ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 6 : Aeronautical navigation issues

REVIEW OF ANNEX 10 SARPS FOR GROUND-BASED RADIO NAVIGATION AIDS IN THE LIGHT OF PRESENT AND PLANNED GNSS SERVICES

(Presented by the Secretariat)

SUMMARY

This document is based on the results of the review of Standards and Recommended Practices (SARPs) in Annex 10, Volume I undertaken by the GNSS Panel at the request of the Air Navigation Commission (ANC) in order to assess the need for updates of the document in the light of present and planned GNSS services. The objective of the paper is to identify the areas where additional work should be initiated to investigate the impact of potential changes to the Standards and develop draft amendments to the Annex if necessary. As the results of the initial review indicated a potential for some major changes to SARPs in Annex 10, Volume I, the scope of these potential changes is reported to the Eleventh Air Navigation Conference and a recommendation of the conference on the continuation of this work is sought.

Action by the conference is in paragraph 4.

1. INTRODUCTION

1.1 Future implementation of global navigation satellite system (GNSS) capable of providing global navigation coverage and area navigation (RNAV) capabilities in support of all phases of flight will overlay a number of capabilities and functions delivered by the existing radio navigation aids defined by Standards and Recommended Practices (SARPs) in Annex 10, Volume I. A preliminary high-level review of the SARPs in the annex identified candidate parts with the potential to require modification in the light of present and planned GNSS services. These will generally be where Standards will become redundant through

the introduction of GNSS or alternatively where Standards in their present form may prove problematic in the transition to satellite navigation.

1.2 Although the review focused on GNSS-related aspects, it also addressed a number of potential updates resulting from the increasing application of ground-based navigation aids in support of RNAV operations.

1.3 As a result of initial review, the areas are identified where future work to investigate the full impact of the introduction of GNSS and RNAV and to develop appropriate amendments would be warranted.

2. DISCUSSION

2.1 Protection dates for non-visual aids to precision approach and landing

2.1.1 The current ICAO strategy for introduction and application of non-visual aids to approach and landing (Annex 10,Volume I, Attachment B) provides for alternative use of three standard systems, namely the instrument landing system (ILS), microwave landing system (MLS) and GNSS . The strategy does not assume a transition to a single globally-established system in the foreseeable future, and until this underlying assumption is changed, the SARPs for these systems that establish their status as an aid to precision approach and landing will not require changes.

2.1.2 It is noted, however, that the current protection dates for ILS (1 January 2010) and MLS (31 December 2015) have been established based on the anticipated time frames for GNSS-based all weather operations and the sole-means concept that are currently being revisited. ILS and MLS protection dates may need to be reviewed respectively.

2.2 Use of DME to support RNAV operations

2.2.1 The increasing use of distance measuring equipment (DME) facilities to support RNAV applications, particularly in the terminal area may introduce new requirements on the performance of the DME ground system. The impact of the use of DME facilities for RNAV applications should be investigated in relation to this and, in particular, the possibility of increased DME coverage requirements (low level coverage) to facilitate terminal area RNAV.

2.2.2 Current DME Standards require the transponder to radiate not less than 700 pulse pairs per second (ppps). Whilst most States operate at these minimum rates, some States choose to operate DME ground systems with the rates set at tactical air navigation (TACAN) type levels in the region of 2 700 ppps. This increases the background interference in the band, and would invoke overly stringent requirements on the GNSS receiver if used as the baseline scenario. The current Standard may need to be reviewed to reflect good practice.

2.2.3 The current DME Standard defines spurious radiation requirements for the on board interrogator. It has been suggested that the current spurious radiation limit may be insufficient to protect airborne GNSS and that additional protection similar to secondary surveillance radar (SSR) (tighter requirements for DME spurious emissions in the band 1 015 to 1 045 MHz) may be necessary.

2.2.4 The protection date for DME (1 January 2010) may need to be reviewed as DME/DME RNAV is being considered as a preferred terrestrial back-up in transition to GNSS-based navigation.

2.3 Requirements for DME/P

2.3.1 The introduction of DME/P was intended to deliver two major benefits: a precision ranging function and additional DME channels (frequency multiplexed with different pulse spacing). Although the precision ranging might not be implemented by the civil aviation community, these extra channels may be needed in the future.

2.3.2 For some MLS applications, the use of DME/P is required. These include MLS/RNAV procedures in obstacle rich environments (mainly for increased integrity) and where large offsets of the azimuth from the runway exist (for computed centre line approaches). If the operational use of MLS continues to be limited to straight-in ILS look-a-like (see paragraph 2.4.1 below), then the civil requirement for DME/P is hard to justify. However, military users in some States may have implemented DME/P ground systems and avionics.

2.3.3 Considerable analysis has been performed on the ability of GNSS and DME to co-exist in the DME band 960 - 1 215 MHz. To date this analysis indicates that these systems can co-exist with no change to the DME Standards. This analysis has not considered the effect on DME/P, since the current DME/P channel plan uses frequencies from 1 041 to 1 143 MHz that are well below the lowest frequency allocated for RNSS in the band (i.e. 1 164 MHz). However, the DME/P frequencies associated with the MLS in the MLS expansion band go up to 1 206 MHz where DME/P and RNSS compatibility have not been analysed.

2.3.4 Further work is therefore required to investigate the expected future use of DME/P and to determine the implications of removing DME/P from the SARPs.

2.4 MLS/RNAV

2.4.1 Category III MLS ground stations currently being installed in Europe accommodate the MLS/RNAV capability. However, the prospects of using this capability are uncertain (e.g. the current Airbus A319 Category III MLS implementation does not encompass DME/P avionics which supports MLS/RNAV capability). Although the widespread use of MLS/RNAV is not foreseen at this point in time, it is not known if some States would implement it in the future. However, it is acknowledged that in reality the RNAV functionality is more likely to be delivered by GNSS and/or by DME/DME, enabling reductions in the complexity and cost of MLS installations.

2.4.2 The vertical coordinate of the MLS datum point was coded in MLS data as “relative to mean sea level” pending the introduction of the vertical component of WGS-84 (which is now being implemented). Relevant MLS SARPs specification has to be reviewed to harmonize glide paths provided by GNSS and MLS. However, the full implications of such a change need to be more fully analysed in terms of impact on aviation equipment and the possible impact on the existing or soon to be installed MLS ground systems.

2.5 Review of Annex 10 guidance material — DME, ILS and VOR service volumes

2.5.1 Considering the time frames envisaged for continued use of DME, ILS and VOR facilities, current Annex 10 guidance on frequency planning criteria for these systems (Volume I, Attachment C) needs to be updated and harmonized with the material based on the other sources (e.g. FAA AC00-31A).

2.6 Protection considerations

2.6.1 Any change to the SARPs should account for the investments made by equipment manufacturers and service providers to ensure that any changes preserve these installations as SARPs compliant.

3. CONCLUSIONS

3.1 A preliminary analysis of the current SARPs for ground based radio navigation aids in Annex 10, Volume I highlighted the areas where updates of SARPs and guidance material may be required. Further work is required to investigate the feasibility of amending SARPs taking into account the potential for reduction of redundant navigation functionalities and protection considerations, and to develop draft amendments to the Annex if necessary.

3.2 The issues to be addressed include:

a) general review of protection dates;

b) changes to DME specifications, taking account of the increasing use of this system in support of terminal RNAV operations and the use of DME/DME RNAV as a back up option to GNSS;

c) requirements for DME/P;

d) requirements for MLS/RNAV and updates of MLS specifications; and

e) guidance material on DME, ILS and VOR service volumes and frequency planning.

4. ACTION BY THE CONFERENCE

4.1 Noting the above, the conference is invited to agree on the following recommendation.

RSPP

Recommendation 6/G — Amendment to Annex 10, Volume I — Updating of SARPs for radio navigation aids

That ICAO undertake a review of SARPs and guidance material in Annex 10, Volume I in the areas identified in paragraph 3.2 of this working paper.

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