European Aviation Safety Agency

Deviations request #69 for an ETSO approval for CS-ETSO applicable to Airborne Area Navigation Equipment Using Multi-Sensor Inputs (ETSO-C115b) Consultation Paper

1. Introductory note

The hereby presented deviation request shall be subject to public consultation, in accordance with EASA Management Board Decision No 7-2004 as amended by EASA Management Board Decision No 12-2007[1] products certification procedure dated 11. September 2007, Article 3 (2.) of which states:

"Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means of compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least 3 weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency."

2. ETSO-C115b : Airborne Area Navigation Equipment Using Multi-Sensor Inputs

Deviate from EUROCAE ED-58 Appendix G 2.2.7 and only provide position consistency monitoring combined with sensor validity monitoring instead of the additionally requested velocity consistency monitoring.

Requirement:

EUROCAE ED-58 (Minimum Operational Performance Specification for Area Navigation Equipment Using Multi-Sensor Inputs).

Appendix G

Special Requirements for MNPS use in Europe

1.0 Recommendations of NARG for the Implementation of RNAV Routes Within Europe

1.1 Introduction

A Working Group was established by the European Air Navigation Planning Group (EANPG) of ICAO to review the deployment of navigation aids and to consider the steps necessary to implement RNAV procedures in the short term in Europe. This Group, called the Navigation Aids Deployment Criteria and Area Navigation Working Group (NARG), recommended that there should be two classifications of RNAV systems according to their accuracy. The Group believed that the provision of routes designed for lower accuracy systems could allow the introduction of RNAV routes whilst awaiting the performance evaluations required before precision routes could be introduced. Three types of RNAV route were considered to be appropriate to both precision and non-precision systems (paragraph 1.3).

It was recommended that States in the EUR region give particular consideration to the establishment of international RNAV routes to obtain the greatest benefit from their implementation.

The work of NARG was concentrated upon en-route area navigation and so SIDS and STARS were not considered by the Group.

[1]) http://easa.europa.eu/management-board/meetings/2007/04/MB%20Decision%2012-2007%20amending%20the%20certification%20procedure.pdf

This Appendix is a summary of the recommendations and for further information and explanation reference should be made to current NARG documentation.

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2.0 **Possible** Additional Requirements for Compliance with the European Minimum Navigation Performance Specification (MNPS)

2.1 Introduction

The EUROCONTROL Organisation and other European States in collaboration with IATA, IFALPA and ICAO, have **commenced the development** of a Minimum Navigation Performance Specification (MNPS) for **possible future application in the European area**. The **foreseen** requirement for an MNPS stems from the belief that, by the mid-to-late 1990's, the demand for optimal air routes in certain areas will be such that it can only be accommodated through the use of closely spaced parallel tracks. At present it is envisaged that the separation will be of the order of 5-7n miles. It will thus be important to ensure that full use is made, within Europe, of the navigational capability that is **expected to be demonstrated** by the majority of the aircraft during and beyond the 1990's. This will provide benefits to both ATC and the aircraft operations, e.g. route flexibility, closely spaced parallel tracks and reduced pilot and controller workloads.

Studies to date indicate that the basic requirements for track-keeping accuracy including flight technical error (FTE) will be 1.0 n mile (95%) during all operations pertinent to the MNPS, including track changes of up to 20°; **this track change limit is subject to modification during the development of the European MNPS**. While the track-keeping accuracy of the multisensor system is capable of meeting the 1.0 n mile (95%) requirement on straight routes whilst using at least 2 DME's for position estimation, a number of additional features which will increase the level of automation are expected to be required before it could be exploited for MNPS purposes.

In the following paragraphs the additional system requirements and means of compliance are specified to **meet the European MNPS as presently envisaged**. It is anticipated that the MNPS will initially be applied in the upper airspace but will be extended into lower airspace as experience and needs develop. **It will be necessary to add to, and amend, the following requirements in the light of future developments in the definition of a European MNPS**.

2.2 Additional System Requirements

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2.2.7 Sensor Monitoring

At frequent intervals the system shall monitor the data obtained from sensors in use by reference to the RNAV computed position. **The system shall monitor all sensors for consistency in position and velocity information.** If a significant error is revealed (**a value to be determined from the MNPS**) and automatic reconfiguration possibilities have been exhausted, a warning shall be displayed to the crew and the equipment shall ignore the position derived from an out of tolerance sensor. Provision shall be made to enable the crew to identify and deselect the discrepant sensor.

Industry:

EUROCAE ED-58 appendix G 2.2.7 requires the monitoring of sensors used in the RNAV position computation. EUROCAE ED-58 includes position monitoring and velocity monitoring. The equipment complies with the requirement by considering that the monitoring of a position which integrates a velocity fulfils the RNAV computed position required performance.

The equipment manages sensors providing mainly position: GPS and RADIO NAV sensors and a sensor providing only velocity: air data sensor. In the equipment, in nominal mode, GPS and radio navigation sensor velocities are only used to compute the intermediate positions between each position reception from sensors.

In degraded mode, when no more position sensor is available, the equipment uses air speed to keep computing position.

Position monitoring is performed:

- for consistency among all sources which are providing data for position computation: sensors and equipment computed position (conform to EUROCAE ED-58/RTCA DO-187 2.2.1.11.e)
- for accuracy of the equipment selected position (conform to EUROCAE ED-58/RTCA DO-187 2.2.1.11 and to TSO C129 a.3.xiii.2.a)
- for consistency between the two equipments regarding required navigation performance (conform to EUROCAE ED-58/RTCA DO-187 1.2.7)

The equipment raises an alert when a position discrepancy is detected.

The equipment uses sensor velocity to compute its own position. As a consequence, a velocity discrepancy will automatically lead to a position deriving from an out of tolerance sensor (EUROCAE ED-58 Requirement Appendix G 2.2.7), and then to a crew alert:

Alerts generated for position actually cover all cases of alerts related to velocity.

Furthermore, in the equipment, velocity monitoring is performed by automatic reconfiguration if sensor velocity information is not valid.

EASA: The EUROCAE ED-58 Requirement Appendix G 2.2.7 does not exist in RTCA DO-187 which is the basis for FAA TSO-C115b. ETSO-C115b and TSO-C115b are considered technically equivalent. Appendix G in EUROCAE ED-58 document detailed specific additional requirements for the European Minimum Navigation Performance Specification (MNPS) as anticipated during the early implementation of RNAV (area navigation which is based on waypoints instead of on ground navigation aids). Moreover, the document already included clear statements regarding the necessary modifications and additions necessary to implement the European MNPS that was being defined. The error to be detected by the position and velocity monitoring was not specified. The additional requirements as described in EUROCAE ED-58 Appendix G were linked to the preliminary RNAV introduction in Europe and have now become obsolete. AMC 20-4 and JAA TGL 10 rev. 1 provide the corresponding RNAV requirements superseding the guidelines from EUROCAE ED-58 Appendix G.

As EUROCAE ED-58 Appendix G is obsolete and a sound monitoring is provided by the equipment, EASA accepts the equivalent level of safety for the intent of EUROCAE ED-58 Appendix G. Furthermore, it is proposed to consider that EUROCAE ED-58 Appendix G is obsolete and document in the Declaration of Design and Performance of the equipment how position monitoring and alert are generated by the equipment to meet the intent of appendix G 2.2.7 from EUROCAE ED-58.

The following should also be noted in this context:

- Initially for navigation systems there were no requirements for the ground speed. E.g. EUROCAE ED-72a as called by ETSO-C129a and ETSO-C115b for GPS sensors states that there are no velocity accuracy specifications. The corresponding Minimum Operational Performance Specifications concentrate purely on the provided position information.
- With the usage of speed information in the ATM (Air Traffic Management) system as provided through ADS-B or Mode S messages the performance of the velocity

information became more important. RTCA DO-229() Appendix F describes a method to calculate the velocity directly from GPS data and how to determine velocity uncertainty information. The ADS-B out certification requirements, currently under development to support the new Commission Implementing Regulation (EU) No 1207/2011 of 22 November 2011 laying down requirements for the performance and the interoperability of surveillance for the single European sky, will include requirements for the velocity information provided by the ADS-B out function.

- For the 0.5 nautical miles 2 D accuracy as specified by EUROCAE ED-58, EASA agrees that a position monitoring of a sensor could be sufficient instead of monitoring position and speed information from that sensor. The situation may be different when operating in the degraded mode in which the position is purely calculated based on airspeed integration without further position update from any sensor. This degraded mode, generally referred as dead reckoning, is already indicated as a failure mode and has no specific accuracy requirements. Consequently, EASA considers that a position monitoring of a sensor is sufficient for the 0.5 nautical miles 2 D accuracy mode.
- Speed monitoring in addition to a pure position monitoring would be able to reveal data inconstancies as the flight dynamic of the aircraft is not allowing for abrupt changes or discontinuities in speed. This allows developing an easy signal validity analysis.