

09POS05

Future Flight Deck – Cockpit instrumentation for the RNP environment

Executive summary

IFALPA believes that for all the increases in flight safety and benefits of improved operational efficiency that the full RNP environment presents it is necessary for Primary Cockpit Instrumentation to be updated and all the information must be in direct view of the flight crew in an easy to use presentation. In this way, flight crews can make full use of the benefits of the instrumentation the without the need for special requirements, procedures or training.

Background

Present cockpit instrumentation in aircraft equipped with glass cockpits consisting of a Primary Flight Display (PFD) and Navigation Display (ND) was developed as an evolution from the clocks and dials of earlier analogue instrumentation. Furthermore, these displays were designed with traditional forms of ground based radio navigation aids (VOR/DME, ILS, NDBs and so on). In the days of straight courses, airways and approach and departure procedures all with relatively large safety margins these indicators together with flight director (FD) guidance technology were sufficient to provide pilots with an accuracy of information to enable them to monitor the progress of a flight as well as keeping flight technical errors within safe parameters.

Currently, the flight path data presented on the PFD is centered on indications of pitch, indicated airspeed/mach number & vertical speed (newer avionics suites may also include a flight path indicator). Meanwhile, further energy control information is delivered via engine instrumentation. So while in fly by wire aircraft more direct control of flight path is possible it is not necessarily adequately depicted which in turn could lead to delayed reaction to deviations from the desired flight path.

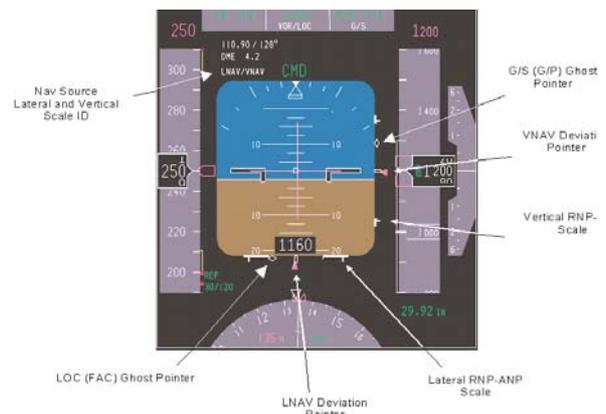
While progress has been made with the development of the modern ND when it is compared with the earlier horizontal situation indicator (HSI) especially in the depiction of VOR radials and ILS courses. The depiction scale on the present generation of ND is not up to the demands on navigational accuracy made by the RNP environment. As a result, of these issues currently specific training, procedures and authorisations are required to maximise the benefits of increased accuracy and flexibility this naturally has cost implications and may limit the use of the improvements.

Presently, the only actual guidance given to the crew is flight guidance information delivered via the FD. Furthermore, the information needed to monitor the system performance of the aircraft for the procedure flown is widely scattered throughout the cockpit. For example, the lateral deviation is on only dis-

Present design PFD



PFD incorporating RNP values



played on the ND as a numerical value (i.e. 0.2L). In some systems, the information relating to availability for Nav aids like GPS receivers and satellites are buried in the third layer of pages on the FMC or MCDU. In addition, the scale selectable on the ND is not adequate to effectively monitor system performance.

Position information, or better still, situation information is not available via the PFD. This, in turn, leads to the crew having degraded situational awareness. This degradation in situational awareness can result in the crew being limited to a reactive response to deviations by the flight guidance and control system rather than having the ability to look ahead and anticipate deviations and the required corrective actions. Inevitably, this leads to delays in responding to system deviations and errors which may well be critical in the narrow confines of RNP requirements (down to RNP.01 in some areas) leading to flight path deviations outside the protected area. This is particularly significant since RNP deviation limits can change instantly, for example transitioning from RNP0.1 to RNP 0.3. This lack of guidance and deviation information further limit the crews responses to abnormal flight conditions to those which utilise the auto flight system to ensure that the aircraft remains with the narrow RNP parameters.

IFALPA Position

The Federation believes that there is a need to update the capabilities of the avionics displays in order that they match the requirements of the task. The information needed by pilots must be displayed in the direct view of the flight crew with an accurate and intuitive presentation without the need to use more than one display to access the relevant data. Furthermore, the deviation scales used must be commensurate with the accuracy of RNP. In addition, the question of missed approach guidance in the case of navigation accuracy loss must also be addressed. Present systems default to a wings level pitch for positive vertical speed cue as is normal for the initial phase of a missed approach from an ILS or non-precision approach will not be sufficient for a curved RNP approach since a continuation of turns may be required during the climb to a safe altitude even with a degraded navigation capability.

Development of a 3D path in the sky combined with a flight path predictor may be the best way to optimise the display of all the requirements for safe and accurate flight in the RNP environment thus allowing crews the facility to manually operate (or

hand fly) the aircraft through complex departure or arrivals procedures or during non-normal operations. The Federation believes that this capability will deliver gains in safety and furthermore enhance airspace use improving capacity and additionally, boost environmental performance through fuel savings and reduced noise and gaseous emissions.

Note 1: Required Navigation Performance (RNP) is defined by ICAO as “a statement of the navigation performance necessary for operation within a defined airspace”. Part of a broader concept called “Performance-based Navigation”, RNP is a method of implementing routes and flight paths that differs from previous methods in that not only does it have an associated performance specification that an aircraft must meet before the path can be flown but must also monitor the achieved performance and provide an alert in the event that this fails to meet the specification. It is the monitoring and alerting facility that distinguishes RNP from RNAV (aRea NAVigation) from which it developed. RNP equipped aircraft can safely operate routes with less separation than previously required which is significant because it increases the number of aircraft that can safely use a particular airspace and therefore accommodate the increasing demand for air traffic capacity.

Note 2: IFALPA recognises the effort of the aircraft manufacturers in the development of RNP/ANP depiction on the PFD, but sees this work as only as the first step to a standardised instrumentation display.

Example future design PFD

