NextGen for Airports, Volume 1: Understanding the Airport's Role in Performance-Based Navigation: Resource Guide

DETAILS

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5 Procedure Design Processes, Personnel, and Tools

This section summarizes the processes for implementing PBN procedures and the personnel who may be involved in developing and implementing these procedures. In this section, *programs* are specific efforts undertaken by the FAA or other entities to promote implementation of PBN flight procedures. *Procedures* are the PBN flight procedures that are the focus of the program.

Processes

The FAA has three processes it is using to develop and implement PBN procedures at airports: the 5-phase process, the metroplex process, and the third-party vendor process. The use of a particular process depends upon the particular initiative that is driving the implementation of PBN procedures at an airport. Procedure development processes typically consist of five steps, loosely summarized as:

1. Definition of the procedure design problem,
2. Design and evaluation of the procedures,
3. Documentation of the designed procedures,
4. Implementation of the procedures, and
5. Post-implementation assessment of the procedures.

The FAA's 5-phase process is the most explicitly documented, while the others are less well documented in their details. The metroplex process has been utilized and developed at numerous sites and is the most explicit in addressing environmental assessment of the proposed procedures. Application of the third-party vendor process is limited to required navigation performance (RNP) authorization required (AR) approach procedures.

5-Phase Process

The FAA 5-Phase Process for implementing public and special PBN procedures originated from a process developed by The MITRE Corporation in the early 2000s, known as the 18-step process. The 5-phase process streamlined the 18-step process into phases and was formally documented in the FAA Order 7100.41, *Performance Based Navigation Implementation Process*. The order describes the process framework, the participants, and the roles and responsibilities of the participants in the process, albeit at a high level. The order explicitly identifies the airport authority as a principal participant in the core working group for developing the PBN procedures. The airport authority contributes information concerning potential operational or environmental impacts on the airport or communities, planned airport development projects, and airport obstacle data. The process is focused on the technical aspects of flight procedure design and therefore does not incorporate community and stakeholder outreach or engagement. A summary of the 5-phase process, as documented in the FAA Order, is summarized in Table 5-1.

Table 5-1. Summary of FAA 5-phase instrument flight procedure (IFP) design process.

STEP	DESCRIPTION
Preliminary Activities	Identify issues with the legacy flight procedure. Specify design objectives for the proposed procedure and metrics to assess them. Analyze baseline operations under the legacy flight procedure to inform the design and support assessing the benefits of the proposed procedure. Propose a PBN procedure to meet the design objectives, including developing conceptual designs, identifying potential environmental issues, and assessing the benefits, costs, and risks of the proposed procedure. Submit the proposed procedures to the Regional Airspace Planning Team (RAPT) for review.
Development Work	Evaluate the proposed procedure against the specified design objectives and any constraints on the design. Assess the viability of the proposed procedure based on its communications, navigation, surveillance and other requirements. Assess the design of the proposed procedure against procedure design criteria and within the subject airspace using the terminal area route generation, evaluation, and traffic simulation (TARGETS) procedure design tool and the aviation environmental design tool (AEDT) noise screening tool. Perform environmental analysis to determine if a categorical exclusion (CatEx) is sufficient or if an environmental assessment (EA) or environmental impact statement (EIS) is required for the procedure to satisfy requirements of the National Environmental Policy Act (NEPA).
Operational Preparations	Address the operational needs for implementation of the proposed procedure, including planning and implementing controller training and air traffic control (ATC) automation updates, pilot training, and flight management system (FMS) database verification.
Implementation	Publish the charted procedures. An implementation team supports deployment of the charted procedure.
Post-Implementation Monitoring and Evaluation	Monitor the procedure after implementation, evaluate against the original design objectives for the procedure, and modify the procedure as needed to meet the original design objectives. Document the analysis of the baseline operations under the legacy procedure, the design of the implemented flight procedure, FAA forms and waivers, environmental reviews, actions, and decisions, the RAPT consensus form, and post-implementation analysis findings.

The Radio Technical Commision for Aeronautics (RTCA) NextGen Advisory Committee (NAC) recently published the *Blueprint for Success to Implementing PBN* procedures (RTCA 2014). This document specifies categories of stakeholders in PBN development and provides descriptions of procedure development and recommendations to the FAA for conducting the 5-phase procedure development process. For each phase, recommendations account for capturing the needs of stakeholders, defining objectives and metrics for the flight procedures, involving technical and non-technical stakeholders in the development process, planning and coordinating community outreach with flight procedure development, managing data, and capturing lessons learned. While these recommendations are pending review and approval of the FAA, and may not be accepted and applied wholesale, they can help to gain further understanding of each design phase and the potential contributions of the airport operator.

Metroplex Process

The FAA uses a similar process for designing flight procedures in its Metroplex program. The process takes approximately three years to complete but has widely been considered beneficial. It has been extensively applied and refined in numerous PBN flight procedure design projects across the U.S. It directly incorporates the EA process as part of NEPA in the development of the flight procedures. It includes characterization of current day operations to establish a sound baseline for flight procedure design and to assess the benefits of the procedures. It also includes a formal process for deploying the procedures. The steps are summarized in Table 5-2.

Table 5-2. Summary of FAA Metroplex program IFP design process.

STEP	DESCRIPTION
Study and Scoping (3 months)	The study team meets with facility and industry representatives to identify issues with the legacy procedures and airspace and to propose solutions. The study team produces conceptual designs of proposed procedures and a high-level assessment of the benefits, costs, and risks of the procedures.
Design (6–9 months)	The design & implementation team (D&I) conducts integrated airspace and procedure design based on the findings of the study team. The D&I team includes representatives of the lead aircraft operator. Additional analyses, including human-in-the-loop simulations, may be conducted to support this work.
Evaluation (12–18 months)	The D&I Team conducts operational modeling, safety management system (SMS) analyses, and environmental reviews with representatives of the lead carrier. The evaluation phase may also continue design analyses. Evaluation includes a project kickoff, completing the design of the procedures, and validating the final operations. The evaluation phase includes SMS processes of facilitating the safety risk management (SRM) panel, completing the SMS process, and creating and completing the final SMS documentation. Evaluation includes drafting the complete EA as required by NEPA, including the Purpose and Need section, the Alternatives section, the Affected Environment section, and the Environmental Consequences section with a goal of achieving the final EA finding of no significant impact (FONSI).
Implementation (9–15 months)	The D&I Team works with the representatives of the lead aircraft operator to conduct all steps for implementation, including flight inspections, publishing procedures and planning, and executing training. Implementation includes developing a procedure implementation plan, a training plan, flight checks, stakeholder coordination, training, and procedure implementation.
Post-Implementation Monitoring and Evaluation (2–3 months)	The D&I team reviews the benefits and impacts of the implemented airspace and procedures and modifies the procedures as needed.

The metroplex process includes extensive analysis to characterize baseline operations and to support the design and benefits analysis of the PBN procedures. Analyses may include the following:

- Characterizing standard terminal arrival route (STAR) traffic flow conflicts with other flows;
- Characterizing the level segments of arrival or departure flights;
- Quantifying the number of aircraft in each arrival traffic flow to the airport as well as major and satellite airport arrivals;
- Analyzing the traffic loading of airspace sectors;
- Comparing the tracks and published routes;
- Conducting conceptual airspace and procedure design and simulation;
- Analyzing traffic management initiatives and playbook route usage;
- Analyzing annual traffic counts and aircraft type;
- Developing traffic density charts; and
- Evaluating the fleet mix from PBN capability report.

The metroplex process may also include outreach to impacted stakeholders with regularly scheduled briefings for each milestone in the design and development phase.

Third-Party Vendor Process

In 2007, the FAA developed a pilot program to certify third-party commercial vendors for the development of RNP AR procedures. This program was mandated by Congress and was intended to accelerate the availability of PBN procedures throughout the NAS. The program is limited to RNP AR procedures and requires the third-party vendor to own, maintain, and assume the liability of the procedures it develops. This is in contrast to procedures developed under public and special programs.

Table 5-3 highlights the difference between the third-party vendor, special, and FAA programs for developing flight procedures. In this table, *public* refers to procedures developed by the FAA. *Special* refers to procedures developed by aircraft operators or vendors. *Third Party* refers to procedures developed by third-party vendors. For public programs, the FAA certifies, owns and maintains the flight procedures, and assumes the liability for them. The FAA Metroplex program is developing public flight procedures as a distinct public development program. For special programs, flight procedures are developed by any vendor or airline and are certified and maintained by the FAA.

Table 5-3. IFP Development Program Comparison.

Program	Owner	Developer	Certifier	Maintenance	Liability
Public	FAA	FAA	FAA	FAA	FAA
Special	FAA[1]/ Operator	FAA or Any Service Provider	FAA	FAA	FAA
Third Party	Third-Party Vendor	Third-Party Vendor	FAA	Third-Party Vendor	Third-Party Vendor

[1]FAA owns and maintains some special approach procedures in cases where there is benefit to the NAS.

FAA Advisory Circular 90-110A *Instrument Flight Procedure Service Provider Authorization Guidance for Required Navigation Performance Authorization Required Procedures* details the certification requirements and guidance on the procedure development process for third-party vendors. To date, there are three vendors who are certified as part of this program. Very few procedures have been developed under this program due to the liability requirements associated with the program. The procedure development process specified by the Federal Aviation Administration (2015a) is summarized in Table 5-4. With respect to airport environmental concerns, it was stated that the vendor's responsibility included preparing environmental paperwork for EAs, although this was not explicitly accounted for in documentation of their processes.

Table 5-4. Summary of FAA third-party vendor IFP design process.

STEP	DESCRIPTION
Preliminary Activities	Preliminary activities include initial coordination among the working group members including air traffic facilities, the airport, aircraft operators and the IFP service provider; approval by the RAPT; and a project kickoff meeting to confirm the objectives, finalize the conceptual design, and establish the project timeline among the working group members.
Procedure Design	Procedure design includes developing the concept for the procedure, including defining the lateral and vertical path of the procedure; conducting environmental review as per FAA Order 1050.1 (FAA 1986); validating the concept for the procedure; and developing the procedure design.
Instrument Flight Procedure Validation (IFPV)	IFPV includes ground obstacle assessment, simulator evaluations, airborne obstacle assessment, and flight validation of the detailed procedure design as per FAA Advisory Circular 90-113 (FAA 2011a) and FAA Order 8900.1 Volume 11, Chapter 12 (FAA 2010).
Pre-Implementation	In pre-implementation, the IFP service provider coordinates the final design with all stakeholders. The readiness of aircraft operators and air traffic control for the new procedure is addressed. The final procedure is reviewed.
Publish Procedure	The final procedure is prepared for publication, published, and deployed operationally.
Post-implementation Review	The IFP service provider conducts implementation review of the implemented procedure consistent with principles of the FAA SMS.

Source: Federal Aviation Administration 2015a.

Design Iteration to Address Noise

The U.S. Government Accountability Office's analysis of the New York/New Jersey/Philadelphia airspace design provides an example for evaluating and addressing noise issues in the development of flight procedures. The following sequence of steps was used to address noise issues identified during

the design. This process could be applied within the frameworks of the FAA 5-phase, FAA metroplex or FAA third-party vendor procedure development processes:

1. *Develop alternative procedure designs,*
2. *Analyze the alternatives for operational impacts,*
3. *Analyze the alternatives for noise impacts,*
4. *Select the preferred alternative,*
5. *Identify potential noise mitigation measures,*
6. *Analyze mitigation measures for operational impacts,*
7. *Analyze mitigation measures for noise impacts, and*
8. *Develop mitigated preferred alternative.*

After selecting the preferred alternative, the designers began identifying measures to mitigate the noise impacts associated with the preferred alternative, and initiating an iterative process of identifying potential noise mitigation strategies and using operational and noise modeling tools to measure impacts. In this process, noise mitigation served as a design constraint, not as a design objective.

Personnel

The FAA 5-phase, metroplex, and third-party vendor processes, as well as other sources, indicate the design and implementation of PBN procedures may include the personnel listed in Table 5-5. An airport authority or operator is called out explicitly in the FAA 5-phase process. Other personnel that may represent the interests of the airport include the FAA Airports Office and FAA Air Traffic Organization (ATO) Service Center Operations Support Group, and the aircraft operator. Others, such as the PBN Policy and Support Group and the TARGETS operator, are conducting analyses that may use airport data and determine the impact on the airport and its communities.

Table 5-5. Personnel involved in PBN IFP development.

ENTITY	ROLE
Instrument Flight Procedure (IFP) Proponent	Contracts with the FAA or an approved service provider to design the IFP. The IFP Proponent may be an airport sponsor, an aircraft operator, a facility, or an entity of the FAA requesting an IFP for specific airspace.
FAA Airports Office	Supports identifying standards for airport design, construction, and operation.
FAA Flight Procedures Office	Supports identifying the design and obstacle clearance standards, criteria, and policies governing departure, en route, arrival, and approach IFPs.
Facilitator	Manages and oversees the IFP development project.

Table 5-5. Continued

ENTITY	ROLE
Aircraft Operator	Fulfills the technical role of lead operator and coordinates with industry stakeholders throughout the IFP development. Assesses the proposed IFPs according to the needs of the air crew, the aircraft, and the FMS of the aircraft.
Airport Authority or Operator	Provides information on the local operational or environmental considerations for the proposed IFP, including potential impacts on the surrounding communities. Provides knowledge of airport construction and obstacles that may impact the design of the IFP. Provides input or support in the local stakeholder engagement efforts.
Air Traffic Facilities	Provides detailed operational insight that supports the design of the IFP and develops and implements training programs and updates automation in order to implement the IFP.
FAA ATO Service Center Operations Support Group (OSG)	Provides expertise in the areas of environmental, local air traffic, airspace, operational rules, and flight procedures. Personnel will include an environmental specialist to identify issues and ensure compliance with governing standards, criteria, and policy; and a flight procedures specialist to develop the IFP and ensure compliance with governing standards, criteria, and policy.
Regional NextGen Branch	Represents the FAA Flight Standards division and provides policies and procedures concerning PBN capabilities leveraged in the procedure design.
PBN Policy and Support Group	Determines if categorical exclusion (CatEx) criteria apply or if an environmental assessment (EA) or environmental impact statement (EIS) is required to satisfy the National Environmental Policy Act (NEPA). This includes conducting noise screening analysis, assessing the navigation requirements, and assessing the feasibility of the proposed IFP in preparation for submission to the regional airspace and procedures team (RAPT).
Analyst	Models the proposed IFP and evaluates the flyability, operational viability, and other technical aspects of the proposed procedure.
FAA Aeronautical Information Services	Validates the new procedures against design criteria and publishes the new procedures on charts.

The personnel listed in Table 5-5, as well as others, may be involved in development of the PBN flight procedures. All flight procedure requests are submitted to the RAPT for review and ultimate approval.

Regional Airspace and Procedures Team (RAPT)

The RAPT meets monthly to review flight procedure requests in the local context, and approves or denies the requests based on a number of criteria. The RAPT evaluates and approves or denies all local requests for flight procedures.

RAPT personnel include numerous Operations Service Center (Western, Central, or Eastern) managers including the Regional Airports Division, ATO Support, Flight Standards, and the NextGen Branch. Personnel may also include airport operators and users and ATC Facilities. The Regional Airports Division Manager ensures that airport projects do not interfere with the proposed procedures and that the proposed procedures meet the standards in the FAA Advisory Circular 150/5300-13A, *Airport Design*. The Regional Airports Division Manager and airport operators and users can work to ensure that the proposed PBN procedures meet local airport and community criteria and concerns. Ultimately, procedure design is decided upon by the FAA and in coordination with the lead carrier(s).

The criteria for assessing procedure requests include national initiatives, congressional mandates, industry activities, airport operator and users' needs, conceptual design, traffic flow, and airport layout. The team looks for possible conflicts with waivers, naming, equipage, infrastructure, and non-standard methods, and considers timing of implementation of the proposed procedure with activities of the airport, FAA, and others.

The National Airspace Planning Team (NAPT) provides national-level oversight to ensure standard methods are applied across the regions.

Tools

Standard tools are used in the design of flight procedures. The design tools are used to verify that aircraft can fly the designed procedure and to estimate the resulting noise, fuel burn, and exhaust emissions of aircraft flying the designed procedure. These tools are also useful in assessing the impacts of the flight procedure on the airport, local community, and the environment. The primary tools for designing procedures are listed in Table 5-6.

Table 5-6. Standard tools for designing flight procedures.

TOOL	DESCRIPTION
Terminal Area Route Generation, Evaluation, and Traffic Simulation (TARGETS)	TARGETS is a flight procedure design tool with navigation data presentation, procedure design tools, flyability assessment and traffic simulation capabilities. It supports noise screening and operational assessment of proposed procedures according to the mix of aircraft types and percentage of area navigation (RNAV) equipped aircraft.
RNAV Pro™	RNAV-Pro™ is the FAA's flight standards-approved tool for screening of RNAV and required navigation performance (RNP) route elements. Screenings include terminal instrument procedures (TERPS) criteria, flyability, distance measuring equipment (DME), radar coverage, and communication coverage.

Table 5-6. Continued

TOOL	DESCRIPTION
Aviation Environmental Design Tool (AEDT)	AEDT is a software system that models aircraft performance in space and time to estimate fuel consumption, emissions, noise, and air quality consequences. AEDT replaced the Integrated Noise Model (INM) and the Noise Integrated Routing System (NIRS) in 2015 and is a comprehensive tool that provides information to FAA stakeholders on each of these specific environmental impacts. AEDT facilitates environmental review activities required under NEPA by consolidating the modeling of these environmental impacts in a single tool. AEDT is designed to model individual studies ranging in scope from a single flight at an airport to scenarios at the regional, national, and global levels. AEDT leverages geographic information system (GIS) and relational database technology to achieve this scalability and offers rich opportunities for exploring and presenting results. The use of AEDT is required for all new environmental projects. However, projects initiated in previous years may still be using INM or NIRS.

Additional tools have been used on particular projects on a case-by-case basis. The Total Airspace and Airport Modeler (TAAM) is a simulation tool that models airports and airspace and is used to assess the traffic flow impacts of flight procedures. The Monte-Carlo FMS Aircraft Simulation Tool (MFAST) models aircraft FMS characteristics and is used to assess the operational variation in the trajectories of aircraft flying the procedure. The Base of Aircraft Data (BADA) is an energy-based kinetic aircraft performance model used for trajectory simulations and predictions, in particular for estimating the fuel burn of aircraft flying a procedure. The Graphical Airspace Design Environment (GRADE) is used for displaying, analyzing, designing, and evaluating air traffic operations; it has been used to assess level-offs of arrivals to support designing and analyzing the benefits of PBN arrival procedures.