

# Deviation Request ETSO-C115c#6 for an ETSO approval for CS-ETSO applicable to Airborne Area Navigation Equipment Flight Management Systems (FMS) Using Multi-Sensor Inputs (ETSO-C115c)

## Consultation Paper

### 1 Introductory Note

The hereby presented deviation requests 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](#) products certification procedure dated 11th September 2007, Article 3 (2.) of which states:

“2. 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-C115c#7 Airborne Area Navigation Equipment Flight Management Systems (FMS) Using Multi-Sensor Inputs

#### 2.1 Summary of Deviation

Deviates from RTCA DO-283A Appendix C section C.2.1 by using a different weighting-algorithm to select or exclude VOR stations, and secured with reasonableness checks.

#### 2.2 Original Requirement

*RTCA DO-283A Appendix C*

##### *C.2.1 VHF Omni-directional Range (VOR):*

*(...) When demonstrating compliance to this MOPS, the airborne system shall assume that the VOR infrastructure will provide a radial signal with a Gaussian angular error that has a mean of zero and a standard deviation of 0.7 degrees. VOR signals shall not be used at ranges greater than defined in Table C-1:*

**Table C-1 Maximum VOR Ranges**

<b>Range</b>	<b>max. D</b>
RNP-0.3 RNAV to RNP 0.9 RNAV	20 NM
RNP-1 RNAV to RNP-1.9 RNAV	40 NM
RNP-2 RNAV and above	100 NM

*In addition, VOR signals shall not be used if the elevation angle of the aircraft as evaluated at the VOR exceeds 40 degrees.*

## 2.3 Industry

In the applicant FMS, VOR error is modelled with variance of  $1/64$  degrees quantity squared (0.9 degrees); one standard deviation = square root (0.9) = 0.946 deg.

This is more conservative than the infrastructure assumption.

The FMS will use a VOR station with a range between 2.0 to 180 nm (down to 0.2 nm if collocated DME is used). The station is marked as invalid in the cone of confusion which is defined as an elevation angle above 39 degrees. The VOR contribution to the solution is deweighted as the range increases so at larger ranges the contribution is essentially nil unless there are no other reliable navigation sources. The VOR qualification criteria include tests to insure there are no other VORs with on the same frequency within range, the estimated bearing must agree with the received bearing within 0.2 degrees. This combination of reasonableness checks and VOR weighting has been in use for more than two decades with good service experience. Although this is less conservative than the proscribed range limits, the combination of reasonableness checks and navigation algorithm has proven reliable.

## 2.4 Equivalent Level of Safety

An Equivalent Level of Safety is provided by the FMS alerting when ANP exceeds RNP. The ANP algorithm protects against normal variance in radio-based navigation, but not against undetected faults of nav aids in a single DME VOR environment. Normally multiple DMEs are available, so a multiple DME solution is merely augmented with VOR data. In terminal environments, there may only be a single VOR and DME but the aircraft is generally within the proscribed range limits in that situation. In all cases, the FMS uses reasonableness tests on VORs, and will not use a VOR that fails the test. Given the low weighting for VOR bearings at extended range, this is adequate protection.

## 2.5 EASA position

EASA accepts the deviation.