PBN TRAINING FOR AIR TRAFFIC CONTROLLERS

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PBN Project

Activity 1
Agree Operational Requirement

Activity 2
Create Airspace Design Team

Activity 3
Agree Objectives
Scope & Timescales

Activity 4
Analyse Reference Scenario

Activity 5
Select Safety Criteria
Safety Policy & Performance Criteria

Activity 6
Agree CNS/ATM Assumptions

Activity 7
Airspace Design
Route & Holds

Activity 8
Initial Procedure Design

Activity 9
Airspace Design
Volumes & Sectors

Activity 10
Select ICAO Navigation Specification

Activity 11
Airspace Concept Validation

Activity 12
Finalisation of Procedure Design

Activity 13
Procedure Validation

Activity 14
Implementing Planning

Activity 15
Implementation

Activity 16
Post Implementation review

PBN Airspace Concept Implementation Project
Implementation Phase Considerations

- Implementation Date decision

- PRE IMPLEMENTATION REVIEW
  - ATS LOAs and other considerations
  - TRAINING
  - AIP / AIRAC
AIRSPACE BY AREA OF OPERATION

Oceanic and remote continental

RNAV 10 (RNP 10), RNP 4 and RNP 2 rely primarily on GNSS and may require ATS surveillance for certain applications.

Continental en route

RNAV 5 and RNP 2 applications are expected.
Terminal airspace: arrival and departure

- Include arrival and departure supported by RNAV applications and RNP 2 and 1 application in non-radar, low-density terminal airspace.

Approach

- Approach concepts cover all segments of the instrument approach, i.e. initial, intermediate, final and missed approach. These include RNP specifications requiring a navigation accuracy of 0.3 NM to 0.1 NM or lower.

- Three sorts of RNP applications are characteristic of this phase of flight: RNP APCH and RNP AR APCH as well as A-RNP.
PBN Training

Programme

- BASIC
- RECURRENT
- ADVANCED

Topics

- ENROUTE
  - OCEANIC
  - CONTINENTAL
- TERMINAL
- APPROACH
Gate to Gate concept
Phases of flight (Doc 9854)

COMMUNICATION (COM) - NAVIGATION (NAV) - SURVEILLANCE (SUR)
Airspace Organization and Management (AOM) designers

ICAO SARPS

- Speed and route tailoring here better merges streams and enables extension of the arrival from downwind to the runway even during congested periods.

- Maximum use of aircraft avionics provides maximum flight efficiency for airlines and environment, and maximum predictability for ATS.

Standard operations:
Vectoring and level-off below metering fix

Variable length downwind leg, with level-offs
ATS procedures for airspace utilizing RNAV and RNP applications.

Include procedures to enable the use of the parallel offset on-board functionality or to enable the transition between airspaces having different performance and functionality requirements, as follows:

a) determining the specific points where the traffic will be directed as it transits from airspace requiring a navigation specification with less stringent performance and functional requirements to an airspace requiring a navigation specification having more stringent performance and functional requirements; and

b) coordinating efforts with relevant parties in order to obtain a regional agreement detailing the required responsibilities.

ATCOs should take appropriate action to provide increased separation and to coordinate with other ATC units as appropriate, when informed that the flight is unable to maintain the prescribed level of navigation performance.
Point Merge System (PMS)

Point merge system - example with two inbound flows
Scenario (1/5)

Scenario "talk-through" for Grey, Green, Gold and Blue aircraft

STRUCTURE

A
B
M
Scenario (2/5)

Initial situation with a busy flow of traffic to the merge point
Scenario (3/5)

Grey heavy jet turns to the merge point.
Controller determines when to issue the “Direct to merge point” instruction to the Gold aircraft to ensure that the required WTC spacing behind the preceding aircraft will be achieved.
Controller issues the “Turn left direct to merge point” instruction to the Gold aircraft using the range ring arcs to assess the appropriate WTC spacing from the Grey aircraft.
The same technique is repeated for the Green aircraft
Operational Requirements

Reduce the distance required between laterally separated parallel ATS routes
Operational Requirements (1)

Increase predictability of path flown

Enable routes where terrain or environmental impact demand increased accuracy
Operational Requirements (2)

Improved turn performance including containment of large angle changes

Benefits expected:

• Capacity:
  – Place routes where needed
  – Enable reduced route spacing

• Environmental:
  – Design routes more efficiently to meet environmental requirements
CDO Training

a) speed restrictions

b) level constraints or crossing restrictions

c) the level of automation to be used

d) the possible effect of wind, atmospheric pressure, altimeter setting and expected icing conditions

e) the effect of the transition level

f) ATC phraseology.
CDO Training and Awareness Material

a) CDO benefits and their local importance;

b) training requirements for the selected (open or closed) CDO facilitation method;

c) a simple pamphlet describing the aims and requirements for CDO;

d) the individual roles and responsibilities relevant to the conduct of individual CDO flights; and

e) method for providing ongoing feedback on progress to all participants.
RNAV 5:

a) How area navigation systems work:
   i) include functional capabilities and limitations of this navigation specification;
   ii) accuracy, integrity, availability and continuity; and
   iii) GPS receiver, RAIM, FDE, and integrity alerts;

b) Flight plan requirements;

c) ATC procedures:
   i) ATC contingency procedures;
   ii) separation minima;
   iii) mixed equipage environment (impact of manual VOR tuning);
   iv) transition between different operating environments; and
   v) phraseology.
RNAV 1 and RNAV 2

a) How area navigation systems work (in the context of this navigation specification):
   i) include functional capabilities and limitations of this navigation specification;
   ii) accuracy, integrity, availability and continuity;
   iii) GPS receiver, RAIM, FDE, and integrity alerts; and
   iv) waypoint fly-by versus fly-over concept (and differences in turn performance);

b) Flight plan requirements; and

c) ATC procedures:
   i) ATC contingency procedures;
   ii) separation minima;
   iii) mixed equipage environment (impact of manual VOR tuning);
   iv) transition between different operating environments; and
   v) phraseology.
RNP 4- ATC Training

a) How area navigation systems work:
   i) functional capabilities and limitations of this navigation specification;
   ii) accuracy, integrity, availability and continuity including on-board performance monitoring and alerting;
   iii) GNSS receiver, RAIM, FDE, fault detection and integrity alerts; and
   iv) waypoint fly-by versus fly-over concept (and different turn performance);

b) Flight plan requirements;

c) ATC procedures:
   i) ATC contingency procedures;
   ii) separation minima;
   iii) mixed equipage environment (impact of manual VOR tuning);
   iv) transition between different operating environments; and
   v) phraseology.

Training specific: for application of 30/30 separation minima:

a) CPDLC communications;

b) ADS-C system and simulation training; and

c) effect of periodic reporting delay/failure on longitudinal separation.
RNP 2 - ATC Training

a) How area navigation systems work:
   i) functional capabilities and limitations of this navigation specification;
   ii) accuracy, integrity, availability and continuity including on-board performance monitoring and alerting;
   iii) GNSS receiver, RAIM, FDE, fault detection and integrity alerts; and
   iv) waypoint fly-by versus fly-over concept (and different turn performance);

b) Flight plan requirements;

c) ATC procedures:
   i) ATC contingency procedures;
   ii) separation minima;
   iii) mixed equipage environment (impact of manual VOR tuning);
   iv) transition between different operating environments; and
   v) phraseology.

Training specific:

a) RNP 2 ATS route control requirements (in either ATS surveillance or procedural control environments)
   i) descend/climb clearances; and
   ii) route reporting points;

b) RNP 2 related phraseology; and

c) impact of requesting an in-flight change to route.
RNP 1 - ATC Training

a) How area navigation systems work:
   i) functional capabilities and limitations of this navigation specification;
   ii) accuracy, integrity, availability and continuity including on-board performance monitoring and alerting;
   iii) GNSS receiver, RAIM, FDE, fault detection and integrity alerts; and
   iv) waypoint fly-by versus fly-over concept (and different turn performance);

b) Flight plan requirements;

c) ATC procedures:
   i) ATC contingency procedures;
   ii) separation minima;
   iii) mixed equipage environment (impact of manual VOR tuning);
   iv) transition between different operating environments; and
   v) phraseology.

Training specific:

a) RNP 1 STARs, SIDs, related control procedures:
   i) radar vectoring techniques (where appropriate);
   ii) open and closed STARs;
   iii) altitude constraints; and
   iv) descend/climb clearances;

b) RNP approach and related procedures;

c) RNP 1 related phraseology; and

d) impact of requesting a change to routing during a procedure
ADVANCED RNP (A-RNP) - ATC Training

a) How area navigation systems work:
   i) functional capabilities and limitations of this navigation specification;
   ii) accuracy, integrity, availability and continuity including on-board performance monitoring and alerting;
   iii) Availability of ATS and infrastructure;
   iv) GNSS receiver, RAIM, FDE, and integrity alerts; and
   v) Leg transitions, relative turn performance of waypoint fly-by versus fly-over concept;

b) Flight plan requirements including the applicability of A-RNP to RNAV 1, RNAV 2, RNAV 5, RNP APCH, RNP 1, and RNP 2 navigation applications;

c) ATC procedures:
   i) ATC contingency procedures;
   ii) separation minima;
   iii) mixed equipage environment (impact of manual VOR tuning);
   iv) transition between different operating environments; and
   v) phraseology
   vi) ATC intervention considerations.

Training specific:
a) Related control procedures:
   i) Vectoring techniques (where appropriate);
      1) RF leg limitations including ground speed constraints;

b) RNP approach and related procedures;
   i) Approach minima;
   ii) Potential negative impact of issuing an amended clearance for a procedure when the aircraft is already established on the procedure due to possible difficulty in complying with revised procedure requirements. Sufficient time needs to be allowed for the crew to accomplish navigation systems reprogramming requirements, e.g. a change to the en-route or runway transition;

c) RNP en route:
   i) FRT as a computed turn by the aircraft versus a unique en-route path segment;

d) Parallel offsets. RNP systems termination of offsets and return to original flight plan; and
   i) Related control procedures:
      1) RF leg limitations including ground speed constraints;
RNP APCH - Controller training:
a) How area navigation systems work:
   i) functional capabilities and limitations of this navigation specification;
   ii) accuracy, integrity, availability and continuity including on-board performance monitoring and alerting;
   iii) GNSS receiver, RAIM, FDE, and integrity alerts; and
   iv) waypoint fly-by versus fly-over concept (and different turn performances);
b) Flight plan requirements;
c) ATC procedures:
   i) ATC contingency procedures;
   ii) separation minima;
   iii) mixed equipage environment (impact of manual VOR tuning);
   iv) transition between different operating environments; and
   v) phraseology.

Training specific:
a) Related control procedures:
   i) Radar vectoring techniques (where appropriate);
b) RNP approach and related procedures;
   i) including T and Y approaches; and
   ii) approach minima;
c) impact of requesting a change to routing during a procedure.
RNP APCH - ATC Training

a) How area navigation systems work:
i) functional capabilities and limitations of this navigation specification;
ii) accuracy, integrity, availability and continuity including on-board performance monitoring and alerting;
iii) GNSS receiver, RAIM, FDE, and integrity alerts; and
iv) waypoint fly-by versus fly-over concept (and different turn performances);

b) Flight plan requirements;

c) ATC procedures:

   i) ATC contingency procedures;
   ii) separation minima;
   iii) mixed equipage environment (impact of manual VOR tuning);
   iv) transition between different operating environments; and
   v) phraseology.

Training specific:
a) Related control procedures:
   i) Radar vectoring techniques (where appropriate);

b) RNP approach and related procedures;
   i) including T and Y approaches; and
   ii) approach minima;

c) impact of requesting a change to routing during a procedure.
RNP AR APCH - ATC Training

a) How area navigation systems work:
   i) functional capabilities and limitations of this navigation specification;
   ii) accuracy, integrity, availability and continuity including on-board performance monitoring and alerting;
   iii) GNSS receiver, RAIM, FDE, and integrity alerts;
   iv) waypoint fly-by versus fly-over concept (and different turn performances); and
   v) RF leg applications in RNP AR APCH procedure design;

b) Flight plan requirements;

c) ATC procedures:

   i) ATC contingency procedures;
   ii) separation minima;
   iii) mixed equipage environment (impact of manual VOR tuning);
   iv) transition between different operating environments; and
   v) phraseology.

Training specific:

a) Related control procedures:

   i) Radar vectoring techniques (where appropriate);
      — RF leg limitations;
      — airspeed constraints;

b) RNP AR APCH procedures;

   i) approach minima; and
   ii) additional requests for altimeter settings;

c) impact of requesting a change to routing during a procedure.
# PBN, Navigation Specification

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<thead>
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<th>FLIGHT PHASE</th>
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**ICAO New FPL 2012 & PBN**

**PBN/ indication of RNAV and/or RNP capabilities. Include as many of descriptors below, as apply to the flight, up to a maximum of 8 entries, i.e. a total of not more than 16 characters.**

**In Item 10:** R = PBN levels that can be met are shown in Item 18 if FPL

**In Item 18:**

**RNAV specifications**

<table>
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<tr>
<th>AI</th>
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<tr>
<td>B1</td>
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**RNP specifications**

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<tr>
<td>T2</td>
<td>RNP AR APCH without RF (special authorization required)</td>
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WATRS STRUCTURE
Thank You