Definition and IATA Positions

on

Performance Based Navigation (PBN)

Runway End Safety Area (RESA)

and

Engineered Materials Arresting Systems (EMAS)

These IATA positions are included in the Runway Excursion Risk Reduction (RERR) Toolkit to provide background material on issues related to runway excursion prevention and mitigation. The implementation of PBN can greatly reduce the risk of a runway excursion, while the installation of RESA or EMAS systems can substantially reduce the effects of a runway excursion.

Extract from the Runway Excursion Risk Reduction (RERR) Toolkit
First Edition 2009 and subject the disclaimer contained therein.

Performance Based Navigation (PBN)

Performance-based navigation (PBN) is a global set of area navigation standards, defined by ICAO, based on performance requirements for aircraft navigating on departure, arrival, approach or en-route. These performance requirements are expressed as navigation specifications in terms of accuracy, integrity, continuity, availability and functionality required for a particular airspace or airport. PBN will eliminate the regional differences of various Required Navigation Performance (RNP) and Area Navigation (RNAV) specifications that exist today.

The PBN concept encompasses two types of navigation specifications:

- **RNAV specification**: navigation specification based on area navigation that does not include the requirement for on-board performance monitoring and alerting, designated by the prefix RNAV, e.g. RNAV 5, RNAV 1.
- **RNP specification**: navigation specification based on area navigation that includes the requirement for on-board performance monitoring and alerting, designated by the prefix RNP, e.g. RNP 4.

The 2007 36th ICAO General Assembly resolution A36-23 urges all States to implement PBN for en route and terminal areas, and to implement PBN approach procedures with vertical guidance (APV) using Baro-VNAV and/or augmented GNSS (see section 6.1) for all instrument runway ends (as primary or back-up for precision approach) by 2016 - with 30% by 2010, 70% by 2014.

It is expected that all future navigation applications will identify the navigation requirements through the use of PBN performance specifications, rather than defining equipage of specific navigation sensors. Table 4 gives a more complete description and status of the PBN RNAV and RNP values.

Table 4. PBN Values & Application

Area of Application	Navigation Accuracy (NM)	Navigation Specification (current)	Navigation Specification (new)	Require performance monitoring & alerting
Oceanic & Remote	10	RNP 10	RNP 10	No
	4	RNP 4	RNP 4	Yes
En route – Continental	5	RNP 5 Basic RNAV	RNAV 5	No
En route – Continental and Terminal	2	US RNAV type A	RNAV 2	No
	2	*N/A*	*Basic-RNP 2 (TBD*)*	*Yes*
Terminal	1	US RNAV type B P RNAV	RNAV 1	No
	1	N/A	Basic-RNP 1	Yes
	1	*N/A*	*Advanced RNP 1 (TBD)*	*Yes*
Approach	0.3	RNP 0.3	RNP APCH (RNP 0.3)	Yes
	0.3-0.1	RNP SAAAR	RNP AR APCH (RNP 0.3-0.1)	Yes

* *To be Developed (TBD)*

Benefits

The advantage of PBN to the ANSP is that PBN avoids the need to purchase and deploy navigation aids for each new route or instrument procedure. The advantage to everyone is that PBN clarifies how area navigation systems are used and facilitates the operational approval process for operators by providing a limited set of navigation specifications intended for global use.

The safety benefits to PBN are significant, as even airports located in the poorest areas of the world can have runway aligned approaches with horizontal and vertical guidance to any runway end without having to install, calibrate and monitor expensive ground based navigation aids. Therefore, with PBN all airports can have a stabilized instrument approach that will allow aircraft to land into the wind, as opposed to a tail wind landing.

Airline Requirements

Airlines want to quickly adopt PBN, as the benefits are significant for all phases of flight.

- For departures, airlines want standard instrument departures (SIDs) for every departing runway that quickly allows aircraft to join their route to destination.
- For en-route, airlines ideally want routes that are flexible based on that day's operating conditions and upper winds. If flexible routes are not possible then a network of RNAV or RNP direct routes is preferred.
- For arrivals, airlines want standard arrivals (STARs) off every airway that provides the least track miles to the initial approach fix, preferably with a continuous descent profile from the top of descent.
- For approaches airlines need a runway aligned approach with lateral and vertical guidance (APV) for every runway end that terrain allows.

The decision to plan for RNAV or RNP has to be decided on a case by case basis in consultation with the airspace user. Some areas need only a simple RNAV to maximise the benefits, while other areas such as nearby steep terrain or dense air traffic may require the most stringent RNP. Also, since RNP AR Approaches require significant investment and training, ANSPs should work closely with airlines to determine where RNP AR Approach should be implemented. In all cases PBN implementation needs to be an agreement between the airspace user, the ANSP and the regulatory authorities.

<u>IATA's Position</u>:

Fully support early implementation of RNAV and RNP based on the ICAO PBN. IATA also supports the implementation of Approach with Vertical Guidance (APV) for all runways with a Barometric VNAV used for vertical path guidance during the final approach segment.

During the transition period to PBN, regional specific area navigation requirements should honour PBN navigation approvals that also meet the regional specific criteria. For example, in the European Flight Efficiency Plan there is a provision where all operators that are approved against the PBN criteria for RNAV 1 should be eligible to operate on European P-RNAV routes with no further approval required.

Runway End Safety Areas and Aircraft Arresting Systems

In 2005, overruns involving air transport category aircraft averaged 3.6 events per month. IATA's 2006 figures indicated 22 overrun events that meet the definition of accident and data for 2007 showed 26 overruns. ICAO Annex 14 requires that a Runway End Safety Area (RESA) of 90 m shall be extended from the end of each runway. Additionally, ICAO recommends a RESA of at least 240 meters for runways 1800 m and longer. Where the RESA is inadequate, some States have implemented arresting systems that are designed to be generally equivalent to a 300m RESA.

Engineered Materials Arresting Systems (EMAS) is an arrestor system based on a bed of lightweight crushable concrete. Data derived over a 12-year period indicates that approximately 90% of all runway overruns occur at exit speeds of 70 knots or less and most come to rest between the extended runway edges, within 300m of the runway end. Therefore, EMAS is normally engineered to stop overruns at 70 knots or less, with minimal damage to aircraft or injury to passengers. When an aircraft rolls into an EMAS arrestor system, the tires of the aircraft sink into the lightweight concrete and the aircraft is decelerated by having to roll through the crushable material.

Empirical evidence confirms that in overrun situations, an EMAS arresting system is successful in preventing injury to passengers and limiting damage to aircraft. The ICAO Global Aviation Safety Roadmap recommends an EMAS be installed where runway configuration does not allow for the provision of a RESA as recommended by ICAO (Annex 14). The FAA published an order that requires either a 1000ft (300m) RESA at each runway end or, in its place, an EMAS for all (FAR part 139) airports in the United States by 2015.

IATA's Position

- ***IATA recommends a minimum 240m RESA for all runways 1800m or greater. If this is impractical, then IATA recommends a runway arrestor system that is designed to protect aircraft and passengers, such as EMAS, that is engineered to stop an overrunning aircraft at 70 knots or less.***
- ***Supports installation of EMAS type arrestor systems at commercial airports that do not provide 240m RESA for runways 1800m or longer, as recommended by ICAO Annex 14.***