PBN
Performance Based Navigations

Challenges to Helicopter Operations

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Welcome

• You are the Expert
• We integrate
• Your responsibility to let us know for any questions, differences, errors, etc

Rule of the game
No Mobile / Hand phone Silent
Interruption questions welcome
Daftar Hadir & survey:aerotekavia.com/pbns
### Workshop Facilitator

- IPTN/PTDI: Flight Test, Military & Airlines
- MSc Aerospace & Test Pilot UK
- ICAO Ops Panel: FDA / FLTREC, EFOD AN6(All)
- Sr Flight Ops Inspector GCAA UAE
- GCAA Specials Ops (FDM, EFB, AWO/LVO, PBN, MNPS, ETOPS & Polar)
- Aerotekavia - Flitejob.com

### Aerotekavia

**OUR PRODUCTS:**

Design, produce Training Devices out of Video
Products

Aerotekavia

OUR SERVICES

- Aviation Software
- Crew scheduling and Flight time limitation: formsaero.com (EU FTL)
- Recruitment apps: Flitejob.com
- Integrated with Technical knowledge screening system

Diagram:

- Employer
- Job Posting
- Job Seekers
- Screen(Score/Rank): Math, General, etc
- Pass/Fail
- Further Training
AGENDA

✓ BRIEF PBN: WHAT, WHY, HOW & WHEN
✓ NAVIGATION SPECIFICATIONS
✓ AIRCRAFT EQUIPMENT
✓ OPERATIONAL APPROVAL
✓ CHALLENGES
✓ RECENT CHANGES IN AVIATION
  • AIRCRAFT TRACKING
  • EFB

References

• ICAO Annex 6, 14, 19
• Doc 9613 – PBN Manual
• *Doc 9992, 9997 PBN Airspace Design Approval (*Subscribers)
• UAE PBN Ops Approval
• EASA TGL AMC
• FAA AC 20-138D AW Approval of Nav System
PBN?

Area navigation based on
• performance requirements for aircraft operating along an ATS route, on
• Instrument approach procedure OR
• a designated airspace.

• Performance requirements = term of accuracy, integrity, continuity and availability

PBN CONCEPT

Component PBN concept
• Navigation Application enabled by two components:
• NAVAID Infrastructure and
• Navigation Specification.

PBN NAVIGATION COMPONENT

NAVIGATION APPLICATION

INFRASTRUCTURE SPECIFICATIONS
BEFORE PBN

Conventional (Ground based)

AFTER PBN

Non Conventional (Space Based)

GNSS
EGNOS, MSAS, GAGAN
GBAS
LAAS
PBN VS Non PBN

APPROACHES PROFILE

Non PBN

PBN

Helicopter

Point in Space

PBN / RNAV

Visual Segment

PInS Arrival
GNSS / SBAS (LPV)

PInS Departure
RNAV RNP1
NAVAID INFRASTRUCTURE

Space-based Nav-aids:
- GNSS (Global Navigation Satellite System): GPS (US), Glonas (RU), Galileo (EU)
- or (GBAS: Groud Based Augmented System)

Ground-based (DME and VOR).

DIFFERENCES

EQUIPMENT

PBN

ALERTING

AIRCRAFT

RNAV

RNP

PERFORMANCE MONITORING

NPS
(Nav Perf Scales)

RNP ALERT
ALERTING > WORKLOAD

- UNABLE RNP
- GPS PRIMARY LOST
- NAV ACCURACY DOWNGRADE
- GPS (EPE, DOP, RAIM, etc)

FOV (Field Of View)
- 2D projection of Flight Deck

- Primary FOV
- Acceptable Alert
- Unacceptable Alert
RNAV EQUIPMENT

• TAWS (Exc: Mode 5 GS)
• 2 FMCs, 2 GPS, CDUs *
• 2 Radio Altimeters
• 2 ADIRUs, IRSs in NAV mode *
• 2 EFIS/MAP or PFD/ND displays *
• 1 A/P & 2 F/Ds LNAV and VNAV * (RNP > 0.15)
• 2 A/P & 2 F/Ds LNAV and VNAV *(RNP < 0.15)
• Current Navigation Database

In Future These will qualify all AC A-RNP (but AR)
Helicopter Specific

AN6/III Amendment:

a) Procedure design criteria and charting
   PBN & Helicopter PinS App & Dept;

b) Harmonization EFBs, HUDs & vision
   systems, and fuel use;

c) Flight recorder requirements to align
   underwater location device (ULD)

NAVIGATIONS SPECIFICATIONS

• Criteria

  RNAV
  \- RNAV 10 (RNP 10)
    \- En Route & Terminal
      navigation applications
  \- RNAV 5, 2 & 1
    \- For Oceanic and Remote
      Continental navigation
        applications
  \- GNSS Optional

  RNP
  \- RNP 4
  \- RNP 2
  \- RNP 2, RNP 1
    \- A-RNP
    \- RNP APCH
    \- RNP AR APCH
    \- RNP 0.3 (H)
  \- RNP
    \- Additional requirements TBD (e.g.
      3D, 4D etc)
  \- GNSS Mandatory

GNSS Optional

GNSS Mandatory

CPDLC / ADS-C
Oceanic and Remote
Nav Application

En-route and terminal
### Nav Accuracy

<table>
<thead>
<tr>
<th>Navigation Specification</th>
<th>FLIGHT PHASE</th>
<th>Approach</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>ENR</td>
<td>ENR</td>
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<tr>
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<td>Oceanic/</td>
<td>Continental</td>
</tr>
<tr>
<td>RNAV 10</td>
<td>10</td>
<td></td>
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<tr>
<td>RNAV 5 (30Nm)</td>
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<td>RNAV 2 &amp; RNAV 1</td>
<td>2</td>
<td>1</td>
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<td>RNP 4</td>
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<tr>
<td>RNP 2</td>
<td>2</td>
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<tr>
<td>RNP 1</td>
<td>1a</td>
<td>1a</td>
</tr>
<tr>
<td>Adv RNP</td>
<td>2</td>
<td>2 or 1</td>
</tr>
<tr>
<td>RNP APCH</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>RNP AR APCH</td>
<td>1 - 0.1</td>
<td>1 - 0.1</td>
</tr>
<tr>
<td>RNP 0.3</td>
<td>0.3</td>
<td>0.3</td>
</tr>
</tbody>
</table>

### Challenges

- **EARTH ½ Circumference 10500 Nm**
- **Pacific (Syd-Seattle) 7000 Nm**
- **Indian (Capetown-Jog) 5000 Nm**
CHALLENGES Helicopter

- How many approaches required?

<table>
<thead>
<tr>
<th>YR</th>
<th>HELIDECK</th>
<th>ELEVATED</th>
<th>HELIPORT</th>
<th>TOT</th>
</tr>
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<tbody>
<tr>
<td>2009</td>
<td>36</td>
<td>2</td>
<td>14</td>
<td>52</td>
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<tr>
<td>2010</td>
<td>85</td>
<td>13</td>
<td>38</td>
<td>136</td>
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<tr>
<td>2011</td>
<td>117</td>
<td>20</td>
<td>45</td>
<td>182</td>
</tr>
<tr>
<td>2012</td>
<td>155</td>
<td>22</td>
<td>61</td>
<td>238</td>
</tr>
<tr>
<td>2013</td>
<td>185</td>
<td>29</td>
<td>60</td>
<td>284</td>
</tr>
<tr>
<td>2014</td>
<td>199</td>
<td>36</td>
<td>77</td>
<td>312</td>
</tr>
</tbody>
</table>

CHALLENGES

- Landing Sites Data
- Route, Aerodrome, Obstacle, Operations
OTHER CHALLENGES

Multi state involvements
- Oceanic / remote (RNAV 10 / 4)
- PBN RNAV with Ground Nav update

Multi operator / organization involvements
- Operating in to single site by various Opr
- Utilising Route / approach / coordination's
- Charting, Speed control
- Pins (Point IN Space) H

RNP WAAS
Notes about RNP AR APCH

- Approach charts titled RNAV (RNP)
- Lowest DA currently authorized is 250ft
- RNP 0.3 (AR) commonly achieves 250ft DA
- RNP < 0.3 used where required for lower DA
- Most RNP AR approaches are RNP 0.3
- TAWS is not part of the design criteria
- No (formal) train-the-trainer courses on the subject

Helideck Data

- Route (entry / exit)
- Height ? Elevation (Fixed / variable)
CHALLENGES

- PBN Manual not accounted OEI, OPR
  Data validation required (eg simulator)
- ANSP or FOO/Dispatcher
- FOO Dispatcher (Preparations, RAIM forecast, New ATC Flt Plan (item10)
- ERROR ? RAIM
- www.aimindonesia.info

- http://sapt.faa.gov/outages.php?outageType=1290111450&outageResolution=0.7

Sample RAIM Prediction
TYPICAL STAR PATH

No restriction

Area limited

ICAO PBN Evolution 2015

- Through State Letter 15 April 2015
- ICAO ANC - FLTOPSP
- An6/I/II & III, PANS-ATM, Doc 4444 and PANS-OPS I — *Flight Procedures* (Doc 8168) regarding:
  - Harmonization and alignment of terms, **PBN**, vision systems, icing and ACAS.
Recent ICAO Changes

An6/III 5.2.3 State of the OPR shall, established and documented: (PBN)

a) Proc (Normal, Abn & Contingency)\(^1,2\);

b) Flt crew qual & proficiency req’t;

c) Trg Prog ; and

d) Maint proc.

• Note: 1Safety & Risk assessment An 19 = Doc 9997.
• Note 2. Include Nav data management

Recent ICAO Changes

• An6/III par 5.2.4 State of the OPR shall issue a specific approval for complex navigation specifications. (RNP APCH, RNP AR APCH, ETC)

• Ref PBN Operational Approval Manual (Doc 9997).

Through:

• LETTER OF AUTHORISATION
• OPERATIONS SPECIFICATIONS
• Or OPERATIONS MANUAL (Part A and C Route and Aerodrome information's)

• Helicopter: Current helicopter instrument procedure design criteria do not incorporate the use of vertical guidance that is available today through space-based systems nor does it allow for the design of instrument departures.
RNP APCH Chart Designation

Until 30 Nov 2022, charts for:

- RNP APCH shall include term RNAV(GNSS) RWY 23
- RNP AR APCH shall include term RNAV RNP RW13

From 1 Dec 2022, charts for:

- RNP APCH nav spec shall be designated RNP RWY 23.
- RNP AR APCH shall include term RNP with a parenthetical suffix (AR). e.g. RNP RWY 23 (AR)

Excepts:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Suffix</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedure has only an LPV line of minima</td>
<td>LPV only</td>
<td>RNP RWY 23 (LPV only)</td>
</tr>
<tr>
<td>Procedure has only an LNAV/VNAV line of minima</td>
<td>LNAV/VNAV only</td>
<td>RNP RWY 23 (LNAV/VNAV only)</td>
</tr>
<tr>
<td>Procedure has both LPV and LNAV/VNAV lines of minima but no LNAV minima</td>
<td>LPV, LNAV/VNAV only</td>
<td>RNP RWY 23 (LPV, LNAV/VNAV only)</td>
</tr>
<tr>
<td>Procedure has only an LP line of minima</td>
<td>LP only</td>
<td>RNP RWY 23 (LP only)</td>
</tr>
</tbody>
</table>
Minima

Future Minima for RNAV approach procedures shall be labelled on the chart as follows:

<table>
<thead>
<tr>
<th>Minima label</th>
<th>Associated navigation specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNAV</td>
<td>RNP APCH</td>
</tr>
<tr>
<td>LNAV/VNAV</td>
<td>RNP APCH</td>
</tr>
<tr>
<td>LP</td>
<td>RNP APCH</td>
</tr>
<tr>
<td>LPV</td>
<td>RNP APCH</td>
</tr>
<tr>
<td>RNP 0.x</td>
<td>RNP AR APCH</td>
</tr>
</tbody>
</table>

Validations tools
Fuel saving (PBN vs Non PBN)

- CGK MDC
- ILS vs RNP(18 or 36) = +/- **25 Nm** / App
- @190KIAS = Saving 8Min
- If FF 1000GPH = 17GPM = +/-136 USG @US2=USD272/app
- For 30 App / mo = USD 8160/mo
- US$ 97000 / yr Saving (GA, Safety, etc)
- #These are assumption / estimate only
Typical Operational Approval

**OPERATOR**
- Informal discussions

**AUTHORITY**

A. Application + supporting doc → B. POI Identify PBN application (Ops / AW/ Eng)

C. Review submitted package

D. Submits Evaluation / compliance Plan

E. POI Review and issues Evaluation Letter

- Typically 3 - 6 months continues update

F. Submits Evaluation Report (Sim, Validation)

G. Issue Approval (Letter & Ops Specs)

6– 24 mo Audit / Review

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Application phase

**OPERATOR**

A. Application + supporting doc

**Application form**

A. Application Details

B. Operations Aspects

C. Airworthiness Aspects
A. Application phase

Airworthiness

1. AFM/applicable section of AFM
2. Equipment related Type Design Approval (STC)
3. Equipment systems installation approval
4. Equipment Maintenance program
5. MEL*: section of MEL State ref doc
6. Maintenance Procedures /continuing airworthiness
7. Downgrading/deferred, tech log entries, release to service, repetitive defects
8. Maintenance training
9. Maintenance practices and procedures including reporting and manuals CAME / MOE / MME, maintenance program, stand-alone document, etc)

A. Application phase

Flight Operations

Application Letter (PBN Details + Documentations)

1. Initial/Recurrent training: reference for training and its syllabus )[OM D]
2. Crew Qualification: Crew qualification [training]
3. Flight Planning: Procedures + Performance & MAB
4. Documentations/ FCOM/Checklist/SOP; Procedures
5. Pre and Post flight procedures: Administrative control / reporting deviation, filling forms
7. MEL reference related to operations / procedures
### Approvals

- **Opspec**
  - As Per ICAO
  - + Extra

### Operations Specifications

(Subject to the approved conditions in the operations manual)

<table>
<thead>
<tr>
<th>Aircraft Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AOC No:</strong> AT-00-10</td>
</tr>
<tr>
<td><strong>Operator Name:</strong> Middle East</td>
</tr>
<tr>
<td><strong>Date:</strong> 28-February-2015</td>
</tr>
</tbody>
</table>

#### Type of Operations

- **Passenger**
- **Cargo**
- **Aerial**
- **Ext Load**
- **EMS**

#### Approaches

- **ILS CAT I**
- **RNAV (GNSS/GPS)**
- **Circling**

#### Navigation Specifications for PBN Operations

- **RNP 0.1, 0.3, 1, 3, 4, 5, 10, BRNAV**

#### Authorised Aircraft

- **A. Authorised Aircraft**
- **B. Type of Ops**
  - Passenger
  - Cargo
  - Aerial
  - Ext Load
  - EMS

#### CNS

- **ETOPS**
- **RVSM**
- **MNPS**
- **ADSB CPDLC**
- **POLAR**
- **METRIC**

#### Special Limitations:

<table>
<thead>
<tr>
<th>Special Limitation</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dangerous Weather</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Low Visibility Operations</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Approach and Landing</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Take Off</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>RVR</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>ETOPS</td>
<td>Y</td>
<td>N</td>
</tr>
</tbody>
</table>

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This document outlines the approved operations and specifications for Middle East operations, including types of operations, approved approaches, navigation specifications, and special limitations. The authorization of aircraft and CNS equipment is also specified.
H. Destinations
1. Scheduled Operator: Airport
2. Non scheduled: Region

K. ULR Operations:
L. Maintenance:
M. Telephony & Three letter designators:
N. Aircraft Lease:

P. Other Approval:
1. EFB
2. HUD /HGS
3. Dangerous Goods
4. Special PIC
5. PRM/SOIA
6. ADS-B
7. RNP AR

R. Personnel accepted by Authority

S. Point of contact
1. Cabin crew, 2. Dangerous Good Officer,

SAFETY ENHANCEMENT

- SDR (Software Defined Radio)
- ADSB Receiver
- Sharing data
- AIRCRAFT TRACKING (New)
- ELECTRONIC FLIGHT BAG (New)
Elapse time from incident: 59 min

Incident at 1 minute

EMERGENCY PHASE

RESCUE COORDINATION CENTER

NO TRACKING
60 minute reporting environment

Elapse time from incident: 89 min

CURRENT

NORMAL TRACKING
60 minute reporting environment

AOC tries to establish contact

Elapse time from incident: 44 min

Elapse time from incident: 89 min

EMERGENCY PHASE

RESCE COORDINATION CENTER

GADSS
Performance-based Standards and recommended practices for normal flight tracking

- No change to ATC procedures
- Establish operator responsibility to track
- Not technology-specific
- Establish communication protocol between Operator and ATC
- Oceanic areas where ATC gets position information more than every 15 min (Recommendation for remote areas)
- Aeroplanes with a take-off mass in excess off 27,000 kg and more than 19 seats

Timelines

- **January 2015**
  - Preliminary review by ICAO ANC
- **March 2015**
  - State Letter
- **November 2015**
  - Adopted
- **November 2016**
  - Applicable (if adopted)
ICAO Annex 6 Part I

APPENDIX 8. FLIGHT RECORDERS
1.1 Non-deployable flight recorder containers shall:
c) securely attached an automatically activated underwater locating device 37.5 kHz < 1 January 2018, operate > 90 days. (Ammendment 36 2012  8.8 kHz.  30 days)
1.2 Automatic deployable flight recorder containers:
c) have an integrated automatically activated ELT.

ICAO ANNOUNCE MONTRÉAL, 3 FEBRUARY 2015
Adoption of new 15-minute aircraft tracking Standard.

EFB Another Cost Saving

• Weight and Efficiency
• Application that replace paper in to electronic
• EFB
Background

Saving?

- + 1% Mass = 0.5% FF (fuel flow)*
- Narrow body = +/- 5 GPH
- For 300Hr/mo @ 2US$/USG = USD3k/mo
- 500 + AC = USD 18 Million / yr
- Man power required to handle Paper documentation, manuals and Charts

*WARNING: Do not use for flight calculation
EFB SYSTEM IDENTIFICATION

- Classification

New Term

PORTABLE

INSTALLED

Class 1
Power Supply / charger

Class 2
Antenna’s
Dedicated power
Processor / Data
Mounting system

Temporary Mounting (viewable stowage)

Integrated with Aircraft
COM/NAV data / AC Design

Requires: TC or STC

Old

1. Class 1: POI review application Type A or B
2. Class 2: Notify AWI (Mounting, Power/ data)
3. Class 3: Notify AWI & Engineering for STC

New

1. Portable (Class 1 / 2 ) Stored / Viewable storage
2. Installed (Amendment TC/STC Separate CAA TC/STC online application)
Questions

- All other questions welcome
- Please fill in
- Attendant data
- Survey and comment welcome

www.aerotekavia.com/pbns