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AIRBORNE COLLISION AVOIDANCE SYSTEM TCAS II

1. INTRODUCTION

- 1.1 The objective of this Aeronautical Information Circular (AIC) is to give a current overview of the evaluation of the Airborne Collision Avoidance System (ACAS).
- 1.2 The ACAS evaluation is being undertaken as part of a worldwide evaluation programme under the aegis of the International Civil Aviation Organisation (ICAO); it is intended to make a major contribution to the implementation of ACAS in a wide variety of operational environment. Particular emphasis is placed on the contributions of flight crew and air traffic controllers.
- 1.3 The ACAS equipment which is currently available for fitment to aircraft is known as TCAS II, which provides collision avoidance manoeuvre advice in the vertical plane. In particular, it should be noted that passenger carrying aircraft of more than 30 seats intending to operate in the United States, whatever their country of registration, are required to carry and operate TCAS II by 30 December 1993. Aircraft Operator's TCAS II fitment programmes are now well established and TCAS II operational experience is being gained in a wide range of airspace environment.

2. ACAS DESCRIPTION

- 2.1 ACAS is intended to serve as a safety equipment, alerting pilots to the presence of transponding aircraft in their vicinity and providing assistance in the detection and resolution of potential conflicts. The equipment is designed to operate independently of the ground-based systems which are used by air traffic services for the prevention of collisions.
- 2.2 TCAS II provides two types of advisories to the flight crew, Traffic Advisories (TAs) and Resolution Advisories (RAs). TAs are indications showing the approximate positions relative to ones own aircraft, either in azimuth only or azimuth and altitude, of neighbouring transponding aircraft which may become a threat; RAs recommend manoeuvres or manoeuvre restrictions in the vertical plane to resolve conflicts with aircraft transponding SSR Mode C altitude.

3. DCA'S POSITION

- 3.1 Development trials have demonstrated the ability of TCAS II to provide information on proximate traffic that pilots could not have known about if they had relied on visual sighting alone. TCAS II is now showing, in line operations, the potential to provide an effective airborne collision avoidance system. Nevertheless, the current ICAO international evaluation of TCAS II has been instrumental in identifying a variety of operational acceptability problems, for example cockpit distraction at critical stages of flight, operationally unnecessary RAs and 'excessive' height deviations resulting from RAs. These are being addressed via a number of modifications to the initial issue TCAS II logic. It is essential that the evaluation continues in the Malaysian environment to give the opportunity to refine operational procedures and to indicate any further necessary equipment changes.

3.2 A clear case has not yet been made for the DCA to mandate the carriage and operation of ACAS by aircraft registered in Malaysia, neither has a case been made to restrict or forbid ACAS use in Malaysian airspace or on Malaysia registered aircraft. Therefore the DCA position on ACAS is not to mandate its use at this time, but to permit suitably equipped aircraft to operate in Malaysian airspace.

3.3 Certification of TCAS II equipment fitted to Malaysia registered aircraft will be undertaken using normal certification procedures.

4. CO-ORDINATION OF THE EVALUATION

4.1 The TCAS II evaluation conducted by DCA Malaysia commenced on 04 July 1993 and is extended until 31 Disember 1995. The continued success of the evaluation requires the active participation of operators, flight crews, national administrations and various specialist staff.

4.2 The evaluation is based on the use of information collected through special pilot and controller reports.

5. OPERATOR'S INVOLVEMENT

5.1 To ensure a comprehensive assessment in a wide range of circumstances, the co-operation is sought of all operators equipping, or intending to equip, aircraft with TCAS II equipment for use in Malaysian airspace. These operators are requested to contact DCA Malaysia, at the address shown in paragraph 6.1(b) before commencing operational use of the equipment.

6. EVALUATION REPORTING PROCEDURES

6.1 For the period of evaluation only, reporting procedures will be as follows :-

- a) All pilots are requested to provide details of all occasions when a Resolution Advisory (RA) occurs - including RAs received in Malaysia airspace. The reports should be filed on a TCAS II Evaluation Pilot Report Form, a specimen copy of which is at Annex A. Data will be used only for the study of TCAS II performance and will be treated as confidential ;
- b) Operators should specify to flight crew, the arrangements for collecting these report forms and for sending them to the appropriate addresses shown below :-

Department of Civil Aviation Malaysia
Block B, 4th. Floor,
Wisma Semantan
No. 12, Jalan Gelenggang
Bukit Damansara
50618 Kuala Lumpur
(Attn : Air Traffic Services Division
or
Flight Operations Division)

7. RA OCCURRENCES IN MALAYSIAN AIRSPACE LEADING TO DEPARTURE FROM AN ATC CLEARANCE - LEGAL ASPECTS

7.1 When flying under IFR or at night, an aircraft initiating a manoeuvre in accordance with a Resolution Advisory (RA) is likely to depart from its air traffic control clearance. This would be a prima facie breach of the Schedule 2 Section III Para 13 of the ANO 1953. However, departure from a clearance given by an ATC unit 'for the purpose of avoiding immediate danger' is sanctioned by Schedule 2 Section V Para 34 of the Air Navigation Order 1953. In these circumstances Schedule 2 Section III Para 25 of the ANO 1953 states that the pilot in command of an aircraft shall have final authority as to the disposition of the aircraft while he is in command. Therefore, to the extent that the action in response to an RA is taken 'for the purpose of avoiding immediate danger' and provided that the TCAS II equipment and its installation are approved by the state of registry and that its operation by flight crew is in accordance with instructions for the use of this equipment specified in their Company's operations manual, acting in accordance with an RA will be lawful.

7.2 Pilots are reminded that, in accordance with the Schedule II Section V, Para 34 of the ANO 1953, reporting requirements imposed upon the commander of an aircraft which departs from an air traffic control clearance in Malaysian Airspace is mandatory. For the evaluation period only in the event that an aircraft has departed from an air traffic control clearance in compliance with an RA, the legal obligation under the above mentioned article will be satisfied if the commander submits a TCAS II Evaluation Pilot report form to the address shown in para 6.1(b).

7.3 RA reporting should be used independently of airmis and other incident occurrence reporting procedures which remain unchanged.

8. ATC INTERFACE

8.1 The operation of TCAS II equipment will affect ATC operations to some degree, irrespective of the type of airspace. ATC will expect flight crew to react to TCAS II indications in participation.

a) Traffic Advisory (TA)

ATC is aware that pilots are not expected to take avoiding action solely on the basis of TA information. Requests for traffic information should not be made unless the other aircraft cannot be seen and the pilots believe their aircraft is about to be endangered ;

b) Resolution Advisory (RA)

ATC is aware that pilots are expected to respond immediately to an RA. If required, avoiding action should be the minimum necessary for conflict resolution. ATC should be informed as soon as possible of any deviation from an ATC clearance. Pilots should be aware that any deviation from an ATC clearance has the potential to disrupt the controller's tactical plan and may result in temporary reduction of standard separation against aircraft other than those which originally caused the RA. It is vital that flight crew maintain a good look out and return to their original flight path as soon as it is safe and practical to do so.

8.2 Responsibility for Separation of Aircraft During Manoeuvres in Compliance with an RA.

8.2.1 Upon on being informed that an aircraft under Air Traffic Control is manoeuvring in accordance with a TCAS RA, a controller should not issue control instructions to that aircraft which are contrary to the RA which has been communicated by the flight crew. Once an aircraft departs from an ATC clearance in compliance with an RA, the controller ceases to be responsible for providing standard separation between that aircraft and other aircraft affected as a direct consequence of that RA manoeuvre. However, controllers should continue to provide traffic advice to aircraft affected by the manoeuvre. The controller's responsibility for providing standard separation for all aircraft resumes when either ;

a) The controller acknowledges a report from the flight crew of the aircraft that had reported the RA that the aircraft has resumed its assigned clearance ; or the controller acknowledges a report from the flight crew of the aircraft that had reported the RA that it is returning to its assigned clearance and then issues an alternative clearance which has been acknowledged by the flight crew.

9. TCAS RTF PHRASEOLOGY

9.1 Work concerning the provision of unambiguous standard TCAS RTF phraseology is being actively pursued in order to provide flight crew and controllers with a mutual understanding of RA manoeuvres during a TCAS encounter. However, it is considered essential that there is international TCAS RTF phraseology agreement before regional implementation takes place. The result of the work is expected to be available by the end of 1993.

9.3 RTF reports made by flight crew when compliance with a TCAS RA induces a deviation from an ATC clearance should contain :

a) Name of the ATC Unit ;

b) Aircraft identification ;

- c) Specific indication of the deviation.

10. ATC EVALUATION INVOLVEMENT

- 10.1 One of the key purposes of the evaluation is to assess the relationship between TCAS II operation and ATC. Evaluation data returns to date been invaluable in identifying and aiding assessment of operational issues. However, continued data return is vital to enable an accurate assessment of operational issues, develop procedures and to aid ACAS policy development. Following an RA and if appropriate, a TA, DCA controllers are requested to complete an ACAS Evaluation Form for ATS. A specimen form is at Annex B. The ATS Evaluation Form should be forwarded to Air Traffic Services Division at the address shown in paragraph 6.1(b).

11. NUISANCE ADVISORIES

- 11.1 TAS and RAS can occur even though standard separation exists. Therefore, controllers should not immediately assume that separation has been lost, or that they are at fault, when a pilot reports that he/she is manoeuvring in response to an RA. Nevertheless, the pilot should be asked if he/she is filing an airmis report.
- 11.2 One cause of an unnecessary RA is high relative vertical speed between two aircraft involved in level-off manoeuvres. TCAS II does not have knowledge of the future intent of either aircraft and assumes that the current flight profiles will be maintained. Pilots and controllers should be aware of the increased probability of nuisance RAs in these circumstances. Modifications to the initial issue of the TCAS II logic, reducing this probability, are expected to be installed in most TCAS II equipped aircraft by mid 1994.

12. DEPENDENCE ON AIRBORNE TRANSPONDER EQUIPMENT

- 12.1 As TCAS II relies upon information from airborne transponders, it cannot detect the presence of aircraft whose transponders are unserviceable or which have not been selected to operate. TAS and RAS will not be produced in such circumstances, and they will not be produced in respect of any aircraft that does not carry transponder equipment, or one whose equipment is incompatible with the international standard.

13. SUPPLEMENTARY INFORMATION

- 13.1 In accordance with para 3.1 Chapter 3 of the ICAO Annex 6 (Part I), an operator shall ensure that all employees when abroad know that they must comply with the laws, regulations and procedures of those state in which operations are conducted. In this respect, operators involved in international operations are required to comply to all TCAS requirements issued by such states which they operate.

(DATO' ZALUDIN BIN HJ. SULONG)

Director General
Department of Civil Aviation
Malaysia

ANNEXE A

TCAS II OPERATIONAL EVALUATION PILOT REPORT FORM

(Fill in blanks/circle correct answers)

Aircraft operator:.....

Name: Telephone:

(Information requested on this line is optional)

Aircraft Call sign: Registration: Type:.....

Aerodrome of departure: Destination:.....

Date of Event: Time (UTC):.....

Own altitude: ft/FL Cleared altitude:.....ft/FL

Own aircraft position: FIR: VOR: Radial: DME:.....

or
LAT: LONG:

or
TMA: SID/STAR Procedure:

Radar vectoring?: YES/NO

ATC unit: Frequency: SSR Code:.....

Phase of flight: Take-off/Climb/Cruise/Initial Descent/Hold/Approach/Final/Missed Approach

TA information (before RA) TA issued?: YES/NO Visual contact as a result of TA?: YES/NO

RA Information

intruder information Bearing:o'clock Range:NM

Relative altitude:ft above/below Climbing/Level/Descending

Original RA: Climb/Crossing Climb/Descend/Crossing Descend/Reduce Climb/Reduce Descent/ Monitor Vertical Speed
if Reduce/Monitor Vertical Speed, limits:fpm tofpm

Subsequent advisory(ies)?: Climb Now/Descend Now/Increase Climb/Increase Descent/Monitor Vertical Speed

Did you follow the RA?: YES/NO
If appropriate, estimated deviation from clearance:ft

RA was: Necessary/Useful/Nuisance

ATC information. ATC traffic information issued?: YES/NO
ATC avoiding action issued?: YES/NO
If yes, consistent with RA?: YES/NO

Flight conditions IMC/VMC Day/Night Visibility:.....NM

Remarks (if necessary, continue overleaf):

ANNEXE B
ACAS EVALUATION FORM FOR ATS

Name of reporting unit:

Date and time of occurrence: UTC

Sector/Position:

Workload: low (.....) normal (.....) high (.....)

Is the occurrence related to a TA or a RA TA (.....) RA (.....) ? (.....)

Description of the occurrence:

.....

.....

Position and altitude of the occurrence:;ft/FL

INVOLVED AIRCRAFT

No 1

Call sign: SSR Code: ACAS-equipped: Yes (.....) No (.....) ?(.....)

No 2 Unknown?(.....), otherwise:

Call sign: SSR Code: ACAS-equipped: Yes (.....) No (.....) ?(.....)

VFR (.....) Military (.....) Other (.....)

R/T with a/c No 1? Yes (.....) No (.....)

R/T with a/c No 2? Yes (.....) No (.....)

Did either pilot report an airmiss? Yes (.....) No (.....)

Did either pilot ask for traffic information? Yes (.....) No (.....)

If 'yes', was it before manoeuvring? (.....) after manoeuvring? (.....)

Was the action taken by the pilot justified in your view? Yes (.....) No (.....)

(if 'yes' comment under 'Remarks' below)

Will recorded radar data become available? Yes (.....) No (.....) ? (.....)

Did the occurrence disrupt your activities? Yes (.....) No (.....)

(if 'yes' comment under 'Remarks' below)

REMARKS