IFALPA
The Global Voice of Pilots

Position

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Performance-Based Navigation

Performance-Based Navigation (PBN) is now being implemented in many states and areas worldwide. IFALPA welcomes this development as the next generation navigation application recognizing that PBN is necessary to resolve the current effects on flight operations with an increase in traffic, demands on airspace capacity, an increased concentration on efficiency and environmental requirements.

As PBN is implemented several issues have come to light that must be addressed from an individual user, aircraft, procedural/ regulatory, and air traffic system management level that must be harmonized and standardized. It is important to note that present safety standards should not only be met but improved with the continuing implementation of PBN.

PBN CONCEPT

The PBN system consists of a navigation system whose performance requirements are defined in terms of:

- Accuracy
- Integrity
- Availability
- Continuity
- Functionality

PBN ADVANTAGES

This concept represents a shift from sensor based (ILS, NDB, VOR) to Performance-Based navigation and offers a number of advantages:

- Reduces need to maintain sensor specific applications
- Avoids the need to develop sensor specific operations
- Allows more efficient use of airspace
- Eases operational approval process

With the implementation of applications there could be an increase in capacity; reduction in environmental impact; and improved airport access.

PBN ISSUES

1. Proficiency and Training

IFALPA further recognizes that several of the new PBN approach procedures have made some airports more accessible. PBN departures have been developed to replace hazardous departures by requiring minimum climb performance, or by designing departures that keep clear of terrain by making use of the navigation capability.

However, IFALPA has concerns regarding the quality and levels of training that are provided for aircrews. Globally, pilots do not have the same knowledge level because not all flight operations and training departments understand the complexity,

and requirements, benefits and capabilities of PBN operations. Additionally, some state authorities are not as engaged in the PBN operation approval process as they need to be. Therefore, there is a need to establish a common level of training and proficiency amongst the pilots.

IFALPA recommends that the technical specifications of PBN and proficiency are integrated into the flight training curriculum for both initial and recurrent training. Some companies do an initial two-day ground school followed by the practical instruction in the simulator, while others have up to five days of training and some have only minimal mention of scenarios. A common standard of proficiency should be defined by ICAO, put into regulation by the state regulator, complied with by the operator, and demonstrated by the aircrews. The training should be taught by qualified personnel with a deep understanding in procedures and regulations. The training must include a conceptual overview, PBN procedures, airplane related PBN procedures including system malfunction scenarios, training and demonstration of proficiency in full motion simulators.

Training by "bulletin" is NOT an option;

Distance learning is not a good option for acceptable proficiency demonstration

Specific simulator training;

PBN technologies and procedures need introduction in basic functionalities of:

- Deficiencies of Baro VNAV (such as temperature above ISA causes higher than the nominal vertical path)
- APV (approach procedure with vertical guidance)
- LNAV Missed Approaches with only 1 FMC
- Failures of PBN avionics such as GNSS, (single FMC)
- Variations of PBN operations such as RNAV/RNP, RNAV SIDs and RNAV STAR
- Manual deletion or insertion of WPT restrictions
- Specific training on RF/TF operations and limitations, such as engine failure, FMC failure when on the RF leg, and speed limits

The training needs to cover: (this is not a complete list of topics)

- Realistic setup/briefing
- Required equipment onboard and on the ground
- FMC Database integrity checks
- Phraseology
- FMC as sole navigational source
- Less or No opportunity to revert to raw data
- System Degradations/Failure
- PBN requirements
- PBN technologies and procedures create unique failures and most failures require familiarization in a simulator environment
- Loss of vertical guidance path
- Continue/Discontinue decision
- Recovery and reintegration after ATC interrupts the PBN procedure

In addition, contingencies require a greater understanding of abnormal procedures and a mental picture and situational awareness. The MEL (Minimum Equipment List) interpretation can be complex on the ground and should be simplified so that the impact of system degradation on RNP capabilities can be understood. When airborne there must be an easy to interpret Non-normal Checklist that reflects the effects of system failure of PBN equipment to the required PBN requirement in the airspace operating in. Crews must be sure of the displayed RNP value on their FMS. (Most of todays displayed RNP status, while enroute, is not the real required RNP for the airspace, but a default value from the manufacturer or the operator. Awareness of this limitation should be explained to flight crew).

For pilot proficency, it should be recognized not all pilots fly PBN procedures on a regular basis. Therefore, there needs to be:

- Tools and Standard Operating Procedures to help to maintain a standard performance criteria
- Quick Reference Lists
- PBN section in Normal and Supplementary Procedures
- Training Information Manual
- CBT (Computer Based Training)
- Regular PBN simulator training

IFALPA further recommends the introduction of a navigational expert/manager per flight operations department and be responsible for:

- Performance monitoring
- Training and procedural concept
- Train-The-Trainer program
- Chart and database quality review
- Q & A

Therefore, PBN training to aircrews, operators and regulators must include:

The definitions of RNAV- and RNP- systems and the difference between them.

- The definitions of Performance requirements that are defined in terms of accuracy, integrity, continuity, availability and functionality.
- The explanation of ABAS; Aircraft-Based Augmentation System, SBAS; Satellite-Based Augmentation System, GBAS- Ground-Based Augmentation System.
- The definitions of APV; approach with vertical guidance.
- The definitions of Baro-VNAV and the actual operation Baro-VNAV. The definitions of RNP APCH. (If authorized the definition of RNP AR APCH)
- The explanation of RAIM (Receiver Autonomous Integrity Monitoring).
- Differences in terminology use for approach procedures across different jurisdictions.

The operational approval for these procedures is the responsibility of the Operator. While it is not necessary for the pilot to have detailed information on the process, it is essential for the pilot to know what the aircraft and the operator is approved to do. Furthermore, the pilot should be made aware of where this information can be found.

2. Aircraft Systems

Aircraft automation will become more precise and possibly more complex resulting in divergent user platforms based on the operator's avionics and aircraft manufacturer requirements. These future displays should be capable of displaying any or all technological advances that improve situational awareness with regard to traffic, terrain as well as vertical and lateral profile management.

Therefore, IFALPA calls for the systems to be made upgradable, have common "look and feel" characteristics with common procedures between applications and aircraft, and be intuitive for the pilot to readily interpret the information displayed and perform the proper procedure(s).

3. Procedures and design

As with any new technology there are many definitions, names and criteria and these are still evolving. For example: RNP APCH being charted as RNAV (GNSS)/RNAV (GPS); BRNAV instead of RNAV5; RNP10 instead of RNAV10.

The term RNP understood as a synonym for RNP AR APCH; RNP AR vs. RNP SAAAR.

There are also a diversity of navigation application types:

RNAV 1, RNAV 2, Advanced RNAV 1, RNP AR, RNP, APV, etc.

All of this creates confusion among pilots, airlines and regulators.

4. Charting and information display

Charting requirements are changing, as one chart contains different types of approaches for example:

RNAV GPS VNAV to RNP APCH VNAV= Approach Procedure with vertical guidance (APV) will have a Decision Altitude (DA).

RNAV GPS LNAV to RNP APCH LNAV = Approach Procedure without vertical guidance (NPA) will have a Minimum Descend Altitude (MDA).

RNAV GPS LPV to RNP APCH LPV = Approach Procedure with Vertical Guidance by SBAS.

Pilots need to know about the consequences of the different minima and how this effects the daily flying.

They need to be educated about the technology.

There are many chart inconsistencies which need to be resolved over time but for now there needs to be clear interpretation.

There are multiple approach identifiers which need to be clearly defined and inevitably there will be times when aircrew could be faced with something they have not seen before.

5. Global Harmonization and Implementation

Despite a global PBN plan there appears to be little harmonization in the State implementation of PBN. SESAR (Single European Sky ATM Research) and NextGen (USA programme) have provided regional implementations of PBN but these implementations need to be globally harmonized. ICAO should promote this by upgrading the procedures to SARPs (Standards and Recommended Practices). There is also a lack of harmonized state implementation of PBN phraseologies. ICAO should publish standard phraseologies for PBN approaches for use by ANSPs and Operators.

6. Charting

There needs to be more consistency with how arrival and approach procedures are structured.

At some airports there are published charts with Arrivals (multiple named procedures on one chart), Initial Approach Procedures (multiple named procedures on one chart), and Final Approach Procedures (by runway). On the other hand there are published charts which can contain STARs, Arrival and Initial Approach procedures on a single chart, and the chart contains only a single named procedure with multiple transitions. Charting of PBN has to be according to the ICAO procedures on a worldwide base. If there are deficiencies in charting PBN procedures these deficiencies have to be solved and harmonized

The status of a “transition to final” which is used by States more and more needs to be clarified and whether the transition part of a STAR is part of the approach procedure (initial approach).

It must be recognized that aircrews operate globally and that they need globally harmonized procedures to be able to operate at a high level of safety and efficiency.

CONCLUSIONS

PBN procedures, technology and charts need to be globally harmonized. This method of navigation relies on standardized procedures and regulations. It is incumbent on the airline operators that they provide meaningful training to the pilots and that a professional level of proficiency is demonstrated and maintained. The evolution of using these procedures must be done in a proactive and supportive manner by the operator. For the pilots who have lived in an industry of conventional navigation, this is a much more complicated method of navigating, and it requires a greater level of precision. There are many safety and efficiency benefits that will result in proper implementation.

The vast majority of pilots have gained their training and experience based on conventional navigation aids. The change from conventional to PBN navigation is fundamental and it must be accomplished systematically by addressing the issues and concerns raised in this paper to maintain the high level of safety we are accustomed to.