the various weather types. Current automatic systems also suffer from the lack of a priori information; they are at a disadvantage compared to human observers because they have no knowledge of local climate, seasons, the time of day — or a weather forecast.

Meteorological sensors available today are limited to a subset of the present weather table. Typically they are able to determine the intensity of precipitation and to identify a limited number of different forms of precipitation, such as rain, drizzle and snow. The sensors may also be capable of identifying some common obscurations. These may be the most prevalent meteorological conditions at many locations, but some critical phenomena are left out. For example, additional measurements are required to identify thunderstorms.

Most advanced current systems are based on combining measurements from several sensors at the system level. This can be done at the aerodrome, or at a national or regional centre. Modern systems may be able to combine information concerning precipitation type, ice accretion, thunderstorms, visibility, cloud height, wind, temperature and dew point.

Nevertheless, some fundamental limitations remain. One key limitation is the performance of precipitation type detectors. Current sensors still make more errors than many users are willing to accept, and some important forms of precipitation, such as hail and ice pellets, are either poorly or incorrectly identified.

Several steps are required to reach a fully satisfactory level of performance in automatic present weather observations. Sensor technology needs to be developed further to minimize the number of incorrect identifications, and sensors also have to be enhanced to detect all critical types of weather (e.g. hail) reliably. Yet another necessary step is the further development of system-level algorithms. Data from several sensors, and even lightning location networks, can be combined for better results.

Photodisc

Finally, it would appear the manner in which requirements for present weather reporting are presented may need to be changed. The current collection of meteorological information is heavily influenced by the capabilities of human observers, and trying to achieve all of the same capabilities with automatic systems is not a realistic goal. Instead, the aim should be to identify the essential present weather parameters and then develop systems capable of detecting these parameters, an ongoing task before the ICAO Aerodrome Meteorological Observing Systems Study Group (AMOSSG).

Reports of clouds. Cloud reporting requirements include cloud height, cloud amount and identification of two cloud types: cumulonimbus (CB) and towering cumulus (TCU).

Traditionally, human observers have used some measuring instrument or other observing aid such as pilot balloons to estimate cloud height, while relying on eyesight to estimate the cloud amount and types. Currently the most common instrument used for cloud height measurement is a ceilometer based on the light detection and ranging (LIDAR) principle.

LIDAR ceilometers can provide an accurate measurement of the distance to the cloud base (i.e. cloud base altitude). The distance is computed from the time it takes short pulses of light to be scattered back by the clouds. Because time can be measured with high precision, the distance measurement can be highly accurate in ideal conditions.

Sensors used in automatic meteorological observing systems need to be improved. Errors still occur too often, and some important forms of precipitation, such as hail and ice pellets, may be poorly or incorrectly identified.

Cloud bases are not always well defined, however, and precipitation may disturb the atmosphere below them. Ceilometers have to use quite sophisticated algorithms to find the cloud base reliably in conditions with precipitation or with ground-based obscurations. The quality of the algorithms and the inherent measurement performance of the ceilometer will make significant differences to the performance in marginal conditions.

The performance in cloud-base detection is not as critical if the sensor is used as an observer's aid. The observer can judge the sensor readings and extract correct information, even from unreliable measurements. The requirements become much more stringent if the sensor has to operate fully automatically. Only a minimal amount of erroneous cloud base readings can be tolerated, and leading sensors today have achieved a level of performance which seems to meet the needs of most users.

A LIDAR ceilometer takes a measurement at a single point in the sky, and

continued on page 31

* Annex 3 to the *Convention on International Civil Aviation* (also known as the Chicago Convention) contains provisions, including standards and recommended practices, for meteorological services required for international air navigation. In all, 18 annexes to the Chicago Convention contain provisions for the safe, secure, orderly and efficient development of international civil aviation.

Pekka Utela is the Product Line Manager (Optical Sensors) for Vaisala Instruments, of Vaisala Oyj, and serves as an advisor to the Finnish member of the ICAO Aerodrome Meteorological Observing Systems Study Group. A supplier of meteorological instruments including automatic meteorological observing equipment, Vaisala is based in Helsinki, Finland (www.vaisala.com).

Ground icing remains a safety issue that warrants further research

The effect of a very thin layer of wing ice or frost on an aircraft's aerodynamic performance has been known for years, but accidents still occur despite introduction of the "clean aircraft" concept. A number of issues, including the role of human factors, still need to be addressed.

DR. OLEG K. TRUNOV
STATE RESEARCH INSTITUTE FOR CIVIL AVIATION (RUSSIAN FEDERATION)

THE aeroplane took off at 0843. Eight seconds after leaving the ground, the Yakovlev Yak-40 pitched nose-up and rolled to the left, and the resulting high angle of attack caused it to stall at a height of less than 10 metres (approx 30 ft). The crew and passengers perished in the ensuing crash.

The accident at Moscow's Sheremyetovo Airport on 9 March 2000 caught the attention of the Russian public and gave rise to heated discussion during the investigation, and is still occasionally mentioned in the press.

Pre-flight preparations had been hurried. During the walk-around, the aeroplane was found to be covered with snow, which was brushed off. The pilot-in-command, perhaps in a rush, may simply have accepted an oral report that everything was OK, rather than inspect the aeroplane personally.

This accident is just one of many cases involving ground icing. The author participated in the investigation as an independent expert from the Interstate Aviation Committee (IAC) Aircraft Register, and, based on personal test flight experience, concluded that there must have been ice on the aircraft's wings. Although ground icing was not observed at the time of the pre-flight preparation and take-off, icing did occur intermittently on the previous two days, when the aircraft had been parked outside. This fact was confirmed by analysing the hourly meteorological data and ground de-icing operations at Sheremyetovo Airport and, a particularly telling point, noting that a significant amount of ice had been observed on the wings of a Tupolev Tu-154M that was parked nearby on the same day.

The Tupolev, which had been de-iced, took off safely. The Yak-40 was not de-iced, and this proved decisive to the outcome. To all appearances, the pilot-in-command did not know that he was taking off in an iced-up aircraft. He made a number of errors, the most serious of which was the selection of insufficient flaps — they were configured for 11 degrees instead of 20 as called for in the operations manual — and the slow and inadequate action taken to counter the abrupt pitch-up.

Very thin ice

Even now, in operational practice, aircraft occasionally take off contaminated with accretions of snow and ice that the crew considers "insignificant," although data on the possible hazardous effect of a very thin layer of ice (0.5 mm) on the aerodynamic characteristics of an aeroplane were first collected more than 30 years ago. Summaries of these test results were published in the *ICAO Bulletin* in October 1977 and June 1985.[1] The goal of the research in question, which began with wind-tunnel tests conducted jointly by Russian and Swedish scientists in the mid-1970s, was to determine the effect that various quantities and forms of ice located on different parts of the airfoil have on the aerodynamic characteristics of that airfoil.

The research showed that for some types of airfoil, the coefficient of lift and the critical angle of attack could be significantly reduced by the presence of a thin (but rough) coat of ice (*Figure 1*). Airfoils were also found to vary significantly in their sensitivity to the effects of ice. These wind-tunnel test data were consistent with the results of flight tests conducted by Russian specialists.

Notably, the publication of these results was greeted with scepticism by a number of specialists, even at major organizations involved in aircraft manufacturing or aerodynamics research. It seemed unlikely that such a thin layer of ice could reduce the lift of a modern aeroplane by almost one-third. Criticism of the results was directed primarily towards the modelling method — the transition from relatively small models tested in a wind tunnel to a full-size aeroplane.[2]

Only after detailed studies conducted by Boeing in the 1980s were the previous results obtained by Russian and Swedish specialists concerning the hazardous effect of very thin layers of ice fully confirmed. Those results suggested that even a thin film of de-icing or anti-icing fluid remaining on the surface of a wing could have a detrimental effect on aircraft performance, which led to a requirement to demonstrate the suitability of such fluids for flight operations.

The investigation into the Yak-40 crash continued for more than a year and required extensive flight and ground tests which were carried out by Russian research organizations in 2000-01. The findings of the Russian-Swedish studies into the aerodynamics of an iced-up aeroplane proved extremely useful to investigators. The most important part of the complex investigation was an experiment in the Zhukovsky Central Aerodynamics Institute (TSAGI) wind tunnel using a full-scale Yak-40 wing. The wind tunnel was not equipped to create real icing conditions, unlike the facilities for the earlier Russian-Swedish experiments. A substitute for ice had to be developed, a task that fell largely to the author. On the basis of the Russian-Swedish experience, sandpaper with varying grain sizes was chosen to serve as imitation ice. Five varieties of imitation ice were examined, varying in thickness from 0.8 to 1.8 millimetres (mm), and placed at different positions on the wing.

The first experiments with 1.8 mm-thick "ice" placed along the entire span on the upper surface over approximately one-quarter of the chord length, showed a very significant reduction in the maximum lift and critical angle of attack of the "iced-up" wing (see *Figure 2*). Typically, reducing the length of the ice imitator (still 1.8 mm thick) to half the span barely changed the value of the maximum lift coefficient in relation to the full-span application of the imitator.

On the whole, the research demonstrated the decisive role played by ground icing in reducing the lift characteristics of the Yak-40 wing (a loss of about one-quarter of the lift), and once again confirmed the possible hazardous effect of especially thin layers of ice, which must not under any circumstances be dismissed as insignificant.

Another important result was the opportunity to compare data obtained using a full-scale wing with data from wind-tunnel tests using models.

The triad method

Icing falls under the category of hazardous environmental effects. These include atmospheric phenomena such as thunderstorms and wind shear which may, in certain circumstances, contribute to an accident.

Almost all types of hazardous environmental effects (especially icing) depend on many variable and interrelated factors, a fact that makes it more difficult to study and forecast them and to define their reference characteristics (i.e. the characteristics that serve as the basis for developing and testing methods of protecting an aircraft from one type of effect or another, and determining the range of acceptable operating conditions).

Because hazardous environmental effects involve multiple factors, they require a systems approach to their study and resolution. One such approach, developed by the author and dubbed the "triad method," comprises coordinated research and work focused on the interrelated areas of the environment, effect and protection (from environmental hazards).

Ground icing is one aspect of the general problem of aircraft icing, and is caused by almost the same physical and meteorological processes as in-flight icing, but there are fundamental differences between the two. Statistics show that ground icing, which occurs when the aeroplane is parked or taxiing, leads to a catastrophic outcome more often than icing experienced in flight.

In studying ground icing, several elements of the first part of the triad – the environment – are important. The first is an understanding of the physical and meteorological processes that give rise to ground icing. From a practical standpoint, there is the requirement for a sufficiently reliable forecast of the conditions that create ground icing and a determination of the degree of its severity. At present this usually comprises an indication of light, moderate or severe icing, without any quantitative assessment. One must also recognize the types of ground icing, since different kinds of icing have different effects on an aircraft and require different countermeasures.

Jim Jorgenson

Even very thin layers of ice on an aircraft's surfaces must not under any circumstances be dismissed as insignificant.

The most important part of this area of focus is the development of reference ground icing conditions, which must meet safety requirements without being excessive. This task involves the aircraft manufacturer, the manufacturer of de-icing/anti-icing fluids, and the operator, which must know the specific conditions under which a fluid will ensure clean aircraft surfaces on take-off, and the conditions under which this is impossible. For example, testing of de-icing/anti-icing fluids generally entails a standard intensity of freezing rain at a temperature of -5° Celsius. Under these conditions, the holdover time of Type II fluid must be at least 30 minutes, and that of Type I at least three minutes. However, the question that arises very often (and very naturally) is, "What if the intensity of freezing rain is greater than the standard and the temperature is below minus five degrees?" The regulatory material does not answer such questions, obviously because the variability of climatic conditions in different geographical regions makes it extremely difficult to obtain these data.

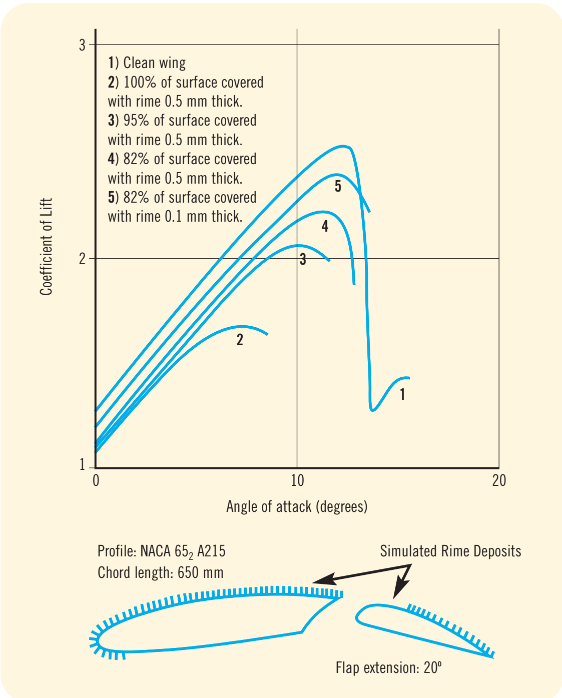


Figure 1. Changes in the maximum coefficient of lift and the critical angle of attack with different degrees of icing on the wing surface.

According to the limited statistical data from a number of regions in the European part of Russia, at a temperature between 0° and -6°C, the intensity of freezing rain exceeds the standard intensity in approximately 30 percent of cases. The current standard should probably be seen as an average, or somewhat above average, freezing rain intensity.

Airworthiness aspects

Before being permitted to fly in icing conditions, modern transport aeroplanes undergo strict certification trials to verify the effects of in-flight ice formation. During this process, it is necessary to demonstrate the safety of the aircraft type in the reference icing conditions. These reference conditions are determined based on the probability of occurrence, and are spelled out in the airworthiness standards.

Such standards only deal, however, with an aircraft in flight. Until recently they did not contain any information on the specific ground icing conditions under which the aircraft must be protected so that its airworthiness is maintained up to the moment of take-off. Under the present definition of flight ("from take-off run to landing roll-out"), airworthiness requirements do not extend to the parking and taxiing phases, although the aeroplane of course is exposed to icing while on the ground.

The main difference between ground and in-flight icing lies in the fact that when on the ground, snow and ice deposits form on a much larger portion of the aircraft's surface, including the upper (and sometimes lower) surfaces of the wings and tail plane, the fuselage, control surfaces, and so on. In flight, snow and ice deposits generally form only on the leading edges of parts that face into the airflow.

The effect of snow and ice accretions on aircraft performance in the case of ground icing may differ greatly from the effects of icing in flight. Research has demonstrated that a thin, rough layer of ice that forms on the surface of an aircraft on the ground may have a more serious impact than a thin layer of ice forming on the leading edge of a wing during flight. The certification issued in accordance with the airworthiness standards permitting an aeroplane to fly in icing conditions cannot therefore be extended to icing conditions before take-off.

At present, when ground icing conditions exist, the airworthiness of an aircraft before take-off is assured by meeting the requirement for "clean surfaces," that is surfaces without trace of snow or ice accretions that would affect the aircraft's design performance characteristics. But what are the reference ground icing conditions that should trigger protective measures to guarantee that the aeroplane surfaces are clean?

This question has only been partially answered to date. In the first stage of the triad method (environment), further studies are needed to determine and refine the reference ground icing conditions on the basis of their probability. Thus, protection from ground icing is a complex problem in which many factors may affect the airworthiness of an aircraft during the take-off phase.

Clean aircraft concept

The fundamental principle for ensuring aircraft airworthiness and a safe take-off in ground icing conditions is the "clean aircraft concept," as described in ICAO Document 9640, the *Manual of Ground De-icing/Anti-icing Operations*.

This concept has in fact been applied in Russian civil aviation for decades. However, the Russian interpretation of the concept may differ somewhat from that applying in countries where aircraft surfaces are divided into "critical surfaces," on which no ice deposits are permitted under any circumstances, and "non-critical surfaces" on which some ice deposits may be permitted.

Russian rules, based on experimental research as well as many years of extensive experience operating aeroplanes in a variety of icing conditions, require that all ice, frost and snow be removed from aircraft surfaces without singling out critical surfaces, although special attention is given to verifying that wing, tail plane, control surfaces and engine air intakes are clean.

There are two basic requirements that make up this concept. Firstly, before take-off, the surface of the aircraft must be completely free of any snow and ice accretions. Second, in *actual* or *possible* icing conditions, the state of the aircraft surfaces must be monitored right up to the take-off position.

The introduction of the concept of critical surfaces, which must be defined by the aeroplane designer (manufacturer), gives rise to a number of questions: What is considered a critical surface? What size and shape of snow or ice accretion is allowed on non-critical parts of the surface? Under certain circumstances, might non-critical surfaces become critical? Some airlines believe, for example, that it is possible to leave a thin layer of rime on the underside of the wing since this would not have an adverse effect during take-off. One could agree with that assessment. But it must be kept in mind that if icing conditions are encountered in flight, a film of ice on the wing's underside may serve as a base for an intensive accumulation of ice that could remain for a long time and play a significant negative role in the later phases of flight. Such situations are rare, but are possible. The author has observed this during test flights. It can be dangerous, for example, to have ice on the underside of the wing near the ailerons.

The clean aircraft concept must apply to all phases of flight, right up to landing. The Russian interpretation of the concept meets this condition. In practical operations, one must not try to assess each time whether a given snow and ice accretion on a certain part of the airframe is dangerous. They must all be completely removed.

In principle, however, it may be acceptable for specific aircraft types to take off with snow and ice accretions on certain parts of the airframe. In this case, the aircraft designer must present evidence — agreed to by the operator and accepted by the certificating authority — that such accretions have no unacceptable adverse effect during taxiing, take-off or later phases of flight on the aerodynamic performance, stability or controllability of the aeroplane, or on the functioning of its power units, systems or equipment. The aircraft's operations manual must clearly define the location, form (type) and size of acceptable accretions. But obtaining such evidence is very difficult, given the well-known unpredictability of the effects of icing.

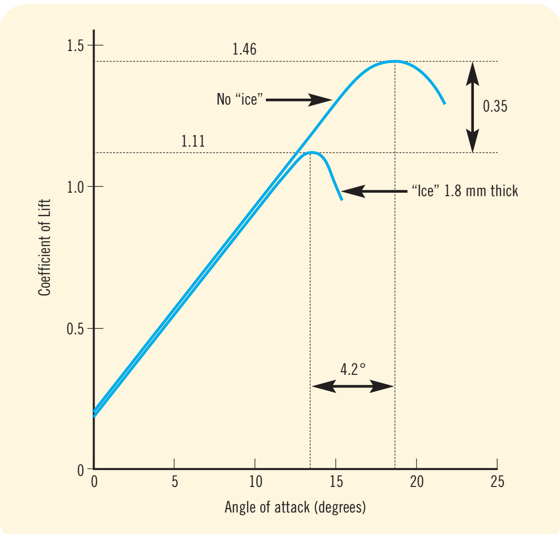


Figure 2. Results of wind-tunnel studies of the effects of very thin layers of ice on a full-scale Yak-40 wing with flaps extended 11 degrees.

A question of responsibility

There have been many cases, including situations that ended in tragedy, in which the pilot decided to take off with ice accretions that were judged to be insignificant. In some cases ground services, deferring to the authority of the pilot-in-command, did not insist on applying de-icing/anti-icing treatment.

One such situation involving a Learjet 35 arose at Sheremyetovo Airport in December 1994. The aeroplane had been parked for 24 hours, and during that time the weather conditions had caused the formation of frost (or hard crystalline film) that was later covered by a layer of dry snow. The snow was brushed off, but a thin layer of ice remained behind. The crew members serviced the small aeroplane themselves. In spite of the recommendations of the airport ground crew, the pilot-in-command did not request application of de-icing fluid, evidently considering the ice accretion to be of no significance. The darkness at that time of day made it more difficult to determine the true condition of the aeroplane's surfaces.

Immediately after leaving the ground, at a height of 20 to 30 metres, the left wing stalled with tragic consequences. The stall was followed by a spontaneous pitch-up. In the ensuing accident, the pilot-in-command was killed and the others on board were injured.

The post-crash inspection, which was documented on videotape, left no doubt that there had been 1-3 mm of snow and ice on the aeroplane's surfaces. In this case, the pilot's decision to take-off without first de-icing clearly led to the accident. If the ground crew had applied de-icing fluid without waiting for the pilot's request, the accident would not have happened.

While pilots are responsible for applying the clean aircraft concept, it may be beneficial to give authority to ground crews as well. For example, authorities might consider establishing a regulation to the following effect. *"The pilot-in-command does not have the right to take off without carrying out de-icing/anti-icing if the ground crew has detected snow and ice on the aeroplane and considers the procedure to be necessary. The pilot-in-command does, however, have the right to demand de-icing/anti-icing even if the ground crew does not consider it necessary, and also to demand a second application at any point in the pre-flight preparation. Ground technical personnel must comply unconditionally with such a request from the pilot-in-command."*

On the advice of the author, a similar recommendation was introduced into Aeroflot's operations manual. This text has also been approved by European and Canadian specialists at an SAE Conference which was held in May 2004.

Holdover timetables

There are different points of view on the use of holdover tables. The value of

continued on page 33

1. See "Aircraft icing: Still a severe flight safety problem," October 1977, pp. 11-13; and "Aircraft icing must never be underestimated," June 1985, pp. 17-19.
2. The method of simulating icing in the wind tunnel was developed and confirmed through experimentation by A.K. Ivaniko, who wrote (and successfully defended) his thesis on the subject.

Dr. Oleg K. Trunov is the Chief Expert on Flight Safety at the Aviation Certification Centre of the Russian State Research Institute for Civil Aviation.

ICAO UPDATE

Bombardment of Beirut airport brings operations to a standstill

Following the bombardment of Beirut Rafic Hariri International Airport by Israeli military forces on 13 July 2006, which rendered the airport inoperable, ICAO immediately reminded the Government of Israel of its obligations to comply with the provisions of the *Convention on International Civil Aviation*, or Chicago Convention.

In a letter addressed to the Deputy Prime Minister of Israel, who also serves as Minister of Transport and Road Safety, Dr. Kotaite described the shelling of Beirut's airport as a violation of the principles enshrined in the Chicago Convention, and he urged restraint to ensure no further harmful acts against civil aviation.

Citing other air law instruments as well, the Council President indicated that the attack on the airport violated the Montreal Convention of 1971 and the Montreal Protocol of 1988. He highlighted an ICAO Council resolution of March 2002, adopted following the destruction of Gaza International Airport, which strongly condemned "all acts of unlawful interference against civil aviation, wherever, by whomever and for whatever reasons they are perpetrated."

Dr. Kotaite added that ICAO was prepared to work closely with those involved in order to restore safe flight operations at the earliest opportunity. ICAO has already begun coordinating efforts to facilitate flights of humanitarian aid to Lebanon organized by the UN World Food Programme. The organization has been in discussion with various parties concerning a humanitarian aid initiative, but at press time (1 August) such operations had not yet commenced.

Lebanon responded to the attack on the Beirut airport and other aviation facilities by requesting that ICAO make its member States aware of the total paralysis of the civil aviation system caused by the attacks on vital infrastructure. Mohamad Al-Safady, the Minister of Public Works and Transport of Lebanon, indicated that the bombardments had destroyed the runways and fuel reservoirs at Beirut Airport, as well as access roads and bridges. In addition, vital facilities at two alternative aerodromes had been destroyed by military action. The recent attacks, he stated, had led to "a total halt of air traffic to and from Lebanon, until further notice," and posed "extremely serious threats to the security and safety of Lebanese civil aviation." □

Walter Binaghi

Walter Binaghi, ICAO Council President from 1957 to 1976, died in Montreal on 16 July 2006, at the age of 87.

Mr. Binaghi, an Argentinean citizen, presided over the Council during a time of great change, with the introduction of jet transports and later the arrival of the first "jumbo" jets. He oversaw the development of a number of annexes to the Chicago Convention, and distinguished himself by his outstanding contribution to efforts to develop international civil aviation in a safe and efficient manner.

Mr. Binaghi was born in Buenos Aires in July 1919. Soon after earning a degree in civil engineering from the University of Buenos Aires, he began teaching physics and mathematics while also working as an engineer in the Argentine Ministry of Aeronautics. He was named a member of the Argentine Delegation to the First Assembly of ICAO, held in Montreal in May 1947. The following September he joined his country's delegation at ICAO headquarters, serving as Alternate Representative of Argentina on the Council of ICAO until 1957, and concurrently as Chairman of the Air Navigation Commission during the 1949-57 period.

Mr. Binaghi was first elected as Council President in 1957, and retired from the post after 19 years of service, and after 29 years of service to ICAO. □

Ballistic missile launches spark safety concerns

Citing an ICAO Assembly resolution on the safety of navigation and provisions contained in Annex 11 to the Chicago Convention, ICAO Council President Dr. Assad Kotaite has written to the Democratic People's Republic of Korea (DPRK) concerning recent ballistic missile launches that could have endangered civil aircraft operating on international air routes over the high seas. The letter of 6 July emphasizes the requirement for States to comply with Chicago Convention provisions, including the requirement for coordinating activities that are potentially hazardous to civil aircraft.

On 15 July 2006, the United Nations Security Council condemned the recent test firing of a series of missiles, and demanded that the Democratic People's Republic of Korea suspend all ballistic missile-related activity and reinstate its moratorium on missile launches. □

Disclosure authorized

In recent months nearly 40 percent of ICAO Contracting States have signed consent forms permitting the organization to disclose safety information on its public website beginning in March 2008. By the end of July 2006, a total of 75 ICAO member States and two territories had agreed to the disclosure of either their full safety oversight audit report or an executive summary of the audit report.

The decision to release the results of ICAO safety oversight audits to the public was made by the world's directors general of civil aviation (DGCAs) at a conference at ICAO headquarters in late March 2006 (see Issue 2/2006, pp 5-7). The meeting resulted in a comprehensive set of conclusions and recommendations that give shape to an action-oriented global aviation safety, with greater transparency as its cornerstone. □

Council President gives keynote address to meeting of International Aviation Club

In his last major speech as President of the ICAO Council, Dr. Assad Kotaite reminded his audience at a luncheon of the International Aviation Club in Washington, D.C. of the collective mission to facilitate the growth of the "safest and most efficient mode of mass transportation ever created" by working together in a spirit of global cooperation.

His address, which highlighted major developments and issues in the aviation world, also praised the United States for its steadfast support of ICAO's work. "From the very beginning, the United States has been one of the most ardent supporters of ICAO as a global forum for the safe and orderly development of international civil aviation. Through heavy turbulence and calmer skies, your country has enthusiastically shared its expertise and its resources as an active member on the Council of ICAO, the Air Navigation Commission, and as a loyal supporter of all major programmes and activities designed to shape the future course of global air transport," he informed an audience that included a number of senior U.S. government officials and industry leaders.

The Council President reflected on his forthcoming retirement from ICAO after a record long 53-year association with the organization, saying that he considered himself fortunate to have witnessed and played a role in the evolution of civil aviation in the technological, operational and regulatory areas. "I have seen it grow from a fledgling industry during the 1950s to a vital component of our modern global society," he said. (Special coverage of Dr. Kotaite's departure from the organization, "ICAO bids farewell to its long serving Council President," appears as an insert in the centrespread of this edition.)

In introducing Dr. Kotaite as the keynote speaker at the luncheon in Washington, Ambassador Donald Bliss, Representative of the United States on the Council of ICAO, paid tribute to the Council President's leadership. "It is difficult," he admitted, "to capsulize in a few words the extraordinary contribution of Dr. Kotaite in forging international consensus on high standards of aviation safety, in addressing the post-September 11 challenges of aviation security, in prodding governments and industry to achieve tougher but balanced environmental standards, in promoting more efficient air transport and navigation, in managing crises and in building the legal framework of international aviation." Dr. Kotaite's many achievements, Mr. Bliss insightfully observed, corresponded to the six strategic objectives that ICAO had recently embraced after much reflection and discussion.

Mr. Bliss described his experience of working with Dr. Kotaite as a lesson in leadership. At Council sessions, he recalled, Dr. Kotaite was always well prepared, listening carefully to all points of view, and treating each Council member with unfailing courtesy and respect, while gently prodding the Council toward a consensus that advances the public interest, rarely calling for a vote. With his lawyer's precision in five languages, Dr. Kotaite was able to articulate a decision that commands global acceptance, Mr. Bliss said.

Focusing on the ongoing shift in ICAO's role as a standard setting organization to one focused on ensuring compliance with international standards, Mr. Bliss highlighted the challenge of building on the strong foundation established by Dr. Kotaite in order to meet the new challenges of international aviation. Whether ICAO can successfully reinvent itself for the 21st century "is the challenge we face in building on the legacy of President Kotaite," he contended.

During his visit to Washington, the Council President met with authorities at the Department of Transportation and the State Department. Discussions with the Acting Secretary of Transportation, the Administrator of the Federal Aviation Administration and other high-level authorities focused on the ICAO safety and security audit programmes, integration of the voluntarily funded activities of the ICAO aviation security plan of action into the organization's regular programme budget, and the issue of aircraft engine emissions. In a meeting with the Under Secretary of State for arms control and international security as well as other high-level officials at the State Department, discussions included the ICAO budget for the next triennium, the threat of man-portable air defence systems (MANPADS), and support from the United Nations Development Programme (UNDP) for the civil aviation sector in Iraq. Also discussed were the safety and security impact of trade embargoes involving U.S.-made equipment and spare parts and the ability of affected States to participate in international aviation.

During his stay in Washington, the U.S. Government and aviation industry paid tribute to Dr. Kotaite's lifetime contribution to the development of international civil aviation. □

ICAO convenes SMS training courses

ICAO has conducted the first in a series of safety management system (SMS) training courses. The course, aimed exclusively at representatives from civil aviation administrations, is intended to assist with implementing safety management systems across all safety-related disciplines in all member States. The objective is to develop participants' knowledge of safety management concepts and ICAO standards and recommended practices (SARPs) on safety management contained in Chicago Convention Annexes 6, 11 and 14, and related guidance material. Another objective is to develop the knowledge and skills needed to certify and oversee the implementation of key components of a basic SMS, in compliance with relevant ICAO SARPs and national regulations.

The initial course of 15-19 May 2006, for 35 participants from 10 States and one international organization, was presented at the ICAO Eastern and Southern African Office in Nairobi by staff from ICAO's Air Navigation Bureau. The programme of regional courses on SMS is expected to be completed by the end of next year; currently a course for the Asia/Pacific region, sponsored by the Government of Thailand, is scheduled to take place in Bangkok in September 2006. The third course, for participants from the European and North Atlantic regions, will be held in Kyiv in November 2006, with the sponsorship of the Government of the Ukraine.

ICAO Journal Issue 6/2006, which is scheduled to appear in mid-December, will be dedicated to the subject of safety management systems and their implementation. □

NEW PUBLICATIONS
FROM ICAO

Manual on the Approval of Flight Crew Training Organizations (Doc 9841)
1st edition, 2006. 42 pages
ISBN 92-9194-724-5
Order No. 9841 … $21

Manual on Air Traffic Forecasting (Doc 8991)
3rd edition, 2006. 98 pages
ISBN 92-9194-717-2
Order No. 8991 … $52

Safety Oversight Manual (Doc 9734)
Part A — The Establishment and Management of a State's Safety Oversight System
2nd Edition, 2006. 52 pages
ISBN 92-9194-631-1
Order No. 9734A … $28

Manual on Low-level Wind Shear and Turbulence (Doc 9817)
1st edition, 2005. 222 pages
ISBN 92-9194-609-5
Order No. 9817 … $113

Airport Economics Manual (Doc 9562)
2nd edition, 2006. 156 pages
ISBN 92-9194-683-4
Order No. 9562 … $83

Safety Management Manual (Doc 9859)
1st edition, 2006. 316 pages
ISBN 92-9194-675-3
Order No. 9859 … $167

Manual of Radiotelephony (Doc 9432)
3rd edition, 2006. 106 pages
ISBN 92-9194-633-8
Order No. 9432 … $56

To order documents or obtain a complete list of ICAO publications and audio-visual training aids visit ICAO's website at www.icao.int

or contact:

Document Sales Unit, International Civil Aviation Organization, 999 University St., Montreal, Quebec, Canada H3C 5H7

Telephone: +1 (514) 954-8022 • Facsimile: +1 (514) 954-6769
E-mail: sales@icao.int

All prices are in U.S. dollars and are subject to change. Prices include the cost of delivery by best method, as determined by ICAO, from ICAO Headquarters and from ICAO Regional Offices.

World's air carriers see profit grow in 2005 despite increase in fuel cost

The world's scheduled airlines last year carried more than two billion passengers for the first time, at the same time posting a combined operating profit of 1 percent of operating revenues, according to preliminary data collected from ICAO's 189 member States. The financial result is a slight improvement, despite substantial increases in fuel costs, over the operating profit for 2004.

Operating revenues for 2005 have been tentatively estimated at U.S. $413,300 million (all financial figures in U.S. currency), an increase of about 9.1 percent over 2004, while operating expenses amounted to approximately $409,000 million, up approximately 9 percent from 2004. Operating revenues per tonne-kilometre performed rose to an estimated 80.2 cents from 77.1 cents in 2004, while expenses per tonne-kilometre performed climbed to about 79.3 cents from 76.4 cents in 2004. (A tonne-kilometre is a combined measure of passengers, freight and mail traffic which takes into account the distance flown.)

The positive operating results occurred in a year when average fuel prices rose by some 49 percent over the previous year. However, the increase in unit costs in 2005 was limited to a manageable 4 percent compared to 2004, an increase that was more than compensated for by traffic growth and a 4 percent rise in unit revenues (yield).

The net financial result, after inclusion of non-operating items such as interest charges, subsidies, capital gains or losses and the deduction of income taxes (but excluding any provision for reorganization expenses by U.S. carriers), is provisionally estimated to be a loss of about 0.8 percent of operating revenues, an improvement over the loss of about 1.5 percent in 2004.

Scheduled traffic data, measured in tonne-kilometres performed, showed a relatively strong growth of 6 percent in total (i.e. domestic and international passengers, freight and mail combined). Worldwide passenger traffic posted 7 percent growth over 2004, to exceed two billion, while passenger traffic on international services alone also increased by approximately 7 percent. Freight traffic, on the other hand, showed a very modest increase of some 0.3 percent in total services and about 0.9 percent on international flights.

More efficient management of capacity in 2005 saw the average passenger load factor rise to 75 percent on total scheduled services, up from 73 percent in 2004. The load factor also reached 75 percent on international flights, compared with 74 percent in 2004.

On a regional basis, strong traffic growth was shown by the airlines of all regions except North America, where scheduled traffic rose by only 3 percent over 2004, well below the world average of 4.9 percent growth.

In 2006, further increases or continuing high fuel prices could act as a dampener and reduce traffic growth and the profitability of an industry which is showing signs of resurgence. Without this dampening effect, however, ICAO predicts airline scheduled passenger traffic will grow by 6.1 percent in 2006, followed by 5.8 percent and 5.6 percent in 2007 and 2008 respectively. (More information on ICAO's latest medium-term forecast will appear in Issue 5/2006.) □

Visit to France includes ECAC meeting, discussions with government and industry leaders

ICAO and the European Civil Aviation Conference (ECAC) have worked closely together over the years, so much so that ECAC represents the "voice of ICAO in Europe," according to ICAO Council President Dr. Assad Kotaite.

Addressing the opening of the 29th Plenary Session of ECAC in Strasbourg on 21 June, the Council President explained that ECAC, in close liaison with ICAO, "has consistently assisted its member States in achieving the aims and objectives of the Chicago Convention." At the same time, he added, ICAO has offered ECAC a global forum through which it can cooperate with other regions of the world in building a strong and sustainable global air transport system.

Dr. Kotaite's address focused on the challenge of managing air transport growth, calling this the "overarching challenge facing the world aviation community in the first half of the 21st century, as it was at the end of the 20th century."

The Council President observed that air transport growth in Europe had been consistently strong, largely as a result of western Europe's economic performance. Over the 1995-2005 period, he indicated, scheduled passenger traffic carried by European airlines grew at an average annual rate of 5.9 percent. In 2005, the region's share of global traffic was estimated at 27 percent, and at 37 percent of the world's international services — the highest proportion of any ICAO region.

Dr. Kotaite added that the volume of passenger-kilometres in the region was likely to continue rising at over 6 percent in 2006, and slightly less in 2007 and 2008, according to the latest ICAO forecast. At the same time, scheduled passenger traffic for the European region is expected to rise by 6.5 percent in 2006, followed by 6.2 percent in 2007 and 6 percent in 2008.

But the strong growth foreseen by ICAO, the President explained, depends on successful management of the industry's expansion. "These numbers assume," he cautioned, "that we will have succeeded in keeping in check major impediments to sustained growth, such as airspace and airport congestion, threats to the security of airline operations, airports and critical ground installations such as air traffic control towers, as well as the negative impact of aviation on the environment."

On a personal note, the Council President informed the meeting that he had taken part in 1955 in the 1st Plenary Session of ECAC as an observer from his country, Lebanon, and that he considered that event to be "the true beginning of my international career in aviation." Looking back, he described the evolution of the global air transport industry as extraordinary. The industry "is now more than ever a catalyst for economic, social and cultural development worldwide. Europe is a prime example of the power of air travel to transform societies for the better and to connect them to the rest of the world." ECAC, for its part, paid tribute to the Council President, recognizing his lifetime achievement in the development of international civil aviation.

The ECAC session was attended by 40 of ECAC's 42 member States, together with observers from a number of other ICAO Contracting States and several international organizations. ECAC dealt with issues related to facilitation and security, safety, and the environment. Also discussed was the progressive integration of the voluntarily funded aviation security plan of action into ICAO's regular programme budget. ECAC elected the Director General of Civil Aviation (DGCA) of France as its new President for the next three years.

During his visit to France from 19 to 24 June, the Council President met with government and industry leaders. Accompanied by the Representative of France on the Council, Dr. Kotaite met with the Director of UN and International Organization Affairs at the Ministry of Foreign Affairs in Paris, as well as with the DGCA. Their discussions included the agenda for the 2007 Session of the ICAO Assembly and air law matters. Together with the Council President-elect and the Representative of France on the ICAO Council, Dr. Kotaite visited the ICAO Regional Office and addressed a ceremony marking the completion of recent office renovations.

The Council President also travelled to Airbus headquarters in Toulouse for briefings about the A380 programme, and met with the President and the Chief Executive Officer-Operations. □

Workshop to highlight Circular 303

ICAO and Transport Canada next month will conduct a workshop on aviation operational measures for reducing fuel burn and aircraft engine emissions. The workshop, to be held at ICAO headquarters from 20 to 21 September 2006, will highlight the best practices and practical solutions contained in ICAO Circular 303, *Operational Opportunities to Minimize Fuel Use and Reduce Emissions*, and will provide a forum for experts and stakeholders to exchange ideas and develop beneficial partnerships. Readers may obtain more information at ICAO's website (http://www.icao.int/icao/en/conf/index.html).

DEPOSIT BY ECUADOR

Ecuador deposited its instrument of accession to the Montreal Convention of 1999 during a brief ceremony at ICAO headquarters on 27 June 2006, bringing the number of parties to the Convention, which entered into force in November 2003, to 72. Shown on the occasion are Verónica Bustamante, Consul General of Ecuador in Montreal, and Denys Wibaux, Director of the ICAO Legal Bureau.

International beacon registration database enters service

An international database for the registration of 406 megahertz (MHz) distress beacons, including emergency locator transmitters (ELTs), entered operation in January 2006. The International Beacon Registration Database (IBRD) is managed and maintained by the Cospas-Sarsat Secretariat as an important supporting element of the satellite alert and location system that detects and distributes emergency signals transmitted by ELTs. (The Cospas-Sarsat system comprises two satellite constellations and associated ground stations that are used to locate the site of an emergency or accident.)

The service that the Cospas-Sarsat system can provide users of 406 MHz ELTs is much enhanced over that available to next-generation 121.5 MHz ELT users. With a 406 MHz ELT, the position of the activated ELT can be relayed to rescue services more quickly, more reliably and with greater accuracy. Another of the valuable functions of 406 MHz ELTs is that they transmit digital data with a unique identification that greatly facilitates more timely and effective SAR response. For this system to operate effectively, however, it requires that owners register their ELTs and that search and rescue (SAR) providers have ready access to registration databases.

The new IBRD is not intended to replace existing national ELT registration facilities, but is provided by Cospas-Sarsat to supplement the 406 MHz registration process by providing 24-hour, global access to SAR service providers in retrieving valuable data during a SAR operation. It will be particularly useful when no established national database is available or when administrations cannot provide access to their national databases at all times. SAR service providers will be able to query the IBRD directly over the Internet.

The IBRD Internet site (https://www.406registration.com) provides extensive online assistance, and is freely available to users with no access to national registration facilities. The IBRD has been configured to accept, by default, registrations from all ELT owners except in those circumstances where the authority administering the country code of the ELT has advised Cospas-Sarsat that it operates an independent national database with a 24-hour point of contact, or that it wishes to control the registration of ELTs in the IBRD with its country code. The IBRD may also be used by State administrations that wish to avail themselves of the facility to make their national ELT registration data more available to SAR services.

SAR service providers and others wishing to interrogate the IBRD will require passwords issued by the Cospas-Sarsat Secretariat. If individual use of the IBRD is allowed by their national administrations, individual owners may register their ELTs and select their own passwords during the registration process. State administrations should designate a State IBRD point of contact and request that the Cospas-Sarsat Secretariat allocate a user identification and password to that point of contact. The process for registering an ELT is described at the Cospas-Sarsat website (www.cospas-sarsat.org), where a letter template and points of contact for ELT information in various States is also available.

The Cospas-Sarsat systems will cease satellite processing of 121.5 and 243 MHz ELTs from 1 February 2009, and it is recommended that all ELT owners and users of 121.5 or 243 MHz ELTs upgrade to 406 MHz ELTs on a timely basis before February 2009. For in-depth articles on the 406 MHz ELT, see Issue 3/2001 (pp 27-29) and Issue 3/2006 (pp 18-20). □

ICAO working to help implement language proficiency requirements

Since introducing language proficiency requirements in 2003, ICAO has taken several steps to assist States with implementation of the provisions, including dissemination of a manual (Document 9835) and a 135-minute long training aid that includes rated speech samples. Under language proficiency standards, pilots and air traffic controllers involved in international civil aviation are required by March 2008 to demonstrate a sufficient level of proficiency in aviation English.

The organization has also conducted a language symposium at ICAO headquarters as well as regional seminars held in Argentina, Azerbaijan, China, Japan, Ukraine and at Eurocontrol's headquarters in Brussels. Another seminar will be conducted in Senegal in September 2006.

A recent meeting of an ICAO study group on language proficiency requirements prepared additional guidance material for inclusion in Document 9835. The new material concerns test design and administration as well as tasks and qualifications for personnel involved in developing and administering tests. A checklist designed to facilitate test development and implementation is under development. □

Hybrid nav system

continued from page 12

interference for two reasons. Firstly, RNP 0.1 operations typically occur in airspace that is physically close to potential interference sources (i.e. at low altitude in the vicinity of populated areas). Second, RNP 0.1 requires an extremely low horizontal alert limit that offers little design margin against the effects of interference.

HIGH Step II makes RNP operations available and robust even in the presence of GPS interference.

The integrity coasting capability of HIGH Step II is demonstrated in *Figure 5*. This figure provides an integrity coasting scenario using a simulator. All of the satellites are suddenly removed and the HIGH Step II system continues to provide a valid HPL. For these conditions, a standalone GPS system would be incapable of providing a navigation solution, much less one with integrity.

Table 1 demonstrates the accuracy coasting performance for the HIGH Step II system under the SA-off condition. During this test, the system was calibrated for one hour of straight-and-level flight with marginal satellite geometry. All satellite measurements were then removed and the system coasted for one hour, during which several trials based on the Monte Carlo method were performed. Table 1 contains the 95 percent RPE values at various coasting times.

Table 2 shows results from an availability analysis performed for HIGH Step II based on an industry standard method defined in RTCA DO-229C, and using a simulator. Availability of 100 percent implies that HPL calculated at each space-time point is less than the horizontal alert limit. The availability analysis was performed using a mask angle of 2 degrees and SA-off conditions. The alert limit for a particular RNP operational level depends on the aircraft platform but is typically higher than the RNP value (i.e. RNP 0.1 may have an alert level of 0.18 NM). Therefore HIGH Step II may support future RNP levels even lower that RNP 0.1.

Figure 6 shows HIGH Step II HPL distribution versus the HPL distribution from a snapshot RAIM system (with calibrated pressure altitude) at the same instant, with the receiver configured for SA-off mode. These figures clearly show the improved availability of RNP 0.1 provided by the HIGH Step II system.

Certification and implementation. The HIGH Step II system has been implemented in a variety of navigation platforms. It will be standard on the air data inertial reference unit to be certified on the Airbus A380 as well as on the Airbus A320, A330 and A340 families of aircraft as part of Honeywell's Block III update of the ADIRU.

Given the complexity of tightly integrated GPS/inertial systems, compliance with RTCA DO-229C (Appendix R) is necessary to ensure that algorithms provide a valid and safe implementation. By specifying requirements and test procedures for confirming that navigation performance levels are met, this industry standard provides a basis for certification of hybrid systems such as HIGH Step II, which has already demonstrated full compliance with DO-229C. □

Tailored arrivals

continued from page 8

to conduct an in-service demonstration of oceanic tailored arrivals (OTA) involving inbound transpacific flights in the San Francisco Bay area beginning in July 2006. The demonstration will involve the Oakland Center oceanic and en-route radar sectors as well as the Northern California terminal radar approach control (TRACON) service. The initial demonstration will limit the delivery of OTA clearances to selected aircraft during periods of relatively low congestion. Additional airline partners are also being considered.

In these near-term trials, the OTA concept will be applied to relatively uncongested traffic environments in which static procedures for minimizing fuel burn and environmental impact can be flown. These trials will be used to collect data on the flyability and operational viability of a tailored arrival clearance and procedures involving both static and dynamic components from both an aircraft and ATC perspective, with particular emphasis on the airspace integration aspects concerning coordination of clearances delivered in oceanic sectors that stretch across at least three different ATC sectors to the arrival runway.

The key objective of these trials is the validation of the en-route descent advisor trajectory prediction and profile adjustment logic, and in particular EDA's capability to generate accurate "fine tuning" adjustments to an aircraft's arrival time over a metering fix at the TRACON boundary (generally at 10,000 ft). Prior to clearance delivery, OTA clearances and associated intent data are shared and coordinated for approval across the oceanic, en-route domestic and TRACON facilities that the aircraft is expected to traverse.

Clearance delivery will be conducted via the FAA's new Ocean-21 ATOP system. Ocean 21, with CPDLC, provides the controller with enhanced flight track monitoring and communication capabilities to safely coordinate the arrival clearances for selected FANS/1-equipped aircraft during the initial in-service demonstration. Once uplinked to the flight deck in the form of a FANS-1/A CPDLC route clearance, the trajectory associated with the OTA clearance is loaded as a modified route into the FMS and reviewed by the flight crew. If acceptable, the crew executes the new trajectory, which is then flown by the FMS.

Flight crew acceptance of the OTA clearance is confirmed via data link, thus "closing the loop" with the controller. ATOP will also capture ADS-C data reflecting the aircraft's predicted path and arrival times over various points in the descent profile. These data will be collected before and after delivery of the clearance, after delivery of an EDA-commanded speed schedule instruction to adjust the time over the metering fix, and at other key points along the trajectory.

A key element of the OTA trials will be the uplink of the current cruise and descent wind forecasts available to ATC, which should improve aircraft trajectory prediction accuracy and adherence to those predictions. In a mature tailored arrivals system, these data would be used by the controller to monitor the aircraft's progress along the OTA trajectory, while actual winds are captured from preceding aircraft and uplinked to the aircraft on a tailored arrival so that adherence to the expected path can be improved.

In summary, tailored arrivals offer a significant step towards advanced ATM concepts such as the Next Generation Air Transport System (NGATS) in the United States and the Single European Sky ATM Research (SESAR) initiative in Europe. The concept provides a solution to several issues that are steadily growing in importance. It provides the means by which to reduce aircraft fuel consumption, noise and emissions, while increasing predictability both in air and on the ground, thereby setting the stage for initial closed-loop 4D trajectory-based operations.

Through joint development in multiple operating regions in the world, the partnership formed for developing tailored arrivals is seeking to establish globally applicable and globally beneficial arrival procedures and capabilities. □

AMOS hurdles

continued from page 21

typically two to four times every minute. A single measurement does not provide any information about cloud amount, and additional processing is required to identify cloud layers and cloud amounts in the layers.

The most common method of determining cloud amount automatically is to analyse a series of ceilometer measurements taken over a period of time, typically from 20 to 30 minutes. These "sky condition" algorithms rely on the assumption that representative clouds move into the field of view of the ceilometer within the time period. Studies have proved that such algorithms can achieve quite respectable results statistically. However, users appear not to be fully satisfied with the actual performance.

It is easy to understand that a single ceilometer and an algorithm may produce poor results if the clouds detected do not represent the total sky. Such cases may occur, for example, with weather fronts or other clearly defined changes in cloud amount. An algorithm will always report cloud amount based on clouds already gone past the sensor. It will be late in reacting to a sudden change from clear to overcast, or vice versa.

Various versions of such sky condition algorithms have been developed. Their performance, however, is always limited as long as no other data than the measurements of a single ceilometer are used. Experimental methods of producing more representative sky condition reports have been studied by various agencies and companies around the world.

One method often discussed is the use of a camera to monitor the sky together with algorithms to determine cloud amount automatically from the image. Cameras capable of detecting clouds, even at night, have become more affordable thanks to the development of imaging technology, but clouds are very difficult targets for an image processing algorithm.

The task of differentiating between a cloudy and clear sky is manageable in good weather, but becomes very complex in more difficult conditions. It can be quite difficult, even for a trained observer, to interpret an image of a cloudy sky. Tasks difficult for humans will obviously be even more challenging for automatic systems. Although the method does hold some promise, it may be quite difficult to achieve satisfactory performance.

Another experimental imaging method uses a scanning radiometer to measure the infrared radiation from the sky. The sensor can detect the difference in radiation from a clear sky and from a cloud, and therefore it can estimate the total cloud amount. This method is simpler than a camera-based system, while offering practically the same advantages. Processing of radiometer data is easier, making this method more robust.

Imaging methods cannot provide accurate cloud height information, so height measurement needs to be added to get a full cloud report. However, single point ceilometer measurements are not easy to combine with total cloud amount information. Clouds seen by the imaging method, but not detected by the ceilometer, cannot be reported because their height is unknown. Performance of the total system may be only slightly better than that of a standard sky condition algorithm.

Scanning the sky with a LIDAR-based instrument would provide a rough image of the sky and would include height information as well. Scanning ceilometers have been developed for experimental use, but none have yet entered operational use. The measurement speed of the ceilometers used in these experiments has limited the scanning rate, and a low scanning rate allows only a small number of points to be measured within a reasonable time frame. Without a larger number of samples, the improvements are quite modest.

Vaisala has developed an algorithm to combine the measurements of several ceilometers. Many international airports have more than one ceilometer installed, with the sensors often placed several kilometres apart. Combining the measurements of all these ceilometers will improve the representativeness of the cloud report.

AVIATION PROFILE

Madagascar

Aircraft on civil register	141
Active pilot licences	172
Commercial air transport operators	11
Approved maintenance organizations	7
Aviation training establishments	4
Aircraft manufacturing organizations	0
Aircraft type certificates issued	0
International airports	7

(data from November 2004)

Although there are various alternative ways to improve automatic cloud reporting, none of them has entered wide operational use. One reason may be the fact that it is difficult to prove the significance of the improvements. The more complex and expensive methods achieve better results than a single ceilometer with an algorithm, but the differences appear relatively modest in a straightforward statistical analysis. The analysis should perhaps be concentrated on critical cases or on the number of significant errors, an approach that might better reveal any truly promising methods.

The final component in cloud reports is the detection of cumulonimbus and towering cumulus clouds. There are only a few publicly documented methods of detecting these cloud types automatically. Vaisala has carried out an experiment to analyse ceilometer measurements with a special algorithm which looks for characteristic shapes of cloud edges. This experiment showed that ceilometer measurements provide information that can be used in cloud type detection, but that this information alone is clearly not sufficient.

A much more complete method has been developed by Météo France. This system combines weather radar measurements with lightning location data to identify heavy convective activity. The goal is not to identify the specific cloud types directly, but to identify the hazard related to these cloud types. This is a good example of redefining the user requirement: the real significance of observing CB and TCU is not necessarily the clouds themselves, but the heavy convection currents associated with them.

In summary, while current ICAO requirements for aviation weather observations cannot be fully met with entirely automatic systems, some cost savings are possibly already being achieved through semi-automatic systems, in which local personnel augment and correct meteorological reports before transmission. Such tasks can be performed by selected airport personnel part-time, thus reducing overall manpower requirements. Another possible strategy is to concentrate the augmentation and quality control tasks at a regional or national centre. Trained personnel there can have access to a variety of weather data, such as satellite and radar images, in addition to the local airport measurements. Remotely controlled cameras could also be used to help in determining the actual conditions.

It seems that several steps need to be taken before full automation can be widely accepted, and all stakeholders must be involved. Sensor and system manufacturers should work together with aviation weather providers to improve the performance of current automatic systems. In addition, the users need to work with weather service providers to define their real requirements more clearly, taking the possibilities and limitations of automatic systems into account.

The safety and efficiency of operations must be ensured, but some streamlining is probably possible. Plenty of work remains to be done before the capabilities of automatic systems and user requirements converge, but it appears this goal is not many years away. □

ICAO GIS portal

continued from page 15

phased in via the GIS portal as their development is completed. It is planned to include aircraft types and their registrations and to make available evolutionary aircraft type performance and avionics data. To accomplish this demanding but important task of data collection, cooperation and collaboration with other authorized data sources will be established, as appropriate.

The ICAO global air navigation planning database and GIS portal will facilitate the coordination and implementation of regional air navigation plans as well as supporting the Global Air Navigation Plan. It will also contribute to the further development of air navigation planning by providing a framework for the efficient implementation of new air navigation systems and services at the national, regional, inter-regional and global levels. It is fully in line with ICAO's strategic objectives, which include the requirement to develop, coordinate and implement air navigation plans that reduce operational unit costs, facilitate increased traffic and optimize the use of existing and emerging technologies.

A demonstration version of the ICAO global air navigation planning database and GIS portal will be available for viewing after 1 September 2006 at http://www.icao.int/gisportal. □

Ground icing

continued from page 25

the tables must not be exaggerated since they are by nature only approximate and provide information that, while important, is merely a guide.

Many pilots and engineers are not certain how to use the holdover timetables. The fact is that the tables present a range of times, which creates uncertainty. For example, according to the table, in freezing rain and at a temperature of -7°C, the holdover time of concentrated Type II fluid is eight to 20 minutes. Such information does not provide much guidance to the pilot. If one takes into account the fact that both figures are approximations and under some conditions the holdover time could be less than eight minutes or more than 20, it becomes very difficult to use the tables even for a rough estimate of holdover time. Furthermore, the use of a time range has the psychological effect of undermining trust in the overall reliability of the tables.

It would be prudent to revive a previous form of the table which provided a single figure. For example, the table could indicate a probable holdover time of 20 minutes under certain conditions, a period of time for which protection would be assured in the majority of cases.

A survey of Russian flight crew members and ground service personnel involved in de-icing/anti-icing operations showed strong support for this proposal. Notably, instructions for the use of Type II de-icing/anti-icing fluids in Russian operations include a precise holdover time, with the warning that this is only an approximation (i.e. the most probable holdover time).

Type IV fluids. Under international standards, all de-icing/anti-icing fluids must meet certain requirements to be acceptable for use in flight operations. The test method involves determining the boundary layer displacement thickness on a plate covered with a layer of fluid. The thickness is ascertained in a wind tunnel in an accelerating air stream at temperatures ranging from 0 to about -25°C. The empirical relationships thus obtained are converted from a plate to an airfoil, and from the boundary layer thickness on a fluid-covered airfoil to a value representing the reduction in the coefficient of lift. With these data, the adverse effect of the fluid in question can be assessed.

This method has been very useful in preventing the operational use of de-icing or anti-icing fluids that may themselves dangerously degrade the performance of the aeroplane.

Efforts to refine the method must continue, however. In practice, this method is based entirely on the relationship between the coefficient of lift and boundary layer thickness, a relationship that was obtained using only one type of airfoil. To avoid surprises in the future, different airfoil shapes and varying aerodynamic loads must be assessed.

In recent years, with the appearance of Type IV fluids, it was discovered that repeated applications can reduce the stability and controllability of the aircraft in flight. The same phenomenon was observed, although to a lesser extent, following the application of some Type II fluids. Since all of these de-icing/anti-icing fluids were subject to aerodynamic acceptance tests conducted in accordance with the recommended methodology, the inescapable conclusion is that the accepted aerodynamic acceptance test method is not reliable enough and requires immediate improvement.

Studies of this phenomenon, which have been going on for a number of years, have shown that the deterioration in aeroplane stability and controllability is apparently caused by the accumulation on the trailing edge of the wing and tail plane of a residue that hardens in the course of repeated applications. The frequency of hazardous incidents in flight related to the presence of this gel cannot but give rise to serious concern. Insofar as the author can judge, the studies so far carried out are inadequate and do not permit a reliable determination of the reasons and limits of possible degradation of aircraft performance. More accurate and reliable experiments are needed.

There is a need to determine the main reason for the formation of residue, whether it is the high dynamic viscosity of the new generation of fluids, the increase in the thickener content, the composition of the thickener itself, or some other factor.

In both practical operations and flight tests in icing conditions in Russia, there has been quite a high incidence of spontaneous rolling, pitching and changes in control column forces. Such situations arose whenever ice formed either on the aileron and rudder hinges or on the leading edge of the wing or stabilizer.

One of the most recent incidents took place in September 2003, near Lake Baikal, and involved a Yak-40. Before taking off from Bratsk Airport, the aeroplane was treated with Type I fluid (moderate icing conditions; temperature 0°C). Fifteen minutes after take-off, the longitudinal and lateral channels of the autopilot spontaneously disengaged. In the transition to manual control, the crew felt a significant increase in stick forces. The aeroplane spontaneously banked left and right and pitched up and down. Working together, and with great difficulty, the pilots were able to regain control and return safely to Bratsk Airport. A crash was narrowly averted. This incident was not caused by the formation of gel, however. No cases of gel formation following the application of Type I fluid have been recorded.

To date, there have been over 30 cases in Russia of in-flight control problems following multiple applications of Type IV de-icing/anti-icing fluids, and a few cases involving some Type II fluids. There is an urgent need for serious research, both in the laboratory and in flight, to study and prevent this phenomenon. So far, only Type I and low-viscosity Type II fluids are "above suspicion."

The Russian Aviation Technical Committee of air transport operators has decided to discourage the use of Type IV fluids. In the words of the committee, it was necessary "to inform civil aviation operators that the application of Type IV de-icing/anti-icing fluids to protect aircraft against ground icing could lead to a degradation in aircraft stability and controllability. For the time being, therefore, Type IV fluids may not be included in aircraft operational and technical documents …".

Conclusion. In spite of the success that has been achieved in protecting air transport against ground icing, there are still many issues that must be resolved. One of the first such issues is the development and refinement of reference ground icing conditions. The experience gained in determining similar conditions for in-flight icing should be called upon.

The aerodynamic acceptance tests for Type II and Type IV de-icing/anti-icing fluids are not reliable enough and need to be improved immediately. Further studies must be carried out in this area.

Although this article does not include an analysis of aviation accidents and incidents, it can be stated that human factors play a major role in ensuring flight safety in icing conditions. Pilots are not knowledgeable enough in this area; ground personnel often know more. Although pilots certainly have an important role in ensuring safety by adhering to the clean aircraft concept, which requires de-icing if there are any traces of ice or frost on the aircraft's wings, safety may be enhanced if ground crews are required to take action whenever they consider that de-icing is necessary.

The most important factor in the overall resolution of this problem is systematic research, which the certificating authority must organize and carry out in cooperation with flight and ground personnel. □

Airport Economics Manual

continued from page 17

identification processes. In the same vein, this chapter has been expanded with respect to measuring airport performance and productivity, and refers to the various metrics that can be taken into account.

A method for determining the cost basis for the establishment of user charges is described in Chapter 4, which has been restructured to provide a more logical flow. It describes the process that has to be followed to determine the cost basis for charges on air traffic, including the various adjustments that need to be conducted and the method for allocating costs to cost centres and service lines as well as various categories of users. It also contains new guidance on how to attribute non-aeronautical revenues to an airport cost base, presenting the different approaches available to airports.

Chapter 5, dealing with airport charges and their collection, has been slightly amended in order to take into account the revised guidance on consultation with users; in addition to the description of the cost basis for individual charges, it contains new guidance material with respect to the possible use of economic pricing principles in setting airport charges, as well as guidelines for the application of discounts, rebates and other reductions in charges.

Chapter 6 addresses the development and management of non-aeronautical activities. It has been revised and updated in order to incorporate current airport practices.

Finally, Chapter 7, dealing with the financing of airport infrastructure, has also been updated and expanded, notably with respect to economic and financial analyses, while the former Chapter 8, on the application of automation in airport management, has been eliminated as it is no longer considered relevant.

Two cross-cutting issues — the recovery of the cost of security measures and the use of pre-funding arrangements — have also been considered and inserted at appropriate locations throughout the revised manual.

Appendices include a description of service level agreements (SLAs) that can be concluded between airports and airlines, and guidelines on how to implement pre-funding charges for the financing of certain airport capital projects, subject to conditions.

In general, the revised *Airport Economics Manual* now presents a more business-oriented approach. It addresses topical subjects such as the establishment of airport user charges according to ICAO principles, which call for consensus in the global aviation industry, or other difficult areas such as airport financing, including the use of pre-funding of projects through charges, the place that non-aeronautical revenues should have in airport economics, rebates in airport charges granted to certain categories of users, and so forth.

Every effort has been made to harmonize the revised manual with the ICAO *Manual on Air Navigation Services Economics* (Document 9161), which has also been recently revised. The new edition of the *Airport Economics Manual*, with its improved readability and presentation, is also available free of charge on ICAO's website (www.icao.int). □

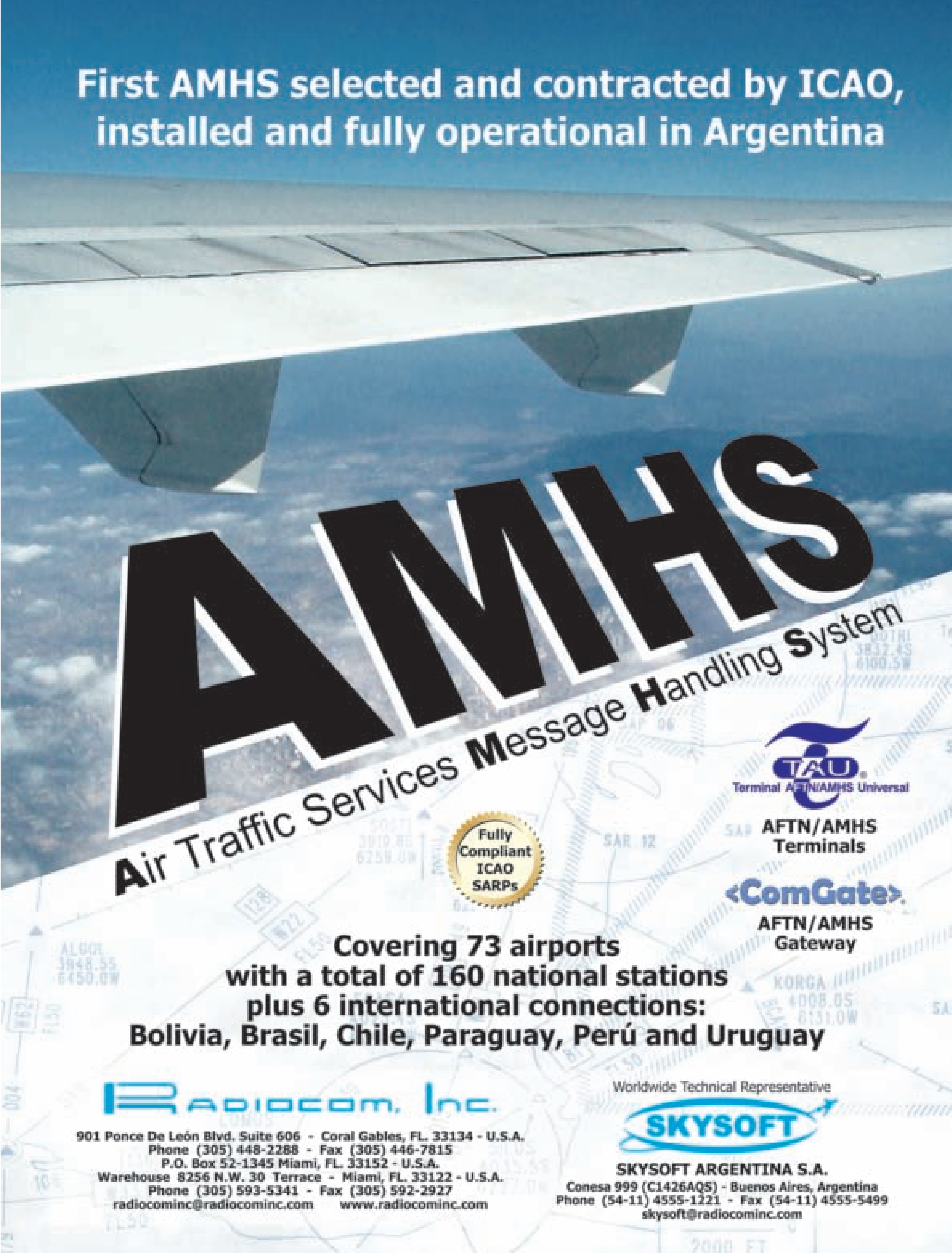
IN THE SPOTLIGHT...

DEPOSIT BY JAPAN
Japan deposited its instrument of ratification of the Protocol of amendment to the *Convention on International Civil Aviation* relating to Article 56 (1989) during a brief ceremony at ICAO headquarters on 19 June 2006. The article, in force since April 2005, increases the number of Air Navigation Commission members to 19 from 15. Shown on the occasion are (l-r): Sou Watanabe, Adviser, Delegation of Japan to ICAO; Rie Arai, Ministry of Foreign Affairs of Japan; Haruhiko Kono, Representative of Japan on the Council of ICAO; Dr. Taïeb Chérif, ICAO Secretary General, and Silvério Espínola, Principal Legal Officer at ICAO.

CIVIL-MILITARY COORDINATION
A seminar on the coordination of civil and military operations was held in Santo Domingo, Dominican Republic from 17 to 18 April 2006 for participants from the North American and Caribbean regions. Discussions focused on the flexible use of airspace as well as States' experience with respect to coordinating civil and military air traffic services and search and rescue operations. Hosted by the Dominican Republic's General Directorate of Civil Aviation, the event attracted 63 participants from Cuba, the Dominican Republic, Guatemala, Haiti, Mexico, Nicaragua and the United States, as well as the Central American Corporation for Air Navigation Services (COCESNA), the International Air Transport Association (IATA) and the International Federation of Air Traffic Controllers' Associations.

MEETING OF METEOROLOGISTS
The operational group responsible for the satellite distribution system for information relating to air navigation (SADIS) met in Cairo in late May 2006. Apart from operational aspects of SADIS, the group addressed a number of issues related to the system's future development, including progress in the SADIS second-generation programme which is to be implemented by all SADIS users by the end of 2008. Also discussed were forthcoming enhancements to the SADIS FTP service provided through the Internet to authorized SADIS users, and the establishment of a concise plan for major development of the SADIS system over a five-year period. The 11th meeting of the SADIS Operations Group (SADISOPSG), attended by 21 experts from seven States as well as representatives from the European OPMET Bulletin Management Group and three international organizations, was held at the ICAO Middle East Regional Office.

DUBAI MEETING
Senior representatives of the civil aviation administrations of Bahrain, Kuwait, Qatar, the United Arab Emirates and Yemen met in Dubai in late April 2006 for a meeting of the Steering Committee for the region's Cooperative Development of Operational Safety and Continuing Airworthiness Programme (COSCAP). The Steering Committee was created as a forum for addressing all flight safety and security matters in a way that promotes the harmonization of regulations, policies and procedures in the Gulf States. Topics at the recent meeting included the sharing of available resources and training for national inspectors.



First AMHS selected and contracted by ICAO, installed and fully operational in Argentina
AMHS
Air Traffic Services Message Handling System
Fully Compliant ICAO SARPs
TAU
Terminal AFTN/AMHS Universal
AFTN/AMHS Terminals
<ComGate>.
AFTN/AMHS Gateway
Covering 73 airports
with a total of 160 national stations
plus 6 international connections:
Bolivia, Brasil, Chile, Paraguay, Perú and Uruguay
Radiocom, Inc.
901 Ponce De León Blvd. Suite 606 - Coral Gables, FL. 33134 - U.S.A.
Phone (305) 448-2288 - Fax (305) 446-7815
P.O. Box 52-1345 Miami, FL. 33152 - U.S.A.
Warehouse 8256 N.W. 30 Terrace - Miami, FL. 33122 - U.S.A.
Phone (305) 593-5341 - Fax (305) 592-2927
radiocominc@radiocominc.com www.radiocominc.com
Worldwide Technical Representative
SKYSOFT
SKYSOFT ARGENTINA S.A.
Conesa 999 (C1426AQS) - Buenos Aires, Argentina
Phone (54-11) 4555-1221 - Fax (54-11) 4555-5499
skysoft@radiocominc.com