WORKING PAPER

INTERNATIONAL CIVIL AVIATION ORGANIZATION

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ASSEMBLY — 32ND SESSION

TECHNICAL COMMISSION

Agenda Item 26: Report on the prevention of controlled flight into terrain programme

SUMMARY

This working paper provides a report on the implementation of the ICAO programme for the prevention of controlled flight into terrain (CFIT) and action taken since the adoption by the 31st Session of the Assembly of Resolution A31-9. The Assembly is requested to note this paper.

REFERENCES

A32-WP/58
Doc 9622, *Assembly Resolutions in Force* (as of 4 October 1995)
State letter AN 11/37-96/21

1. INTRODUCTION

1.1 The development of the ICAO programme for the prevention of controlled flight into terrain (CFIT) has been a continuous process since 1992, particularly since the formation of the ICAO and Industry CFIT Task Force in June 1993 in co-operation with the Flight Safety Foundation (FSF) of Alexandria, Virginia, United States. This prevention programme is now in its implementation phase with the adoption and approval of amendments to ICAO Annexes and procedures and the publication of CFIT prevention material developed by the CFIT Task Force. However, some associated elements involving the amendment of ICAO Standards and Recommended Practices and Procedures are still under development.

1.2 The primary objective of the ICAO and Industry CFIT Task Force, introduced to the 31st Session of the Assembly in 1995, was the reduction of the global CFIT accident rate by 50 per cent by 1998. It was acknowledged that a reduction in the CFIT accident rate had the potential to make a major contribution toward a reduction in the overall accident rate. Figure 1 (see page 4) shows, for airline operations, the number of accidents recorded under CFIT accidents, CFIT accidents

(14 pages)
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which involved hull losses and fatal CFIT accidents for the years 1988 to 1997. The record for 1996 and 1997 thus far indicates a reduction in numbers of CFIT accidents.

2. ASSEMBLY RESOLUTION A31-9

2.1 The 31st Session of the Assembly adopted Resolution A31-9 which referred directly to the ICAO programme for the prevention of CFIT and action by States. In this resolution, which remains in force, the Assembly:

a) directed the Council to continue to develop the ICAO programme for the prevention of CFIT as a matter of high priority;

b) urged States to implement the ICAO programme for the prevention of CFIT including the related ICAO provisions, particularly those concerning the carriage of GPWS, in international and in domestic operations; and

c) urged States to take all necessary measures to assist in achieving the primary objective of a 50 per cent reduction in the global CFIT accident rate by the year 1998.

3. ICAO PROGRAMME FOR THE PREVENTION OF CFIT

3.1 The ICAO programme for the prevention of CFIT consists of the following elements:

a) the *CFIT Education and Training Aid*, including the two associated training videos (*CFIT An Encounter Avoided* and *CFIT Awareness and Prevention*), developed by the CFIT Task Force;

b) the action taken by ICAO to introduce new, and to amend existing, ICAO Standards and Recommended Practices and Procedures; and

c) action currently in hand by ICAO to develop new, and to amend existing, ICAO Standards and Recommended Practices and Procedures.

4. REPORT ON IMPLEMENTATION OF THE PROGRAMME ELEMENTS

4.1 *CFIT Education and Training Aid*

4.1.1 Appendix A describes the *CFIT Education and Training Aid* which has been provided to the International Air Transport Association (IATA) and to the International Federation of Air Line Pilots' Associations (IFALPA) for distribution to their members. The training aid has also been provided to Aero International, Airbus Industrie, Boeing Commercial Airplane Group, Bombardier Aerospace, British Aerospace, Dassault Aviation, Embraer - Empresa Brasileira de Aeronautica S.A., Galaxy Aerospace Corp., Gulfstream Aerospace Corp., Raytheon Aircraft Company and Saab AB, for incorporation into their training programmes and distribution to their customers. Training organizations such as Flight Safety International and Simuflite have also been provided with the training aid. Approximately 3 000 copies of the training aid have been distributed.

4.1.2 The United States Federal Aviation Administration, in conjunction with the Flight Safety Foundation, has distributed the training aid in hard-copy and compact disc (CD) form to the Directors General of Civil Aviation of all ICAO Contracting States, with a copy of the training video *Controlled Flight Into Terrain Awareness and Prevention.*

4.1.3 ICAO will distribute the training aid in CD format to the Directors General of Civil Aviation of all ICAO Contracting and to non-Contracting States, as well as to international organizations, as an enclosure to letter AN 11/37 dated 16 October 1998.

4.2 Amendments to ICAO Annexes and Procedures

4.2.1 Annex 6, Parts I and II, Annex 11, Annex 13 and the *Procedures for Air Navigation Services — Rules of the Air and Air Traffic Services* (PANS-RAC, Doc 4444), and *Procedures for Air Navigation Services — Aircraft Operations* (PANS-OPS, Doc 8168), Volumes I and II have been amended as described in Appendix B.

4.3 Proposals for the amendments of ICAO Annexes and Procedures

4.3.1 Amendments to Annex 3, Annex 4, Annex 6, Parts I and II, Annex 11 and to PANS-OPS, Volumes I and II are being developed as described in Appendix C.

5. GLOBAL AVIATION SAFETY PLAN (GASP)

5.1 The ICAO Global Aviation Safety Plan (GASP), which is described in A32-WP/58, together with the associated draft Assembly resolution contains, as an essential element, all aspects of the ICAO programme for the prevention of CFIT.

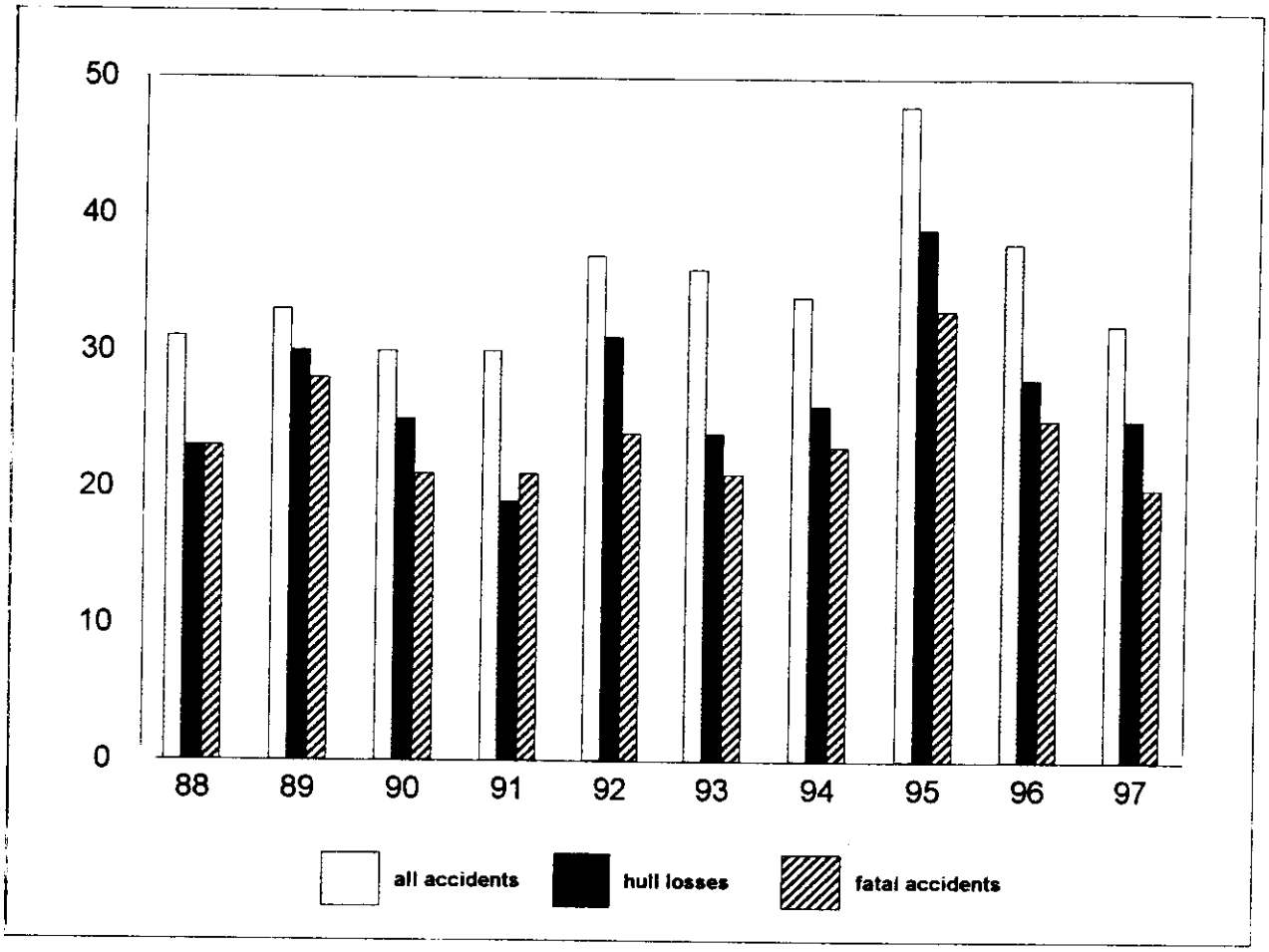
6. CONCLUSION

6.1 It will take several years to establish and to evaluate the success of the ICAO programme for the prevention of CFIT aimed at achieving a steady and favourable trend in the annual accident record. In the meantime, it is essential that the available prevention material be brought into the fullest possible use and that every effort be made toward the reduction of CFIT in conjunction with other flight safety programmes.

7. ACTION BY THE ASSEMBLY

7.1 The Assembly is invited to note the information in this paper.

Figure 1 **CFIT ACCIDENTS — AIRLINE OPERATIONS**



APPENDIX A

CFIT PREVENTION MATERIAL DEVELOPED BY THE ICAO AND INDUSTRY CFIT TASK FORCE AND PUBLISHED BY THE FLIGHT SAFETY FOUNDATION

This material consists of:

- *Controlled Flight Into Terrain Education and Training Aid*, Volumes 1 and 2;
- *Controlled Flight Into Terrain Checklist*;
- training video – *Controlled Flight Into Terrain An Encounter Avoided*; and
- training video – *Controlled Flight Into Terrain Awareness and Prevention*.

The *CFIT Education and Training Aid* is provided in two volumes.

VOLUME I — INTRODUCTION

Message from the President of the ICAO Council

Section 1. Overview for Management. An executive level briefing package intended for use in educating senior level executive management about CFIT phenomena and the role of management in CFIT reduction strategies.

Section 2. Decision Makers Guide. Important considerations for operations managers to help in implementing CFIT operational, training and associated policies and procedures.

Section 3. CFIT Operators Guide. Recommendations for CFIT policy and procedures.

Section 4. Example CFIT Training Programme. A flight crew training programme containing associated instructor documentation, support materials and participant manuals. The programme contains specific ground school and simulator training lessons and recognition, avoidance and recovery strategies. Aircraft specific CFIT recovery procedures are included for those aircraft for which appropriate technical data was available.

VOLUME II

Section 5. CFIT Background Data. Reference material containing selected reading from the extensive material published on the CFIT problem and engineering and testing data developed and used to support the training aid recommendations.

CFIT Checklist. The *CFIT Checklist* was designed as an operational CFIT risk assessment tool. It was intended to assist in the identification of the CFIT risk attached to any particular operation and to enable identification of areas where appropriate corrective action, in terms of operational procedures, training or equipment, could reduce the CFIT risk. The checklist is divided into three parts:

Part I — CFIT Risk assessment. The level of CFIT risk can be calculated for each flight, sector or leg under sections which address specific factors:

Section 1. Destination CFIT risk factors Five groups of factors.
Section 2. Risk multiplier Four groups of factors.

Part II — CFIT Risk-reduction factors. Factors which can reduce the CFIT risk if already implemented or can be implemented. Identifies particular action that can be taken:

Section 1. Company culture Seven factors.
Section 2. Flight standards Twenty four factors.
Section 3. Hazard awareness and training Twelve factors.
Section 4. Aircraft equipment Sixteen factors.

Part III — Your CFIT risk. This section establishes the CFIT risk from Part I (negative) and Part II (positive). A negative CFIT risk indicates a significant threat. Review of Parts I and II of the checklist would identify the changes and improvements that could be made to reduce the risk factors and improve the risk-reduction factors, thus reducing the overall CFIT risk.

Training video — *Controlled Flight Into Terrain An Encounter Avoided*. This video contains a history of CFIT accidents, a review of world-wide CFIT accident statistics and trends, an analysis of the CFIT traps which flight crew may encounter, leading to CFIT accident potential and CFIT avoidance and recovery strategies. The video also contains sample training situations that illustrate how the training aid can be used by an operator. It is introduced by short interviews with aviation leaders who stress the need for support of the CFIT prevention effort at the highest level in all organizations concerned with civil aviation.

Training video — *Controlled Flight Into Terrain Awareness and Prevention*. This video was produced as an accident awareness and prevention aid. It provides case studies of two approach and one departure CFIT accidents and examines ways in which these and other accidents might have been prevented. The video also demonstrates the use of the *CFIT Checklist*.

CONTROLLED FLIGHT INTO TERRAIN EDUCATION AND TRAINING AID DISTRIBUTED BY ICAO

ICAO will distribute the *education and training aid* to the Directors General of Civil Aviation of all Contracting and to non-Contracting States, as well as to international organizations, in CD format. The CD distributed by ICAO differs from the above material in the following respects:

a) the Introduction and the Message from the President of the ICAO Council are provided in six languages;

b) the video presentations are not included as an integral part of the CD; and

c) the *CFIT Checklist* is provided in six languages.

ICAO GUIDANCE MATERIAL RELATED TO THE PREVENTION OF CFIT

ICAO guidance material which relates to the prevention of CFIT is provided in the following documents:

- *Human Factors Training Manual* (Doc 9683);
- *Human Factors Digest No. 7 — Investigation of Human Factors in Accidents and Incidents* (Circular 240);
- *Human Factors Digest No. 10 — Human Factors, Management and Organization* (Circular 247);
- *Human Factors Digest No. 13, Proceedings of the Third ICAO Global Flight Safety and Human factors Symposium (Auckland, April 1996)* (Circular 266).
- *Accident Prevention Manual* (Doc 9422);
- *Preparation of an Operations Manual* (Doc 9376);
- *Manual of All-Weather Operations* (Doc 9365);
- *Manual of Procedures for Operations Inspection, Certification and Continued Surveillance* (Doc 8335); and
- *Safety Oversight Assessment Handbook*

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APPENDIX B

AMENDMENTS TO ICAO ANNEXES AND PROCEDURES

ANNEX 6 — *OPERATION OF AIRCRAFT*
PART I — *INTERNATIONAL COMMERCIAL AIR TRANSPORT*

AMENDMENT NO. 21, ADOPTED 8 MARCH 1995, APPLICABLE 9 NOVEMBER 1995

Sensitive altimeters
A note was added to 6.9 c) to indicate the unsatisfactory nature of drum-pointer altimeters.

Ground proximity warning systems — turbine engine aeroplanes
A new Standard, 6.15.3, was introduced, which requires that all turbine engine aeroplanes of a certificated take-off mass (MCTM) in excess of 5 700 kg or authorized to carry more than nine passengers shall be equipped with GPWS from 1 January 1999. The previous requirement applied to aeroplanes with MCTM in excess of 15 000 kg or authorized to carry more than thirty passengers (Part I, 6.15.1) additionally, aeroplanes for which the certificate of airworthiness was first issued before 1 July 1979, were subject only to a Recommended Practice (Part I, 6.15.2).

Ground proximity warning systems — warning functions
A new Standard, 6.15.5, was introduced, which specifies the circumstances under which a GPWS shall provide a warning from 1 January 1999.

Operations manuals — contents
A new Standard, 11.1 31), was introduced, which requires instructions and training requirements for the avoidance of CFIT and policy on the use of the GPWS to be included in operations manuals.

AMENDMENT NO. 23, ADOPTED 19 MARCH 1998, APPLICABLE 5 NOVEMBER 1998

Sensitive altimeters
The Standard in 6.9.1 c) was revised to specify two sensitive pressure altimeters with counter drum-pointer or equivalent presentation. The note to 6.9.1 c) was revised to indicate that neither three-pointer nor drum-pointer altimeters satisfied the requirement for sensitive pressure altimeters.

Ground proximity warning systems — piston engine aeroplanes
A new Recommended Practice, 6.15.6, was introduced, which recommends that piston engine aeroplanes with MCTM in excess of 5 700 kg or authorized to carry more than nine passengers should be equipped with GPWS.

Operations manuals — contents
The requirements for the content of an operations manual in 11.1 Operations Manual were relocated to a new Appendix 2. Contents of an Operations Manual, the following requirements were added:

2.1 statement of safety policy and personnel responsibilities;
5.9 standard operating procedures for each phase of flight;
5.10 instructions for the use of checklists and timing of their use;
5.13 instructions for the maintenance of altitude awareness and the use of automated or flight crew call-out;
5.14 instructions on the use of auto-pilots and auto-throttles in instrument meteorological conditions (IMC);
5.15 instructions on the clarification and acceptance of air traffic control (ATC) clearances, particularly where terrain clearance is involved;
5.16 departure and approach briefings;
5.17 route and destination familiarization;
5.18 stabilized approach procedure;
5.19 limitation on high rates of descent near the surface;
5.21 instructions for the conduct of precision and non-precision instrument approach procedures; and
5.22 allocation of flight crew duties and procedures for the management of crew workload during night and IMC instrument approach and landing procedures.

ANNEX 6, PART II – *INTERNATIONAL GENERAL AVIATION – AEROPLANES*

AMENDMENT NO. 16, ADOPTED 10 MARCH 1995, APPLICABLE 9 NOVEMBER 1995

Ground proximity warning systems — turbine engine aeroplanes
6.9.2. and 6.9.4 introduced Standards similar to those in Part I, 6.15.3 and 6.15.5 respectively.

AMENDMENT NO. 18, ADOPTED 20 MARCH 1998, APPLICABLE 5 NOVEMBER 1998

Ground proximity warning systems — piston engine aeroplanes
6.9.5 introduced a Recommended Practice similar to that in Part I, 6.15.6.

ANNEX 11 — *AIR TRAFFIC SERVICES*

AMENDMENT NO. 37, ADOPTED 20 MARCH 1997, APPLICABLE 6 NOVEMBER 1997

Identification of SIDs and STARs
A revision to 2.11.3 upgraded to Standards the specifications which govern the identification of standard departure (SID) and arrival routes (STAR).

ANNEX 13 — *AIRCRAFT ACCIDENT AND INCIDENT INVESTIGATION*

AMENDMENT NO. 9, ADOPTED 23 MARCH 1994, APPLICABLE 10 NOVEMBER 1994

Notification of accidents/incidents and reports
Strengthened the specifications for the notification of accidents and serious incidents for the ICAO Accident/Incident Reporting System (ADREP) preliminary and data reports and the requirements for the publication and circulation of the final report. Controlled flight into terrain only marginally avoided was included as an example of a serious incident.

PROCEDURES FOR AIR NAVIGATION SERVICES — RULES OF THE AIR AND AIR TRAFFIC SERVICES (PANS-RAC, DOC 4444)

PANS-RAC (DOC 4444), THIRTEENTH EDITION, APPROVED 11 MARCH 1996, APPLICABLE 7 NOVEMBER 1996

Radar vectoring and MSAW
Revised material on minimum vectoring altitudes to indicate that these should be sufficiently high to minimize activation of the GPWS and that the radar controller shall ensure the prescribed obstacle clearance when vectoring an IFR flight. A specification that radar services should provide for the display of safety-related warnings, including *inter-alia* minimum safe altitude warning (MSAW), was introduced.

PROCEDURES FOR AIR NAVIGATION SERVICES — AIRCRAFT OPERATIONS (PANS-OPS, Doc 8168)

PANS-OPS, Volume I — *Flight Procedures*

AMENDMENT NO. 9, APPROVED 4 MARCH 1996, APPLICABLE 7 NOVEMBER 1996

Introduced definitions and revised material on the standard instrument departure (SID) and the standard instrument arrival (STAR).

AMENDMENT NO. 10, APPROVED 1 MAY 1998, APPLICABLE 5 NOVEMBER 1998

Introduced the following:

a) material concerning the stabilized approach procedure, under factors affecting operational minima;

b) revision to material concerning final approach alignment;

c) a minimum descent gradient of 4.3 per cent and an optimum descent gradient of 5.0 per cent in the final approach of a non-precision approach procedure with a final approach fix (FAF);

d) established maximum and minimum rate of descent tables for the final approach phase of VOR and NDB on aerodrome with no FAF procedures, to control descent gradients;

e) revised material on the location of the FAF in a non-precision approach to allow that the FAF could, if necessary, be located at a greater distance than 19 km (10 NM) from the threshold;

f) revised material on ILS and new material on MLS for the determination of decision altitude or decision height;

g) revised altitude correction tables for temperature;

h) new material for ILS and MLS procedures involving glide paths greater than 3.5°, normally restricted to specifically approved operators and aircraft; and

i) a new Chapter 7 — Area Navigation (RNAV) Approach Procedures for Basic GNSS Receivers.

PANS-OPS, Volume II — *Construction of Visual and Instrument Flight Procedures*

AMENDMENT NO. 8, APPROVED 4 MARCH 1996, APPLICABLE 7 NOVEMBER 1996

Introduced definitions and revised material on SIDs and STARs. The amendment also introduced:

a) a specification for the minimum length of an intermediate approach segment, to allow for deceleration and configuration changes;

b) minimum, optimum and maximum glide path angles for ILS, MLS and radar approach procedures;

c) recommendations that the descent angles for ILS and MLS glide path inoperative procedures should be the same as for the full ILS and MLS procedures;

d) an optimum descent gradient for the final approach segment of a VOR approach with final approach fix, of 5.0 per cent;

e) that the descent gradient used in the final approach segment of an area navigation (RNAV) approach shall be published, the optimum and maximum gradients for an RNAV approach were specified; and

f) new material for obstacle clearance criteria en-route, for VOR and NDB routes.

AMENDMENT NO. 10, APPROVED 1 MAY 1998, APPLICABLE 5 NOVEMBER 1998

Introduced the following:

a) revision to material concerning final approach alignment;

b) a minimum descent gradient of 4.3 per cent and an optimum descent gradient of 5.0 per cent in the final approach of a non-precision approach procedure with a final approach fix (FAF);

c) a maximum descent gradient of 6.5 per cent for a standard non-precision approach;

d) established maximum and minimum rate of descent tables for the final approach phase of VOR and NDB on aerodrome with no FAF procedures, to control descent gradients;

e) revised material on the location of the FAF in a non-precision approach to allow that the FAF could, if necessary, be located at a greater distance than 19 km (10 NM) from the threshold; and

f) a new Chapter 33 — Area Navigation (RNAV) Approach Procedures for Basic GNSS Receivers.

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APPENDIX C

PROPOSALS FOR AMENDMENT TO ICAO ANNEXES AND PROCEDURES

Terrain portrayal on instrument approach and other charts — Proposals for the amendment of Annex 4 — *Aeronautical Charts*

Since 1995 the Air Navigation Commission has been conducting a review of the adequacy of Annex 4 provisions with regard to instrument approach charts and other associated charts in response to recommendations of the CFIT Task Force. This included: portrayal of terrain contours or area minimum altitude contour envelopes, and the use of colour tinting; the provision of the ground profile underlying the final approach segment; and the manner in which area minimum altitude and minimum sector altitude was presented on SID, STAR and area charts.

On 30 April 1998 the Commission agreed to the circulation of proposals for the amendment of Annex 4, to States and international organizations for comment. The next amendment to Annex 4 is scheduled for applicability in November 2001, however, the Air Navigation Commission considers that a special amendment applicability date of 4 November 1999 is appropriate in this case.

Predictive terrain hazard warning systems — Proposals for the amendment of Annex 6 — *Operation of Aircraft*, Part I — *International Commercial Air Transport — Aeroplanes* and Part II — *International General Aviation — Aeroplanes*

On 13 November 1997 the Air Navigation Commission requested the development of requirements for the carriage and use of predictive terrain hazard warning systems by turbine engine aeroplanes and that these proposals should be reviewed by the Commission in its 148th Session in the second quarter of 1998.

On 9 June 1998 the Commission agreed to the circulation of proposals for the amendment of Annex 6, Parts I and II, to States and international organizations for comment. The next amendment to Annex 6, Parts I and II is scheduled for applicability November 2001; however, the Air Navigation Commission considers that considerations of flight safety justify a special applicability date of 4 November 1999 in this case.

Regulations for the commencement and continuation of an instrument approach — Proposals for the amendment of Annex 3 — *Meteorological Service for International Air Navigation* and Annex 6 — *Operation of Aircraft*, Part I — *International Commercial Air Transport — Aeroplanes*

On 9 June 1998 the Air Navigation Commission agreed that amendments to Annex 3 and Annex 6, Part I be developed to introduce conditions for the commencement and continuation of an instrument approach, to strengthen the existing requirement for an operator to formulate rules in this context and to strengthen the provisions concerning Runway Visual Range (RVR) information. These proposals are to be presented to the Commission for initial review in its 149th Session in October 1998.

Implementation of minimum safe altitude warning (MSAW) – Proposals for amendment of *Annex 11 – Air Traffic Series*

On 9 June 1998 the Air Navigation Commission agreed that a Recommended Practice be introduced in Annex 11 for the display of safety related alerts and warnings, including, *inter alia*, minimum safety altitude warning, generated by radar systems. The next amendment to Annex 11 is scheduled for applicability in November 1999.

Design criteria for instrument procedures — Proposals for the amendment of *Procedures for Air Navigation Services — Aircraft Operations* (PANS-OPS, Doc 8168), Volumes I and II

The Obstacle Clearance Panel (OCP) is developing criteria for the design of global navigation satellite system (GNSS) non-precision instrument approach procedures for aircraft with flight management systems which incorporate VNAV. The OCP is also developing material to expand provisions on altimeter corrections for temperature, pressure and strong wind conditions. Proposals for the amendment of PANS-OPS, Volumes I and II are to be presented to the 12th meeting of the OCP (OCP/12) in the second quarter of 1999 and are expected to become applicable in November 2001.

— END —