



**Required Navigation Performance  
Operational Approvals Lessons  
Learned in US**

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## Agenda

- RNP AR Procedures Available for approved operators
- Approved RNP SAAAR Operators
- Operator Approval (LOA) Certification Requirements
- Recommendations for Moving Forward in Europe
- Questions

## RNP AR Airports (August 2010 Status)

- Atlanta KATL
- Atlanta Fulton KFTY
- Atlanta Peachtree KPDK
- Baltimore KBWI
- Birmingham KBHM
- Bishop KBIH
- Boise KBOI
- Bozeman KBZN
- Burbank KBUR
- Charlotte KCLT
- Chicago KMDW
- Cincinnati KCVG
- Dallas/Ft. Worth KDFW
- Ft Lauderdale KFLL
- Gary KGYG
- Guam PGUM
- Gunnison KGUC
- Hailey KSUN
- Hayden KHDN (Steamboat)
- Helena KHLN
- Honolulu PHNL
- Indianapolis KIND
- Jackson Hole KJAC
- Kalispell KGPI
- Kansas City KMCI
- Lewiston KLWS
- Lihue PHLI
- Long Beach KLGB
- Los Angeles KLAX
- Louisville KSDF
- Manchester KMHT
- Memphis KMEM
- Miami KMIA
- Minneapolis KMSP
- Missoula KMSO
- Monterey KMRY
- Nashville KBNA
- New York KJFK
- New York KLGA
- Newark KEWR
- North Bend KOTH
- Oklahoma City KOKC
- Ontario KONT
- Orlando KMCO
- Palm Springs KPSP
- Philadelphia KPHL
- Phoenix KPHX
- Pittsburg KPIT
- Portland KPDX
- Prescott KPRC
- Raleigh KRDU
- Reno KRNO
- Rifle KRIL
- San Francisco KSFO
- San Jose KSJC
- Scottsdale KSDL
- Seattle KBFI
- Sebring KSEF
- Tampa KTPA
- Teterboro KTEB
- Tucson KTUS
- Washington KDCA
- Washington KIAD
- Wenatchee KEAT
- West Palm Beach KPBI
- Windsor Locks KBDL

**66 Airports Published**

## FAA Planned New 2010 RNP AR's

- Amarillo KAMA
- Atlantic City KACY
- Birmingham KBHM
- Boston KBOS
- Bremerton KPWT
- Butte KBTM
- Denver KAPA
- Colorado Springs KCOS
- Columbus KCMH
- Corpus Christi KCRP
- Houston KIAH
- Idaho Falls KIDA
- Lubbock KLBB
- Medford KMFR
- New Orleans KMSY
- Oakland KOAK
- Orange County KSNA
- Sacramento KSMF
- Salt Lake City KSLC
- San Antonio KSAT
- San Diego KSAN
- Savannah KSAV
- Spokane KEGG
- Tulsa KTUL
- White Plains KHPN
- Wichita KICT

FAA plans 60 new procedures per year

## FAA Planned New 2011 RNP AR's

- Albuquerque KABQ
- Aspen KASE
- Carlsbad CA KCRQ
- Chicago Waukegan KUGN
- Detroit KDTW
- Eagle KEGE
- Eugene KEUG
- Farmingdale NY KFRG
- Grand Junction KGJT
- Great Falls KGTF
- Kahului PHOG
- KONA PHKO
- Moses Lake KMWH
- Norfolk VA KORF
- Omaha KOMA
- Pasco WA KPSC
- Trenton KTTN
- Yakima KYKM

### **Key Item:**

**Operators approved for AC 90-101 or equivalent are approved for All current and future approaches. Operational Approvals NOT based per approach, see NAV DB Validation for details.**

## International Planned RNP AR's

- Hong Kong VHHH RNP approaches developed and under evaluation - public
- Innsbruck LOWI RNP approach and departure active for some airlines
- Quito SEQU RNP approaches for airlines now
- La Serena SCSE RNP approaches for airlines now
- Tegucigalpa MHTG RNP approaches for airlines now
- New Zealand NZRO RNP approaches for New Zealand airlines now

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## RNP SAAAR Operators

### Part 121

American  
Delta  
Continental  
Qantas  
Air New Zealand  
Alaska  
Horizon  
JetBlue  
WestJet  
Air China  
United (in work)  
US Airways (in work)  
Southwest Airlines (in work)

### Part 135/91k

NetJets

### Part 91

Honeywell\*  
Verizon\*  
Johnson & Johnson\*  
Qualcomm\*  
Anadarko\*  
WR\*  
Motorola \*  
Baxter Healthcare \*  
Coke (in work)  
Friedkin Aviation \*  
Guthy-Renker (in work)\*  
Million Air (in work)  
Reyes Holdings\*  
Skybird  
Yum Brands \*  
IMS Health\* (in work)  
Boeing flight dept

\* Operators who have used  
Honeywell's Go Direct™ Services

## Agenda

- RNP AR Procedures Available for approved operators
- Approved RNP SAAAR Operators
- **Operator Approval (LOA) Certification Requirements**
- Recommendations for Moving Forward in Europe
- Questions

## AMC 20-26 Overview

# AMC 20-26

## Airworthiness Approval and Operational Criteria for RNP Authorisation Required (RNP AR) Operations



AMC 20-26

**AMC 20-26 Effective: 23/12/2009**  
Annex II to ED Decision 2009/019/R of 16/12/2009

### AMC 20-26 Airworthiness Approval and Operational Criteria for RNP Authorisation Required (RNP AR) Operations

This AMC provides a means of compliance for applicants for an airworthiness approval to conduct Required Navigation Performance Authorisation Required (RNP AR) Operations and the applicable criteria to obtain an operational approval. It relates to the implementation of area navigation within the context of the Single European Sky<sup>1</sup>, in particular in relation to the verification of conformity of the airborne constituents, per Article 5 of EC Regulation 552/2004. Additional guidance material can be found in the ICAO Performance Based Navigation Manual, Document 9613, Volume II, Chapter 6, as contained in ICAO State Letter AN 11/45-07/22.

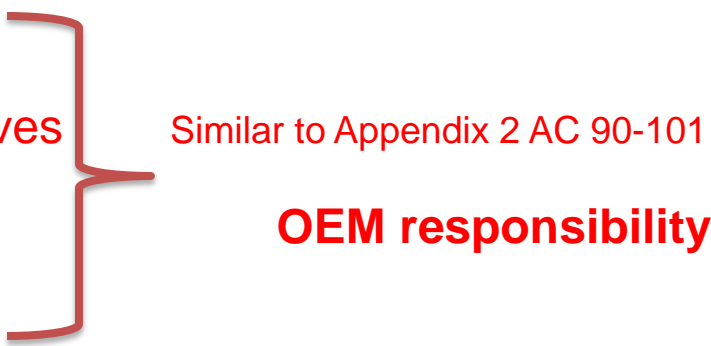
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<sup>1</sup> Regulation (EC) No 549/2004 of the European Parliament and of the Council of 10 March 2004 laying down the framework for the creation of the single European sky (the framework Regulation).

## AMC 20-26 Overview

The AMC is comprised of the following **Sections**:

- Sections 1-3 - Purpose, Scope and Reference documents
  - Section 4 - Assumptions (Procedure design, infrastructure, monitoring, controller training, flight evaluations)
  - **Section 5 - System Description**
  - **Section 6 - Airworthiness Certification Objectives**
  - **Section 7 - Functional Criteria**
  - **Section 8 - Airworthiness Compliance**
  - Section 9 - Aircraft Flight Manual/Pilot Operations handbook
  - Section 10 – Operational Criteria
- 
- Similar to Appendix 2 AC 90-101
- OEM responsibility**

## AMC 20-26 Overview

The AMC is comprised of the following **Appendices**:

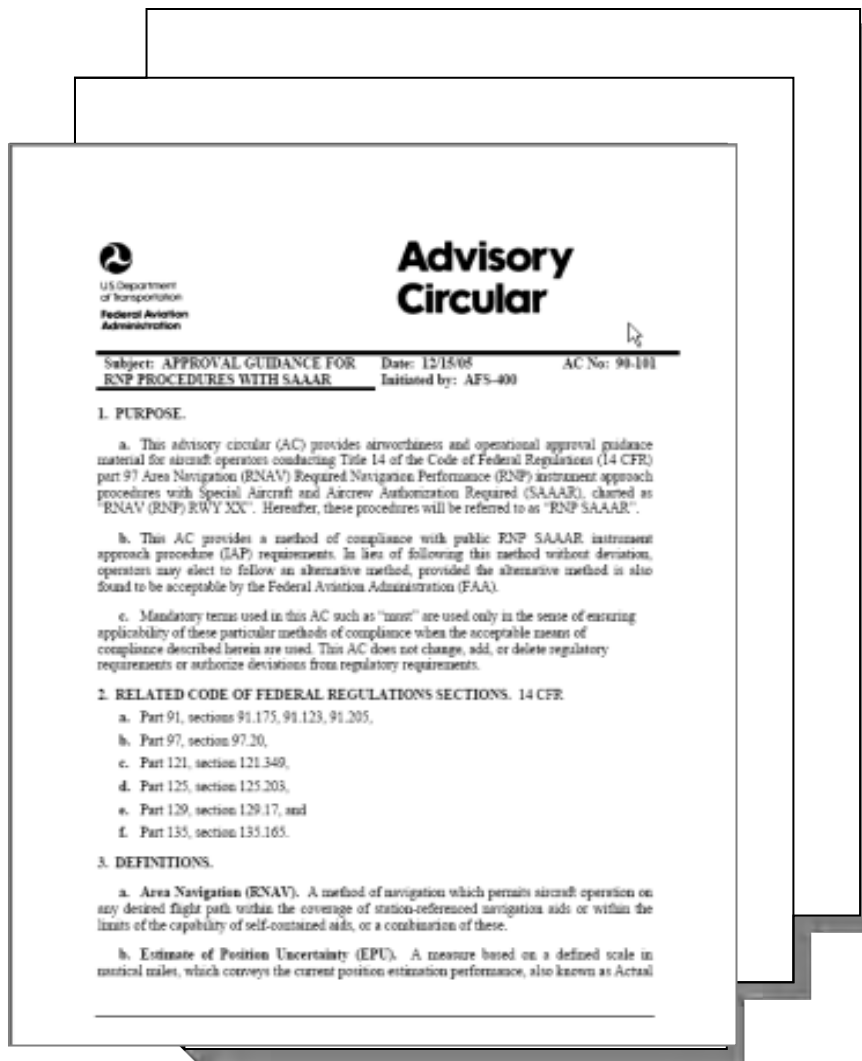
- Appendix 1 - Glossary
- Appendix 2 – Training and Crew Qualification Issues
- Appendix 3 - RNP Operational Considerations
- Appendix 4 – Acceptable methods for FTE assessments  
for RNP
- Appendix 5 – Flight Operation Safety Assessments
- Appendix 6 – AMC 20-26/PBN Manual / AC 90-101  
Comparisons

## RNP SAAAR Guidance

AC 90-101

First release : 12/15/2005

AC 90-101A reviewed for several years, awaiting final publication fall of 2010.



## AC 90-101 RNP SAAAR Requirements

The AC is comprised of 7 Appendices:

- Appendix 1 - RNP SAAAR Instrument Approach Procedures
  - Appendix 2 - Aircraft Qualification } **OEM Responsibility**
  - Appendix 3 - Navigation Data Validation
  - Appendix 4 - Operational Considerations
  - Appendix 5 – Training
  - Appendix 6 - RNP Monitoring Program
  - Appendix 7 – Validation Requirements
- } **Operator Responsibility  
Go Direct™ Services**

## Key Operational Objectives

1. *RNP AR Navigation Database Validation*
  - *Requirements and Process*
2. *Operational Considerations for Flight Dept Flight Operations Manuals (FOM's)*
3. *Pilot Training Requirements*
4. *RNP AR Monitoring Requirements*



## RNP AR Navigation Database Validation

(AMC 20-26 Section 10.4, AC 90-101 Appendix 3)

Requirement: (The two are closely harmonized)

- All RNP AR procedures in the navigation database must be validated prior to use
  - Visual comparison of the navigation database to the source data
    - ✓ FAA Form 8260 or international source such as AIP
  - Flyability simulation (PC based or in FMS Lab)
  - Documented with list of validated procedures

## Section 10.4 Nav Database Validation

- Operator Database Management Process
  - Documented Process Required
    - Accepting, verifying, and loading nav data into the aircraft
    - Responsible manager identified
- Data Suppliers
  - Require LOA for compliance with DO 200A
    - Data quality, integrity and quality management practices
    - Honeywell Type 2 LOA available on [www.honeywellaes.com/navdb](http://www.honeywellaes.com/navdb)

## Nav Database Validation

- Data Validation
  - Initial validation and data updates
    - Visual comparison of FMS data with source data
      - FAA 8260 form
      - Aeronautical Information Publication (foreign countries)
    - Validate procedure in a simulator or aircraft in VMC
      - Flyable
      - No disconnects
      - Consistent with published procedure

## Nav Database Validation

- Re-validation for **Aircraft Modifications**
  - Required if modified system is required for RNP AR
    - (e.g., software change)

### **10.4.4 Aircraft Modifications**

If an aircraft system required for RNP AR operations is modified (e.g. software change), the operator is responsible for validation of RNP AR procedures with the navigation database and the modified system. This may be accomplished without any direct evaluation if the manufacturer verifies that the modification has no effect on the navigation database or path computation. If no such assurance from the manufacturer is available, the operator must conduct initial data validation with the modified system.

## Nav Database Validation

### Initial Data Validation

- New RNP AR procedure
- Changed procedure
- Aircraft modifications that affect procedure

FAA 8260  
Comparison

- Compare nav data for procedure with published procedure (manual checking)
- FAA Form 8260 – from FAA website <http://avn.faa.gov/ndbr.asp>

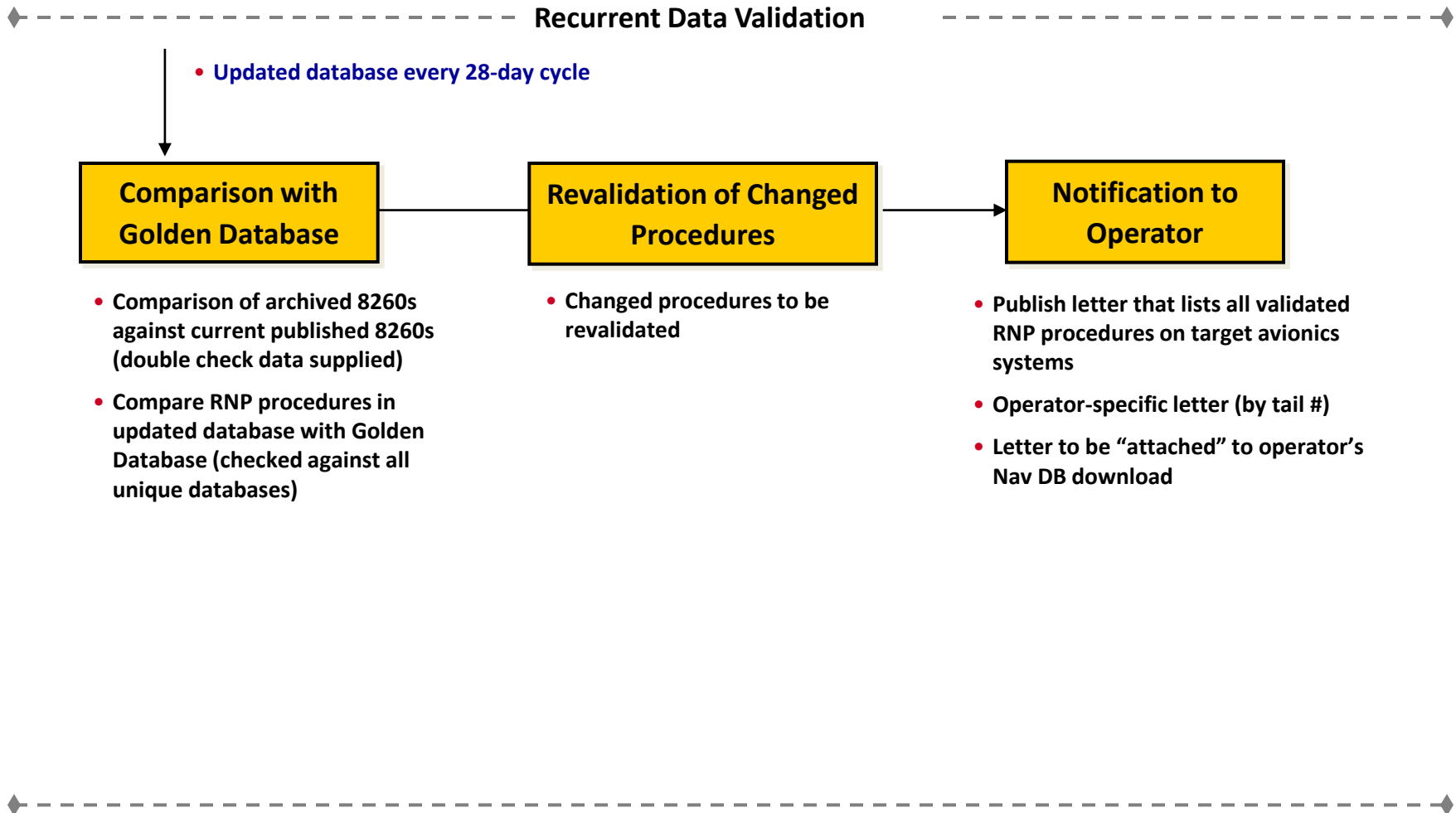
Flyability Validation

- Loaded nav data must be validated for fly-ability (procedure has to be executed) in simulator or in other testing environment for each target avionics system
- Procedure depicted on avionics has to be consistent with published procedure
- Limit checks
- Document results

Golden Database

- Each validated procedure stored and maintained in golden database (archive database in OneNav)
- One database for each FMS binary format
- Database will include Lat, Long information for each Fix, archived 8260s

## Nav Database Validation



## RNP AR Operational Considerations

(AC 20-26 Appendix 3, AC 90-101 Appendix 4)

1. Minimum Equipment List
2. Autopilot and flight director
3. Dispatch RNP assessment
4. NAVAID exclusion
5. Navigation database currency
6. Flight plan modification restrictions
7. Documented list of equipment (quick reference guide)
8. RNP management procedure
9. GNSS updating crew verification
10. Radio updating requirements
11. Approach procedure confirmation
12. Monitoring track deviations
13. Pilot system crosscheck
14. Use of RF legs
15. Use of temperature compensation
16. Altimeter setting and crosschecks
17. Non-standard climb gradients
18. Engine-out procedures
19. Go around missed approach Requirements
20. Contingency procedures and failures en route and on approach

## General Concepts of RNP SAAAR Operation

- Definitions of RNAV, RNAV(GPS), RNP, RNP SAAAR
- The differences between RNAV & RNP
- Obstacle and terrain avoidance
- The Need for RNP SAAAR Training
- Total System Error
- EPU, FTE, Containment & Alerting
- Vertical Error Budget, Containment & Alerting
- Effect of non-Standard Temperatures
- RF Legs and containment
- Contingency Procedures / Missed Approaches
- RAIM



# Why RNP SAAAR Training

- Lower minima is provided by reduced error budgets
- Same obstacle clearance but with less margin of error
- This training addresses specific error classes to reduce or mitigate the risk of operation

## - Operational Considerations

- ◆ Regulations
- ◆ Approach Procedures
- ◆ Aircraft Capability
- ◆ FMS & Database accuracy
- ◆ Altimetry Errors
- ◆ GPS Accuracy & Availability
- ◆ Containment
- ◆ Displays & Alerting
- ◆ Supporting Systems (Radar & EGPWS)

## - Training

- ◆ Ground Training for Flight Crew / Dispatchers
- ◆ Flight Training
- ◆ Initial / Transition / Upgrade / Recurrent



Before Engaging in RNP SAAAR Approaches the operator must do:

- **Ground Training**
  - Regulatory Requirements
  - Basic Concepts, Systems Theory
  - Specific RNP SAAAR operations to be used
- **Flight Training - Initial**
  - 4 approaches in an approved SIM
    - 2 flying/ 2 monitoring
      - 2 approaches to DA(H)
      - 2 approaches to a RNP missed approach

- **Operators shall incorporate RNP SAAAR training & qualification into:**
  - ◆ Initial (Initial RNP SAAAR Training)
  - ◆ Transition
  - ◆ Upgrade
  - ◆ Differences
  - ◆ Recurrent
  
- **Flight Training - Recurrent**
  - ◆ 2 approaches in an approved SIM
    - 1 flying/ 1 monitoring
      - » 1 approach to DA(H)
      - » 1 approach to a RNP missed approach

# RNP Monitoring Program (AC 90-101 Appendix 6)

- Requirement for continued compliance to AC 90-101
- Required following the completion of each RNP SAAAR approach
- Used to identify any negative trends
- Collected and Submitted to POI Every 30 days
  
- Information Required (Provided on form)
  1. Total number of RNP SAAAR procedures conducted
  2. Number of satisfactory approaches by aircraft/system (Satisfactory if completed as planned without any navigation or guidance system anomalies)
  3. Reasons for unsatisfactory approaches, such as:
    - a) UNABLE RNP, UNABLE RNP NEXT WPT, or other RNP messages during approaches
    - b) Excessive lateral or vertical deviation
    - c) EGPWS warnings
    - d) Autopilot system disconnect
    - e) NAV data errors
    - f) Pilot report of any anomaly
  4. Crew Comments

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## Lessons Learned for Approval Success

- 1. Coordinate with all Regulatory as early as possible*
- 2. Require Traceability matrices to Formal Applications*

# RNP AR Regulatory Coordination

## Certification Planning Meeting



## RNP SAAAR – Certification Planning Meeting

- Purpose
  - To present plan for compliance to AC 90-101
  - Get clarification/resolution on issues
    - Prior to submission of application
    - Reduces post-submission application negotiation
  - Forum for questions
  - Bring all levels of Regulatory together (US example)
    - FAA Flight Technologies and Procedures (HDQ)
    - FAA Airworthiness Standards (HDQ)
    - FAA All Weather Operations (Region)
    - FAA Flight Standards District Office (Local)



## Challenges to Implementing RNP SAAAR in the US

- **Complexity**

- AC 90-101 is challenging and requires many approved processes
- Stringent requirements for Navigation Data Base Validation
- Unfamiliarity with approval process by Operator and local regulatory.  
Lack of

- **Cost**

- Cost to get approved
- Manpower, meetings, and travel

- **Timelines**

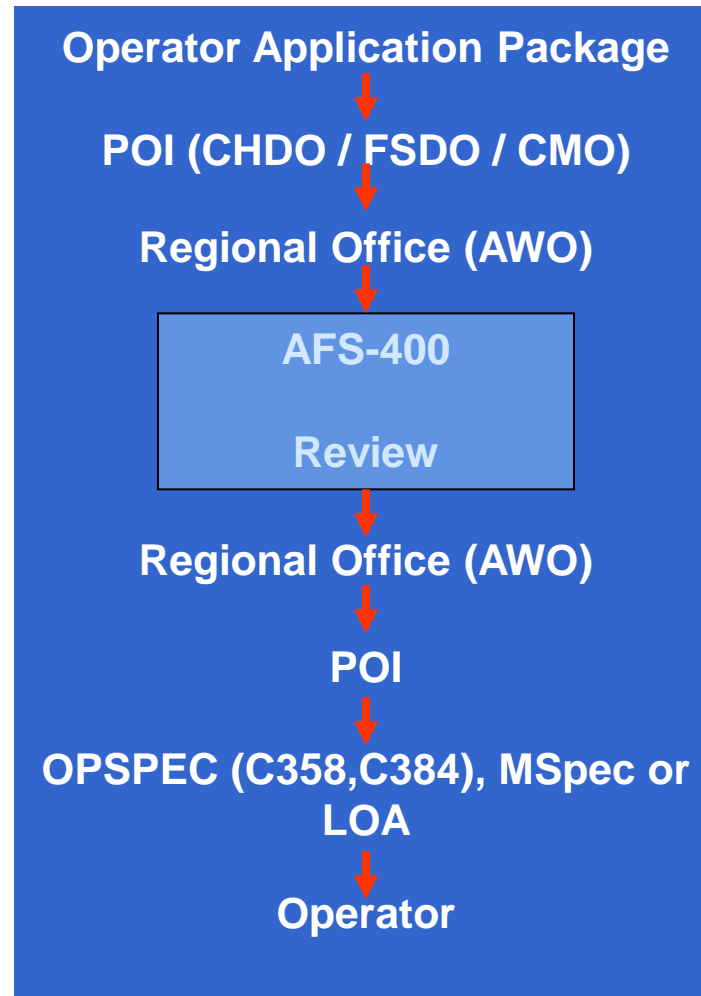
- Current timelines can be on the order of years for approval

**To provide a solution, FAA created the RNP SAAAR Consulting Program.**

**Honeywell was granted RNP SAAAR Consultant Designation in Nov 2007**

## RNP SAAAR Approval Path

Process requires  
multiple FAA  
signatures



## Keys to moving ahead with EASA RNP AR Approvals

- **Consistency of Interpretation of Guidance**

- Both AMC 20-26 and US counterpart AC 90-101 are challenging to understand and have significant legacy wording incorporated.
- In some cases a disharmony in the certification requirements especially moving forward with AC 90-101A.

- **Operators Need processes and methods for Navigation Data Base Validation**

- Key issue technically is to continue to keep the Total System Error (TSE) minimized.

- **Issues both authorities experience are unfamiliarity with approval process by both the operators regulatory**

## Streamlining the approval process for EASA

1. Create a program similar to the FAA designated consultancy program to provide experienced consultants for operators.
  - EASA to approve consultants with written criteria for approvals.
2. Provide detailed level RNP AR certification training to states