Commercial Aviation Safety Team

AVN Implementation Plan

JULY 2000

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Federal Aviation Administration
Aviation System Standards

1. INTRODUCTION

The National Airspace System (NAS) is in a period of unprecedented growth and change. Transition to the new modernized NAS will be filled with challenges for the FAA and the aviation industry. The national airspace comprises more than 29 million square miles and handles more than 55,000 flights per day that use 12,300 instrument approach procedures. Since 1994, the number of instrument procedures has grown by approximately 50% (see Appendix A, U.S. National Airspace System (NAS) Fact Sheet). Technology improvements, funding levels, and other factors will impact the course of the modernization strategy. In addition, global interoperability of technology and harmonization of procedures are essential for continuity of operations and avionics investments.

The NAS Architecture accounts for changes required in procedures, training, airspace design, and certification of both the ground systems as well as avionics systems. All changes must work together to enable a new capability to be realized by the user or service provider.

Improvements in communications, navigation, and surveillance will allow for increased user access and system flexibility. Future developments in decision-support tools will assist controllers in accommodating future system demands. The Aviation System Standards organization (AVN) has the responsibility for designing instrument approach and departure procedures for the 21st Century NAS in accordance with Federal Aviation Regulations (FAR 97) safety standards.

AVN's strategy is effectively integrated with the Federal Aviation Administration's (FAA) NAS Architecture and National Airspace Redesign initiative. The AVN strategy also addresses industries' request to fully utilize ground, aircraft, and space based navigation systems for improved safety, capacity, and operational flexibility. The AVN organization has produced a plan that addresses the Commercial Aviation Safety Team's (CAST) direction toward a 21st Century Precision Landing System. The AVN plan integrates the mandates represented in *The Wendell H. Ford Aviation Investment and Reform Act for the 21st Century* (HR 1000), (AIR21), the initiatives of the Radio Technical Commission for Aeronautics (RTCA), and Special Committee on National Airspace Redesign Planning and Analysis (SC-192). The AVN plan provides a broad framework of flight procedure production options that are linked to specific funding requirements. Thus, it provides choices for policy makers as well as strategic direction and yearly tactical management information. Finally, the plan provides the opportunity for the FAA to effectively and efficiently deliver the improved safety benefits desired by the CAST.

2. BACKGROUND

The national airspace is a critical, but limited resource. While aircraft, navigational systems, and technology have advanced several generations, the structure of the airspace has not changed appreciably in the past few decades. The advances create both the need and the opportunity to revamp the airspace to better meet evolving customer requirements and to improve service provider tools. In April of 1998, the FAA Administrator launched the National Airspace Redesign effort. Charged primarily with this key activity, the Air Traffic Airspace Management Program Office (ATA) oversees the review, redesign, and restructure of the national airspace to effectively meet the needs of diverse customers and dedicated service providers.

The President signed HR 1000 in April 2000. This bill reflects the direction of the NAS redesign and optimization efforts for the new millennium. The language below cites some specific observations and mandates of Congress.

> The national airspace, comprising more than 29 million square miles, handles more than 55,000 flights per day.
>
> Almost 2,000,000 passengers per day traverse the United States through 20 major en route centers, including more than 700 different sectors.
>
> Redesign and review of the national airspace may produce benefits for the traveling public by increasing the efficiency and capacity of the Air Traffic Control (ATC) system and reducing delays.
>
> Redesign of the NAS should be a high priority for the FAA and the air transportation industry.
>
> The Administrator, with advice from the aviation industry and other interested parties, shall conduct a comprehensive redesign of the NAS.
>
> Not later than December 31, 2000, the Administrator shall transmit to the Committee on Commerce, Science, and Transportation of the Senate and Committee on Transportation and Infrastructure of the House of Representatives a report on the Administrator's comprehensive national airspace redesign. The report shall include projected milestones for completion of the redesign and shall also include a date for completion.
>
> The Administrator of the FAA shall:
>
> - Address the problems and concerns raised by the National Research Council in its report "The Future of Air Traffic Control" on air traffic control automation.
> - The Administrator shall work with representatives of the aviation industry and appropriate aviation programs…in landing and approaches and go-around procedures.

Recognizing that the FAA needed to have a consensus among users and service providers, ATA requested the RTCA to provide a forum where representatives of government and the private sector could collaborate on concepts for airspace redesign. RTCA responded by forming SC-192. The concepts developed by SC-192 and other government and industry forums influence the direction of current national redesign efforts.

The RTCA findings concluded: Instrument flight procedures are not implemented in a timely way to exploit current aircraft capabilities, such as Area Navigation (RNAV), Vertical Navigation (VNAV), and Required Navigation Performance (RNP). RTCA recommended: The authorities should work with industry to accelerate the development of instrument flight procedures based on proven operational concepts, such as RNP/RNAV, to exploit existing and anticipated aircraft system capabilities (e.g., Flight Management Systems (FMS)) (RTCA Recommendation #8).

As an outgrowth of the general context described above, the FAA participates with the aviation industry on the Commercial Aviation Safety Team (CAST) to reduce accidents, incidents, and delays. One of the efforts of CAST was to form a subgroup to work on precision-like approach implementation. This sub-group has generated a plan with a series of actions for different FAA organizations, including AVN.

The CAST Plan makes several references to RNAV, Lateral Navigation (LNAV), and VNAV. RNAV is a method of navigation that permits aircraft operation on any desired course within the limits of a self-contained system capability. Many systems also provide vertical guidance. FMS's with multiple sensors, including Global Positioning System (GPS), navigate with reference to geographical positions called waypoints. The Wide Area Augmentation System (WAAS) and Local Area Augmentation System (LAAS) will expand the availability of LNAV/VNAV instrument approach opportunities to very low weather minimums.

To foster and support full and optimum integration of the RNAV into the NAS, the FAA has developed a new charting format for RNAV Standard Instrument Approach Procedures (SIAPS). This new format maximizes the information available to the pilot for the safe and efficient conduct of the instrument procedure.

Vertical guidance is provided as a linear deviation from the desired track defined by a line joining two waypoints with specified altitudes, or as a vertical angle from a specified waypoint. Computed positive vertical guidance is based on barometric, satellite elevation, or other approved systems. The desired vertical path may be pilot selectable or may be determined by the VNAV computer with computations based on the altitudes associated with successive waypoints. These instrument approach procedures provide separate minima for LNAV and LNAV/VNAV. The LNAV/VNAV procedure and the LNAV procedure are designed with different obstruction criteria. The final segment of the approach, or Final Approach Waypoint (FAWP) to Missed Approach Waypoint (MAWP) may have different obstructions controlling the VNAV Decision Altitude (DA) and LNAV Minimum Descent Altitude (MDA). The flight inspection of RNAV procedures evaluates the soundness of the procedures in accordance with FAA Order 8200.1A, Section 214, and identifies any deficiencies in the procedure. Approach safety and fly-ability are evaluated as a non-precision approach with and without vertical guidance. The final segment of the flight inspection may require repeated flights for obstacle evaluation.

Flight inspection of these new procedures will require upgraded FMS equipment in many flight inspection aircraft enabling integration of WAAS and LAAS inputs and Distance Measuring Equipment (DME/DME) inputs necessary to fully certify the new procedures.

Finally, verification that true bearings to next waypoint, distances, and the Flight Path Angle (FPA) indicated on either the FMS or GPS match the procedure is necessary in order to ensure data integrity. Out of tolerance values must be resolved with the procedures development specialists. FMS-equipped aircraft perform a particular procedure based on coded information in the navigation database. This coded information includes type of waypoint (Fly-over or Fly-by), Aeronautical Radio Inc. (ARINC 424) leg type, and speed-altitude restriction. A difference in the coded data from the original procedure design can result in very different navigational performance. The flight inspector must verify that the flight plan, as derived from the database, matches the procedural plan. Thus, the new NAS instrument procedures require new aircraft flight inspection equipment and new training for certified flight inspectors in order to assure the safety of new public instrument procedures.

AVN has been developing flight procedures that take advantage of space based technology. Aviation Week and Space Technology reported that despite certification delays that have slowed the implementation of new systems, "the agency has already made notable advances toward its goal-developing, flight inspecting, and publishing new GPS approach procedures. As of early April, 2000, 2,756 procedures have been developed, 2,521 have been flight inspected and 2,266 published."

- **CAST INITIATIVES**

AVN was assigned responsibility for the following CAST initiatives:

CAST 4

Develop a plan and initiate implementation for procedure production/revision to address "inclusion of vertical angles" on existing procedures starting with Part 139 airports, runways greater than 5000 ft. and all others. The plan must include the following action items:

a. Ensure appropriate operational (i.e., pilot) input in the design of instrument procedures.
b. Conduct research necessary to determine human factor guidelines for design of instrument procedures.
c. Appropriately apply technology, including high precision terrain/obstacle databases and high speed automated procedure design tools, to produce instrument procedures in a more timely manner with less error.
d. Make greater use of electronic means to transmit and distribute instrument procedures.
e. Implement instrument procedure development priorities that reflect the needs of the entire aviation community. Priorities should be set at a national level with input from general, business, military and commercial aviation.
f. Instrument procedure program staffing and funding levels should accurately reflect the flight procedure workload, i.e. maintenance of current procedures, development/flight inspection of new three-dimensional RNAV procedures, and responding to special industry requests.
g. Deal effectively and proactively with private developers of instrument procedures.

CAST 5
Develop a plan and initiate implementation for organizational processes to ensure that appropriate (developed in accordance with agreed-upon FAA standards and criteria) privately-developed "special" procedures are made available for public use (as public procedures or equivalent mechanism) in a timely manner.

CAST 14
Provide procedure development criteria to support Flight Management System (FMS) equipped aircraft to use LNAV and VNAV.

CAST 17
Develop production plan and initiate implementation for 3D RNAV approach procedures, prioritized based on risk for Part 139 runways, runways >5000, all others.

CAST 18
Rename GPS procedures at Part 139 airports as RNAV procedures and include vertical guidance.

CAST 25
Transition to RNAV/RNP procedure production.

The main thrust of the CAST direction for the AVN organization is to develop a comprehensive instrument approach procedure production plan that enables industry to take advantage of new aircraft and space based navigation technology at the earliest possible time. The remainder of this document is dedicated to projecting the AVN efforts to meet the important goals and needs of the FAA and move toward the vision of the CAST report. The production plan outlines the resources and actions required to achieve the desired results.

3. AVN PRODUCTION PLAN

- **General**

The AVN production plan schedules and prioritizes procedures through 2007. The production schedule specifies a "what by when schedule" that enables the aviation industry to plan for the introduction of new instrument approach procedures. In addition, the AVN production schedule is prioritized based upon risk assessment and contains a matrix that displays the priority as directed by the CAST, i.e. #1 Part 139 runways, #2 runways equal to or greater than 5,000 feet, #3 paved public use runways less than 5,000 feet. The plan takes into consideration the available safety risk factors to mitigate accident rates at airports by using National Transportation Safety Board (NTSB) accident data. This production plan supports the Safer Skies objectives **(CAST #17, 14, and 25).**

The first two fiscal years (2001 – 2002) of the production plan contain specific information about the type of procedure that will be published at an identified *airport and runway end* during *each quarter* of the year. Beginning in the third year (2003), the schedule identifies *the airport and runway end* that will be *published during the year* without a quarterly commitment. The production schedule for the remaining years (2004-2007) contains information on the *airport* that will be addressed during that fiscal year. The schedule will be a "rolling schedule" whereby specific information on airport, runway end and quarterly publication plans will be available for a continuous two year period. It is anticipated that the production schedule will be revised every six months, facilitating industry input and assuring that the agency is as responsive as it can be with the resources that are available **(CAST #4e).**

AVN has developed a comprehensive web site that allows the flying community to access information about the instrument flight procedure production schedule. The web site contains general information about the process of flight procedure production, the current FAA production schedule based upon agency resource commitments, and options for private investment in instrument flight procedure production. **(CAST #4g & 5)** Available on the web-site, on a quarterly basis, will be a listing of Vertical Descent Angle (VDA) additions as they are completed and also the accomplishment of renaming the GPS procedures. (**CAST #4 & 18)** Finally, the site offers a listing of responsible individuals and appropriate contacts. The schedule will be available on the web-site in September/October 2000 to assure the widest distribution of information **(CAST #4a, 4e, & 4g).** This web site can be accessed at: http://www.mmac.jccbi.gov/avn/iap/ and an example can be found in Appendix B of this report.

The AVN production schedule considers the Visual Glide-Slope Indicator (VGSI) installation plans of the Airway Facilities organization. Updated information on the adjustment/alignment of the VGSI angles will also be available on the production schedule web-site.

- **AVN Production and NAS Architecture Integration**

The current FAA NAS architecture is divided into three NAS modernization phases from 1998 to 2015. Each phase identifies the broad framework of the expected introduction of new capabilities, technologies, and procedures. AVN has developed its production plan in full consideration of this document. Phase I and II are the initial focuses of the AVN production plan and deal with the years 2000 through 2007.

- **Current NAS Architecture Modernization Phases** Overview

Phase I (1998-2002) Phase I focuses on sustaining essential air traffic control services and delivering early user benefits. The WAAS will be deployed, and air-to-air surveillance will be introduced. During Phase I the redesign will introduce applications of evolving technologies to *increase exposure* to these systems for both pilots and controllers. For example, *minor airspace modifications* will facilitate advanced navigation procedures and overlays in the terminal and en route domains. This experience will be used to support the use of new procedures and airspace management concepts enabled by these technologies.

Phase II (2003-2007) In Phase II the capabilities of new technologies are examined, weighed, and implemented within the overall architecture of the NAS redesign. In this phase the redesign plan follows *a more rigorous structure for leveraging advanced technologies and procedural changes*. Specifically, this phase concentrates on deploying the next generation of Communications, Navigation, and Surveillance (CNS) equipment and the automation upgrades necessary to accommodate new CNS capabilities. WAAS will be completed to provide more coverage and precision instrument approaches. When WAAS becomes fully operational, an aircraft equipped with GPS/WAAS avionics will be capable of en route navigation and non-precision or precision approaches, without the need for additional avionics. GPS/LAAS avionics will be introduced to use satellite-based CAT II/III precision approaches at over 110 airports. CAT I precision approaches will be at more than 30 other airports that are outside of WAAS coverage or where a higher availability of the precision instrument approaches is needed.

Phase III (2008-2015) Phase III completes the required infrastructure and integration of automation advancements. With satellite navigation, the number of published precision approaches will increase and more runways will be served by precision approaches, enhancing safety. Using the WAAS and LAAS as a reference, Automatic Dependant Surveillance-Broadcast (ADS-B) avionics and cockpit displays with surface maps will enable pilots to taxi in significantly reduced visibility conditions, thus sustaining airport operations. Two important features will be NAS-wide information sharing among users and service providers and "four-dimensional" flight profiles that utilize longitudinal and lateral positions and trajectories as a function of time. In addition, combining GPS with cockpit electronic terrain maps and ground proximity warning systems can help pilots avoid controlled flight into terrain.

To reach the initiatives outlined in the three phases of the NAS modernization, AVN has developed four options for its instrument production plan. Each option depends on different resource requirements. The production output for each alternative is clearly indicated facilitating various choices for the commitment of FAA funds.

- **AVN Production Plan Options**

The development rate of "New NAS" instrument approach flight procedures is dependent upon a variety of government and private industry decisions. The availability of resources within AVN (staffing and automation tools) is the variable most closely tied to production capability. As the number of flight procedures continues to grow, AVN must devote increased resources to maintaining existing procedures and procedure updates. Procedure maintenance involves:

analysis of the potential impact of new construction on safe flight altitudes, redrafting approaches due to facility relocation, departure and approach redesign due to magnetic variation facility rotation, issuing Notices To Airmen (NOTAMs), and developing amendments to published procedures due to Air Traffic Control (ATC) airspace changes. These changes/amendments typically average 8 hours per procedure per year. Therefore, as new flight procedures are added to the NAS, the maintenance requirements continue to grow. The chart on page 13 illustrates the current trend and diminishing capacity for the workforce to develop new instrument flight procedures.

AVN has developed four potential options for new instrument flight procedure production, which require various levels of agency investment. These production schedules fully account for the maintenance related issues associated with the expanding number of instrument flight procedures as outlined above.

Option 1: Authorized FY00 staffing through 2007.
Option 2: Implementation of new automation initiatives beginning in FY02 (Option #1 staffing).
Option 3: Expansion of FY00 staffing at a variable rate per year .
Option 4: Combination of staffing expansion and new automation beginning in FY01/02.

Specifically:

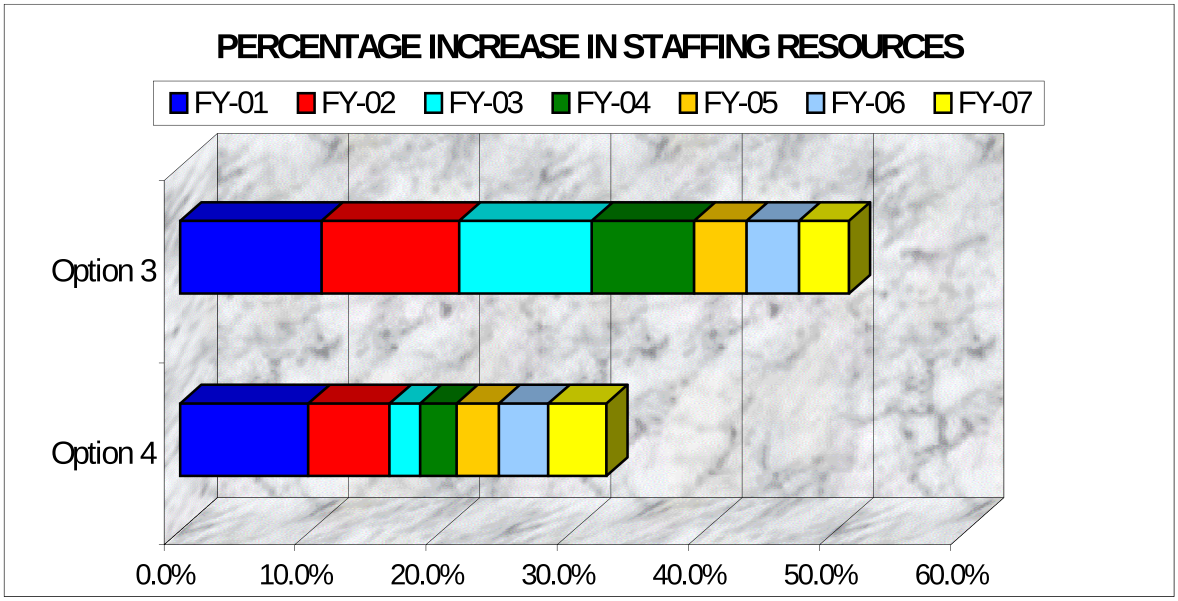
Option 1 is a production schedule that is based upon an increase in staffing at the National Flight Procedures Office to the FY00 authorized level of 129.

Option 2 is a production schedule that is based upon the staffing description outlined in Option 1, but also includes new automation capability. The specific automation requirements are outlined in Section 5. As aviation increases its dependency on space-based navigation and aircraft flight management systems (FMS), data accuracy becomes even more critical. Thus, this option also improves the operational safety of the new NAS in addition to accelerating the production schedule.

Option 3 is a production schedule based upon a continuous staffing increase (variable rate) at the National Flight Procedures Office through FY07. The first staffing adjustment (FY01 – FY04) addresses the 43% growth of the procedures base of the NAS, since FY95. (Note: From FY95 - FY00, staffing levels have *decreased by 10%*). The increase staffing planned for FY05 – FY07 accommodates the growth in the maintenance requirements, thereby enabling the continued NAS growth through FY07.

Option 4 is a production schedule based upon investment in both the staffing increases of Option 3 and the automation initiatives of Option 2. Option 4 yields the greatest increase in procedural production capability. The initial Option 3 staffing (FY01 – FY04) is accomplished in the first two years (FY01 and FY02). There is a requirement for an incremental rise in the staffing level beginning in FY03, in order to accommodate the growth in the required flight procedure maintenance as the NAS expands. The adjustment period and the percentage of adjustment are both reduced based on the efficiencies that will be realized after FY02 from the implementation of the automation initiatives of Option 2. Automation also results in the total staffing increase to be less than that of Option 3 while the production schedule is *accelerated* through the period.

The following chart completes the yearly percentage staffing growth in Options 3 and 4:



The following options each result in a different expected completion dates of instrument flight procedures. **(CAST #4f).** The tables that follow are organized by NTSB air carrier safety risk factors (high, medium and low) for FAR 139 Airports, runways equal to or greater than 5,000 feet, and paved public use runways less than 5,000 feet. Two FAA investment alternatives associated with *each option* can be found in the investment summary in Section 8.

Option 1 Completion Dates

Authorized FY00 staffing levels through 2007

NTSB RATED AIR CARRIER OPS	HIGH RISK	MED RISK	LOW RISK	REMAINING
• PART 139 Runways	2002	2005	2007	2015
• Runways ≥ 5000 feet	N/A	N/A	N/A	Beyond 2015
• Paved Public Use <5K ft	N/A	N/A	N/A	Beyond 2015

*New work capability decreases by 15% per year (beginning in FY-01) due to growth in procedure maintenance/update workloads (see graph on page 13)

Option 2 Completion Dates

New automation investments (FY-01 Implementation beginning in FY02)

NTSB RATED AIR CARRIER OPS	HIGH RISK	MED RISK	LOW RISK	REMAINING
• PART 139 Runways	2002	2004	2006	2013
• Runways ≥ 5000 feet	N/A	N/A	N/A	Beyond 2015
• Paved Public Use <5K ft	N/A	N/A	N/A	Beyond 2015

Note: Staffing is the same as in Option 1

Option 3 Completion Dates

FY00 staffing increased above current authorized level (Beginning FY01 through FY07)

NTSB RATED AIR CARRIER OPS	HIGH RISK	MED RISK	LOW RISK	REMAINING
• PART 139 Runways	2002	2003	2005	2010
• Runways ≥ 5000 feet	N/A	N/A	N/A	Beyond 2015
• Paved Public Use <5K ft	N/A	N/A	N/A	Beyond 2015

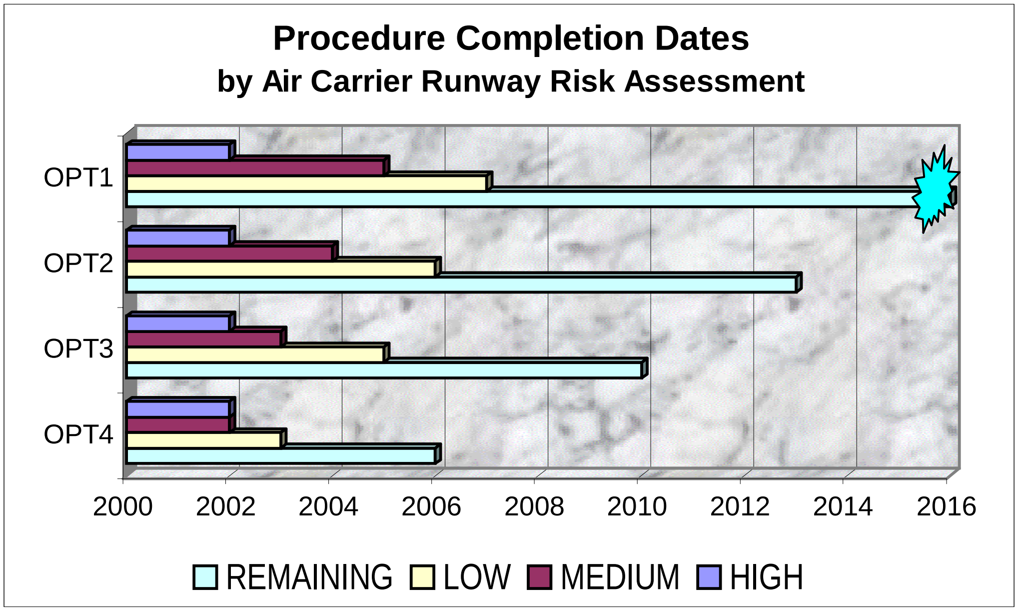
Option 4 Completion Dates

Combination of Options 2 and 3

NTSB RATED AIR CARRIER OPS	HIGH RISK	MED RISK	LOW RISK	REMAINING
• PART 139 Runways	2002	2002	2003	2006
• Runways ≥ 5000 feet	N/A	N/A	N/A	2010
• Paved Public Use <5K ft	N/A	N/A	N/A	2015

Note: Each AVN production plan option requires a corresponding capability of flight inspection aircraft. AVN aircraft are currently being equipped to flight inspect the LNAV and VNAV approaches. Aircraft modification requirements are outlined for each option in the Flight Inspection Impact Analysis in Section 6 of this report.

A summary of the four options of the AVN production plan (Part 139 airports) is shown below:



The completion of Vertical Descent Angle (VDA) additions have been scheduled in phases. Phase I includes all non-precision approaches at Part 139 airport runways without precision approaches. Phase II includes the remaining non-precision approaches at Part 139 runways and non-precision approaches for runways 5000 ft or greater at Non-Part 139 airports. Phase III includes all other non-precision approaches for public paved runways less than 5000 ft. The following chart depicts the completion of the VDA's based on the same assumptions listed in the above options. **(CAST #4)**

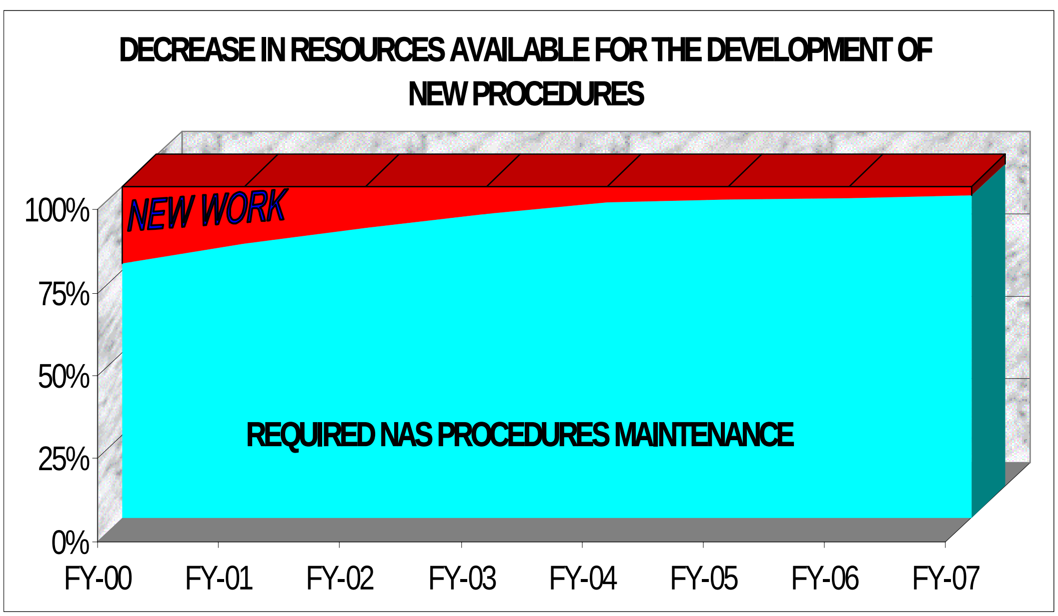
VDA ADDITIONS	PHASE I	PHASE II	PHASE III
Option 1	2002	2005	2010
Option 2	2002	2004	2008
Option 3	2002	2003	2007
Option 4	2002	2003	2005

To date AVN has completed 60% Phase I, 40% Phase II, and less than 10% of Phase III.

4. STAFFING ANALYSIS

The NAS has grown significantly in recent years while the number of flight procedures specialists has declined due to budgetary restrictions and hiring freezes. Specifically, the number of procedure specialists has decreased by 10% since 1995 while the NAS has expanded by 43%. The NAS must continue to grow to accommodate increased passenger and corporate business travel. FAA forecast data suggest that if industry profits continue to rise, the correlation between profits and business travel will become more pronounced. As a result, greater demand will be placed on regional airports as well as air carrier airports. Specifically, FAA has identified 806 regional airports located in 46 states throughout the U.S. that need to expand during the next 10 years to handle increased aviation activity. The National Air Transportation Association (NATA) estimates the cost to develop these 806 airports at $3.3 billion which includes funding to increase capacity, resurface runways and *establish instrument approach procedures.* Thus, the demand for instrument approach procedures is likely to increase in coming years for many general aviation airports.

AVN productivity has increased significantly during the past several years. Specifically, the number of procedures per specialist has grown by 23% per year between 1997 and 2000; however the anticipated growth of the NAS cannot be accomplished solely by productivity increases. The Safer Skies initiatives require growth in the number of new precision approach procedures; however procedure maintenance will reduce and ultimately eliminate AVN's ability to develop new procedures unless changes are made in the current direction. The chart below represents the impact procedure maintenance will have on the current organizational capability to develop new flight procedures unless interventions occur.



5. AUTOMATION ANALYSIS

Next Generation High Speed Procedure Design Tools

The Instrument Approach Procedures Automation (IAPA) program has been in effect since the mid 70's. It has evolved from a mini-computer operating on a main frame to a distributed workstation environment using the UNIX operating system. This system has become extremely costly to operate and maintain. The original IAPA program could only develop a Non-directional Beacon (NDB) NO-Final Approach Fix(FAF) approach. The current program is certified to develop NDB/VOR on and off airport, FAF and NO-FAF, ILS, MLS, GPS for turns less than 15°and WAAS Precision approach procedures. It will also be certified for LNAV/VNAV procedures by the end of August 2000. The current workstations are nearing the end of the "life cycle" (FY04). The process for a replacement system has begun. The next generation IAPA software will provide the procedures specialist with digitized terrain maps, NAVAIDs, fixes, runways and natural and man made obstacles and operate from a state-of-the-art PC platform. In addition, the tool will contain DME/DME evaluation capability and provide a comprehensive safety evaluation (TERPS assessment) of any proposed flight procedure. Finally, the next generation IAPA software will permit an initial look at the fly-ability of a proposed flight procedure before the procedure is designed and flight inspected because it will account for specific aircraft characteristics and human factors performance issues. Thus, the next generation software will save significant expenditures in staffing and aircraft operating costs while improving operational safety and industry acceptance of flight procedures. **(CAST #4b).**

AVN obligated $50,000 in April 2000 for a "proof of concept" study which will be complete in October. Beginning in FY01, AVN recommends and plans an aggressive effort to fully implement the next generation flight procedures design tool as recommended by the CAST. This effort is expected to take approximately 30 months at an estimated cost of $2.6 million. The schedule for implementation is as follows:

Event	Projected Completion Date
Fiscal Year 2000	
Feasibility study	September 2000
Fiscal Year 2001	
Purchase prototype systems	October 2000
Port existing IAPA2 program & testing	September 2001
Fiscal Year 2002	
Certification Testing	July 2001
RFP for systems	September 2001
Fiscal Year 2003	
Training Specialists	May 2002
Implementation Complete	September 2002

- **Obstruction Evaluation (OE) Initiatives**

New tools are required to assess the impact of proposed obstacles on the NAS. The mitigation of the effects of obstacles is important for the development, maintenance, and update of instrument flight procedures. AVN studies each proposed obstacle to determine the obstacle's impact on planned or existing Instrument Flight Rules (IFR) procedures and/or to determine the maximum allowable height that can be accommodated without impact to the navigable airspace. Recommendations to accommodate the object without affect and/or with reduced affects are forwarded to Air Traffic (AT) for discussion/negotiation with the proponent. Labor intensive analyses and searches of various aeronautical records, databases, publications, and maps are currently conducted in order to determine if objects proposed for construction or alteration affect the safe and efficient use of the airspace. An internal FAA 1985 study indicated that the time required for AVN to evaluate and process a single obstruction case was four hours. The process has not changed since the study. During FY-1999 more than 26,000 studies of proposed obstacles were conducted by AVN. The number of assessments completed in FY 2000 will be in excess of 30,000 – a 15% growth over FY99. This growing quantity of OE work has substantially curtailed the ability of AVN personnel assigned in the various FAA Regions to work with the aviation community. The increase is expected to continue at the same rate over the next five years for the following reasons:

- Growing number of cellular telephone towers
- Federal Communication Commission (FCC) commitment to high definition television increasing the number of towers
- Insurers' requirements for recurrent obstacle assessments for liability purposes
- Obstacle assessments of existing structures due to telecommunications mergers

In addition, the planned dramatic increase in the number of RNAV (LNAV/VNAV, FMS) instrument approach procedures is likely to increase the risk of human error in the obstacle assessment process due to the complexity of RNAV procedure design criteria. The current practice of evaluating an increasingly large volume of OE cases using manual analysis techniques is not feasible, nor cost efficient. Error or inadequate processing of an OE case can result in safety degradation and/or reduced airport access and adverse economic impact to the aviation industry. Some examples are:

- *Collisions with obstacles while flying an **approved*** instrument procedure.
- Increased instrument approach minimums, en-route altitudes, holding altitudes, and/or minimum radar vectoring altitudes.
- Cancellation of an instrument approach, departure, route, or fix.
- Increased instrument flight procedure complexity i.e., high descent rates and/or climb gradients, reduced turning areas or restricted circling areas.
- Unnecessary aircraft equipment requirements

Today's computer technology makes it feasible to perform many, if not all, OE analyses using automated methods at potentially greater speed, accuracy, and at reduced cost. **(CAST #4c)**

AVN is currently working with the private sector to test and evaluate an automated OE capability on a limited scale. The test, which will focus only on AVN responsibilities associated with the OE process, is intended to provide supporting data for determining the most efficient and cost effective course of action including:

- Private sector evaluation of OE cases under FAA contract.
- Continue FAA evaluation of OE cases using government automation tools to be developed as part of these OE initiatives.
- FAA evaluation of less complex OE cases (approximately 25%) using relatively simple yet to be developed government automated screening tools and, private sector evaluation of more complex cases requiring detailed study (approximately 75%).

In summary, an automated method of performing OE analyses is required to:

- accommodate the growing number of OE cases within the timeframe expected by our customers **(CAST #4e)**
- accurately assess safety implications of complex RNAV instrument procedures **(CAST #4c, 25)**
- increase the speed and accuracy of obstacle data processing so that instrument flight procedures and NOTAMS always consider and correct obstacle data **(CAST #4c)**
- permit resources to be redirected to work with the aviation community on instrument procedure design issues **(CAST #4a, 4f, 4g)**

The resources required to address the issues outlined above can be found in Section 8 of this report.

- **Database Integration Issues**

Recently, a jury sided with American Airlines in blaming the 1995 crash of a Boeing 757 near Cali, Colombia on a faulty database. American contended that a defective database led the flight from the safety of the valley and into the mountains where the tragedy occurred. In addition, five other lawsuits related to accidents blamed, in part, on alleged data errors or data inadequacies are currently pending in US courts. FMS systems are increasingly being used by air carrier and business aviation for departure, en-route and instrument approach aircraft guidance. Jeppesen charts are already available on CD-ROM and the company is working on ways to deliver them to a “paperless cockpit” through built- in systems or portable units. Thus, the issue of data integrity is extremely important.

A pivotal capability required to implement significant improvements is a well-structured database. There isn’t any aeronautical database that has implemented the structures and relational constraints to fully satisfy the need for improved procedures data processes and the associated forms across FAA organizational lines. Failure to address existing data synchronization and quality issues increasingly jeopardizes aviation safety. In addition, automating data flows will reduce the amount of time spent in data collection and increase the time available for data quality assurance, thereby improving safety. **(CAST #4d)**

There are various sources for obstruction data including National Geodetic Survey (NGS), National Ocean Service (NOS), FCC, and the FAA Regions. Uncoordinated and/or inferior data collection and dissemination processes lead to inconsistent and inadequate data quality for users. In some cases users of data will accept data sources without validation thereby corrupting agency databases. For example, inaccurate airport data has been found to have been entered into the National Airspace System Resources (NASR) because the data collector was considered authorized to submit the data. This situation occurs because: (1) survey data from the states varies depending on the source and usually is less accurate than NGS surveys; (2) airport surveys are not required before beginning procedure development; (3) relevant FAA Orders do not establish primary data responsibility and coordination processes **(CAST #4c).**

As the NAS moves from a fixed-based navigation system to a system requiring coordinates, the need for consistent coordinates is essential to support safe flight operations. The National Spatial Reference System (NSRS), defined and managed by the NGS, provides this consistent national coordinate system.

The NSRS specifies latitude, longitude, height, scale, gravity, and orientation throughout the nation, as well as how these values change with time. This reference system provides the physical link between the WAAS, LAAS, runway coordinates, and waypoints for procedure development, thereby laying the foundation of a consistent reference system to support the "New NAS."

To establish consistent coordinates for runways, navigational aids, obstructions, taxiways, and other airport features, established procedures and accuracy standards for surveying are required. All surveys, including those that provide data in support of the development of Airport Layout Plans, should be performed using established standards. Specification documents, such as the FAA No. 405, Standards for Aeronautical Surveys and Related Products and RTCA/DO-201A, Standards for Aeronautical Information, provide data accuracy specifications for aeronautical data. Conformance to these specification documents assures consistency among all mapping, charting, and survey elements engaged in a coordinated production and maintenance program for aeronautical data.

All data should have traceability. Data traceability is the ability to track the history of the data, the application, and the information acquisition methodology by a means of records. Specifically, it is the degree to which a system or data product can provide a record of the changes to that product and thereby enable an audit trail to be followed from the data originator. This data should include, but is not limited to, the following information: horizontal and vertical data datums, and geoid modeling information. This history data is usually referred to as Metadata. This information is a valuable tool when comparing different databases and checking for data inconsistencies.

The "New NAS" requires the investment in both systems integration and the automation of aviation data for safety and liability purposes as well an automated electronic means of information transmission. Automating data flows will reduce the amount of time spent in AVN data collection and decrease the procedure production, maintenance, and update times because the current system is dependent upon a "manual forms" process. The current paper 8260 series of forms are used to communicate a wide variety of data associated with several types of products (e.g. SIAPs, holding patterns, fixes, NAVAIDs and airways). Other types of data are similarly managed using paper forms: Expanded Service Volume (ESV) requests are submitted and processed on FAA

Form 6050-4, Standard Instrument Departure (SID) route data is recorded and transmitted using Form 7100-4, Standard Terminal Automation Replacement System (STAR) data is recorded and transmitted on Form 7100-3, and paper is used to fax NOTAM information to the National Flight Data Center (NFDC) for manual input into the NOTAM system. These forms and related manual data management processes introduce a significant potential for inaccurate data being entered into the system. The ability to provide a fully automated product would greatly enhance the publication process and be instrumental in providing information to the aviation industry.
(CAST #4 c,d, & e)

AVN initiated an assessment to develop a roadmap for solutions to the database integration challenges identified above. A comprehensive list of issues was addressed in the *Assessment and Analysis of Aeronautical Databases* project completed in February 2000. The analysis focused upon system-level capabilities and limitations and included a comparision of relevant data structures to assess the possibility of enhancing data transfer mechanisms between existing databases. This study supports the FAA and NAS Information Architecture objectives of:

- Streamlining information flows and processes by eliminating duplicate data entry and integrating new capabilities within existing end-user environments
- Transitioning to electronic data transfer thereby eliminating the dependence on paper forms and reducing data re-entry error
- Synchronizing databases thereby reducing or eliminating the use of erroneous or out-of-date information

As a result of the February 2000 study, several technical options for a data transfer architecture between AVN, NFDC and NGS/NOS are being considered. These include:

- *Distributed databases* – provide for non-redundant storage, but would generally be limited by performance and recovery problems.
- *File based data transfers* – provide complete de-coupling of systems that can be standardized through the use of external software, data translation and transport mechanisms.
- *Database replication* – supported by Commercial Off The Shelf (COTS) software developed entirely within the database and require some software development and data translation.

A phased program to develop data transfer mechanisms between AVN, NFDC and NOS has the greatest possibility of success if it is initiated in small "manageable increments," that are completed within a 12 month development duration. The AVN program considers existing and planned activities at AVN, NFDC and NOS. This development strategy is intended to reduce the risk, deploy visible and usable components quickly, get users involved in product evaluation, and recognize the realities of limited budgets. Phase I focuses upon the development of the "procedures data model", the design and testing of the replication architecture and the transfer of facility data limited to form 8260 data. Phase II completes the development of all 8260-related data transfers and, in addition, fully deploys the NASR to AirNav interface for obstacle and survey data. Upon the completion of Phase II, the AVN and NFDC data transfer is fully automated. NOS and NFDC transfers are automated, but with a lesser degree of system integration. **(CAST #4d)**

Finally, AVN is integrating its information with Airway Facilities in order to check the vertical path and visual glide slope indicators and identify procedures that do not accommodate the nominal 3-degree slopes. The tools will define an appropriate vertical angle for each instrument procedure and code it in the navigational database. **(CAST #4e)**

The recommendations outlined in section 5 (next generation software, obstacle evaluation and database integration improvement) are incorporated into the flight procedure production schedules outlined under Options #2 and #4 in this report. A summary of the costs associated with these three initiatives can be found in the investment summary (Section 8) of this report.

- **AVN Web Site**

AVN has developed a comprehensive web site that allows the flying community to access information about the instrument flight procedure production schedule (See appendix B for a sample of the production schedule). In addition, the web site provides information on the standards and process for obtaining an instrument flight procedure. Information on funding the development of an instrument flight procedure is also available at the site. The AVN flight procedure production schedule will be posted on the web site in September/October. Currently, the web site is operational and can be accessed at: http://www.mmac.jccbi.gov/avn/iap/**.** (**CAST #4a, 4e, & 4g).**

6. FLIGHT INSPECTION AIRCRAFT MODERNIZATION (Impact Analysis)

AVN operates a fleet of thirty-three (33) flight inspection aircraft in support of NAS, Department of Defense (DOD), and international commitments. These aircraft vary in their sophistication. The Challenger CL-601-3R's and Lear 60's have the latest technology including state-of-the-art FMS's, Auto-Pilots, etc., and are currently equipped to provide LNAV and VNAV capabilities. In addition, the Lears are presently equipped to provide limited WAAS flight inspection capability through prototype receivers. This capability is integrated into the Automatic Flight Inspection System (AFIS). This should allow AVN to meet the early demands of the WAAS in NAS Architecture Phase I activities. However, once this system begins to develop, a certified receiver will be needed to meet the expanding demands. The receiver must also be integrated into the CL-601-3R's, BAe 125-800's, and BE-300's. In addition, as this system evolves, the BAe 125-800 and BE-300 fleets will require extensive service-life-extension programs to bring their capability in line with the New NAS (Spaced Based NAS). As currently equipped, neither of these two aircraft are capable of providing an integrated solution that supports LNAV and VNAV operations. **(CAST #14)**

LAAS will be introduced during NAS Architecture Phase II along with other CNS equipment and will require the integration of these equipment types into the entire fleet. The BE-300 and BAe-800 will require an extensive service-life-extension program as the current systems only support the (Old NAS) ground based systems. The current FMS, Auto-Pilot, Flight Director, and Electronic Flight Instrument Systems will need to be provided to support the activities during Phase II and Phase III of the NAS Architecture.

Current funding levels will need to be substantially elevated to procure the above equipage. Recent trends in funding aircraft equipment upgrades indicate this could pose substantial risk to the successful upgrade of the NAS.

Aircraft flight inspection scheduling is currently organized to minimize the amount of duplicative enroute flight hours. Two alternatives exist regarding the modernization of flight inspection aircraft in order to meet the production schedules outlined within the four production options. Alternative A maintains the current scheduling philosophy. Alternative B alters the current philosophy. A brief description follows:

Alternative A: Requires investment in the modernization of the "Old NAS" flight inspection aircraft on a "just in time" basis in order to meet the growing LNAV/VNAV production schedules. This alternative preserves the current efficient scheduling practices that minimize the amount of duplicative enroute flight hours.

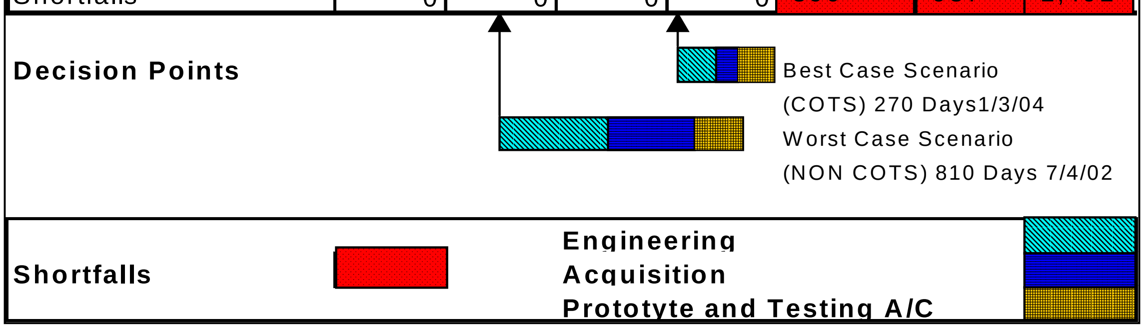
Alternative B: Defers aircraft modernization investment funding beyond FY04 and alters the current efficient scheduling philosophy. Under this alternative, currently equipped "New NAS" aircraft complete the growing "New NAS" work while "Old NAS" aircraft complete the "Old NAS" work. Additional aircraft operational costs occur due to an increase in flight ops hours (additional en-route flight time); however, agency expenditures of Facilities and Equipment (F&E) dollars are delayed. Although this alternative defers the expenditure of aircraft modernization funds, it will become cost prohibitive as the LNAV/VNAV flight hour shortfall grows through FY07 as outlined on the following pages.

The charts below outline the anticipated aircraft flight hour shortfalls for flight inspection LNAV/VNAV procedures under each option of the AVN production plan. The charts also portray when FAA must provide funding for aircraft modification in order to enable engineering, acquisition and testing to be completed. For example, under Option 1 the FAA anticipates a flight hour shortfall of 390 hours in FY05 (i.e. LNAV/VNAV aircraft are fully utilized and not available for further LNAV/VNAV flight inspection). The chart also portrays the best case scenario under Option 1 which occurs if COTS equipment is available enabling the FAA to wait until January of 2004 to provide funding for the modernization. On the other hand, if non COTS equipment is required, the funding must be provided in mid 2002 to meet the aircraft flight hour shortfall. The flight hour shortfalls are portrayed on the charts, as well as the specific timeframes when aircraft modernization funding is required in order to meet the anticipated flight hour shortfall.

OPTION 1 "New NAS" FLIGHT HOUR SHORTFALL

Total Flight Hour Requirements Old/New NAS

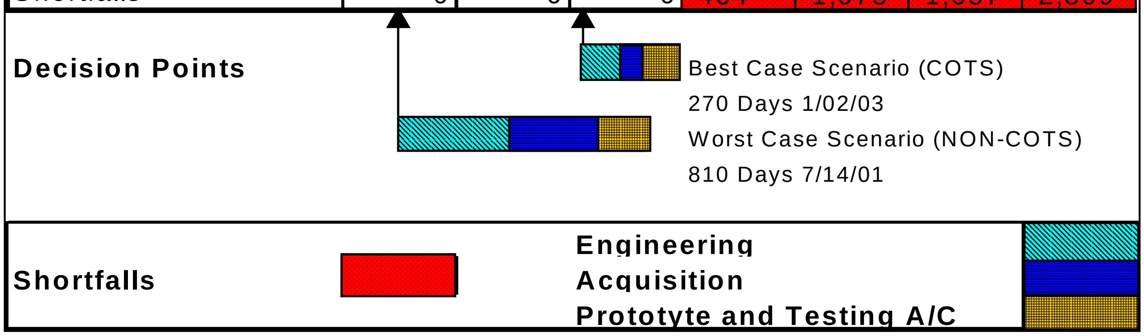
	FY01	FY02	FY03	FY04	FY05	FY06	FY07
Old and New NAS Flight Hours	16,363	16,836	17,314	17,849	18,390	18,937	19,491
New NAS Flight Hour Shortfalls	0	0	0	0	-390	-937	-1,491



The chart on the following page represents the timeframes involved with both options 2 and 3. The increase in flight procedures results in the need to accelerate aircraft modification to address the accelerated/increased flight hour shortfall.

OPTIONS 2 AND 3 "New NAS" FLIGHT HOUR SHORTFALL

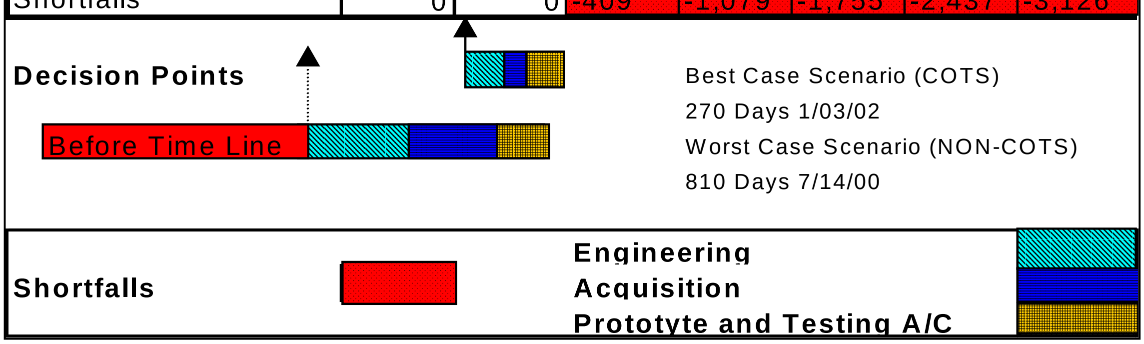
Total Flight Hour Requirements Old/New NAS							
	FY01	FY02	FY03	FY04	FY05	FY06	FY07
Old and New NAS Flight Hours	16,805	17,331	17,861	18,464	19,073	19,687	20,309
New NAS Flight Hour Shortfalls	0	0	0	-464	-1,073	-1,687	-2,309



Under Option 4, the capacity to develop flight procedures increases and further accelerates the required aircraft modernization schedule. Since the non-COTS scenario under this option has already passed, Alternative B is the only alternative for addressing the situation.

OPTION 4 "New NAS" FLIGHT HOUR SHORTFALL

Total Flight Hour Requirements Old/New NAS							
	FY01	FY02	FY03	FY04	FY05	FY06	FY07
Old and New NAS Flight Hours	17,248	17,826	18,409	19,079	19,755	20,437	21,126
New NAS Flight Hour Shortfalls	0	0	-409	-1,079	-1,755	-2,437	-3,126



In summary, alternatives A or B are available for each of the four flight procedure production options and either can address the anticipated flight hour shortfall. Specific costs associated with alternatives A and B for each production option are detailed in Section 8 (Investment Summary) of this document thereby enabling FAA policy makers the opportunity to make informed and thoughtful decisions.

7. PRIVATE INVESTMENT IN PROCEDURE DESIGN

- **Integrating New Flight Procedures into the NAS**

AVN has traditionally been responsible for public instrument flight procedure development in the United States. Developing an instrument procedure is only one step of an intricate process to implement a new approach or departure procedure for public use or as a special authorization for a proponent. Designing an approach procedure that meets all the design criteria is complex; however, the integration of the procedure into the NAS is complicated as well. The integration process often dictates the design, limitations, and use of the flight procedure. For example, items that must be considered/coordinated before procedures can be utilized are:

• Video Map Changes	• Aircrew Training	• NOTAM Issues	• Environ. Assessment
• Survey Data	• Union Coordination	• Controlled Airspace	• Fly-ability
• Design Criteria	• Controller Training	• Airport Layout	• Maneuverability
• Obstacle Protection	• RNP Requirements	• Airport Facilities	• Flight Inspection
• AT Operating Procedures			

The evolution of the NAS to RNAV/RNP has increased the number and complexity of the flight procedures necessitating the documentation of a new coordination process involving many various parts of the FAA. Specifically, Flight Standards, Air Traffic and the Aviation System Standards organizations have drafted a National Order that establishes a Regional Airspace/Procedure Integration Team in each FAA region. All procedures, including those that are privately developed under the Convertible Specials Approach Program, will flow into the regional team to ensure the various requirements with sponsors, users, airport operators, and FAA organizations are properly completed thereby enabling the smooth introduction of the procedure into the NAS. (**CAST 25)**

- **TERPS Data Sharing**

A significant concern is the data sources used by non-AVN procedure developers. Current rules do not require developers to use "official" data. Using data from unauthorized sources could introduce significant errors that may not be discovered until AVN flight inspection or may be overlooked entirely. See Data Integration Issues, page 16. **(CAST #5)**

AVN has recently entered into a series of agreements with private concerns to provide IAPA 2 TERPS data via a web site. AVN will also assist the companies by providing them information on software/hardware requirements needed to receive the data. These reimbursable agreement requests are increasing as private concerns begin to utilize the TERPS information. **(CAST #4e) (CAST #4g) (CAST #5) (CAST #17)**

- **Convertible Specials**

The FAA has initiated a new program called "Convertible Specials". A convertible special is a special (private) instrument approach procedure that is issued to an air carrier(s) or other aviation proponents and it is paid for by private industry. The FAA, the proponent, or the proponent's agent can develop the procedure; however, the procedure must be developed in accordance with FAR 97 Standards and the latest FAA policies and guidance. The FAA (AVN) completes quality control and flight inspection of the procedure and the procedure is integrated in the NAS through the Regional Airspace/Procedure Integration Team process outlined above. The "convertible special program" provides users a method to obtain an RNAV approach procedures earlier than the posted production schedule on the FAA web site. It also avoids all publication delays because it is issued as a special procedure by the principal operations inspector and is not dependant upon NOAA. The proponent reimburses the government for the direct costs incurred in processing the convertible special approach procedures through a reimbursable agreement. The detailed process and costs typically associated with this option are outlined on the FAA web site. Convertible specials can be converted to public procedures with the agreement of the proponent and when FAA resources permit. **(CAST #4g)**

- **Helicopter Approach Plan**

HR 1000, as signed by the President in *SEC.103.FAA OPERATIONS,* revises section 106(k)(2)(D) and authorizes FAA to spend "Such sums as may be necessary for FY 2000 through 2003 to establish helicopter approach procedures using current technologies (such as Global Positioning System) to support all-weather, Emergency Medical Service (EMS) for trauma patients". (*This is an un-funded mandate at this time as no funds have been appropriated for FY01 for this initiative.)*
CAST #4e, 4f)

The total universe of EMS helicopter procedures is estimated at 5,000. An estimated 2,000 EMS GPS approach requests are expected within the next 8 to 10 years. These procedures enable EMS helicopters to provide for the movement of critically injured/ill patients to health care facilities throughout the United States. The availability of special GPS procedures allows the helicopters to continue operating in IFR conditions and results in saving numerous lives. **(CAST #4e)**

AVN has initiated steps to put contracts in place with commercial developers to begin survey, charting, procedure development, and flight inspection of EMS helicopter approaches. These approaches will operate from a GPS point in space and allow IFR approaches into the medical facility. Finally, the FAA is waiving the cost of quality control review for these privately developed EMS procedures throughout the period of the reauthorization language (FY01-FY03) in order to address the "Congressional intent" of the FAA reauthorization language. **(CAST #4f and g)**
(CAST #5)

8. INVESTMENT SUMMARY

The associated costs of the various production plan options (FY01-FY04) are outlined below. The costs of the staffing, training, automation, as well as aircraft equipment modernization investment (Alternatives A or B) are summarized in order to meet the associated production schedules.

OPTION 1 FY00 STAFFING LEVEL

FY00 staffing is currently 7 below the authorized level of 129. The cost of staffing to the FY00 level is $586,516 and the cost of training is $132,979 in 01. There are no additional investment costs associated with automation or aircraft modernization through FY04 with this option.

OPTION 2 AUTOMATION INVESTMENT

Alternative A

Costs to achieve the AVN Production Plan under this alternative require modernization of the "old NAS" flight inspection aircraft in order to meet the growing LNAV/VNAV needs.

OPS				F&E		
	Staffing	Training	A/C Ops	Automation	A/C Equip	Total
01	$ 586,516**	$ 132,979**	$	$ 2,429,000	$	$ 3,148,495
02	$	$	$	$ 3,410,000	$	$ 3,410,000
03	$	$	$	$ 571,000	$	$ 571,000
04	$	$	$	$ 200,000	$ 17,932,000*****	$ 18,132,000
Total	$ 586,516	$ 132,979		$ 6,610,000	$ 17,932,000*	
GRAND TOTAL						**$ 25,261,495**

* Includes $15,000,000 for Non Recurring Engineering (NRE) support costed up front.
**Cost of bringing staffing up to 00 authorized as well as training new hires.

OPTION 2 AUTOMATION INVESTMENT

Alternative B

Costs to achieve the AVN Production Plan under this alternative:

- Delay aircraft modernization funding beyond FY04
- Utilize currently equipped new NAS aircraft complete new NAS work
- Utilize currently equipped old NAS aircraft complete old NAS work
- Add aircraft ops costs due to increase in flight ops hours (en route)

OPS				F&E		
	Staffing	Training	A/C Ops	Automation	A/C Equip	Total
01	$ 586,516*	$ 132,979*	$	$ 2,429,000	$	$ 3,148,495
02	$	$	$	$ 3,410,000	$	$ 3,410,000
03	$	$	$ 610,887	$ 571,000	$	$ 1,181,887
04	$	$	$ 789,802	$ 200,000	$	$ 989,802
Total	$ 586,516	$ 132,979	$1,400,689	$ 6,610,000	$	
GRAND TOTAL						**$ 8,730,184**

*Cost of bringing staffing up to 00 authorized as well as training new hires.

OPTION 3 INCREASED STAFFING (FY01-FY04)

Alternative A
Costs to achieve the AVN Production Plan under this alternative require modernization of the "old NAS" flight inspection aircraft in order to meet the growing LNAV/VNAV needs.

OPS				F&E		
	Staffing	Training	A/C Ops	Automation	A/C Equip	Total
01	$ 1,931,568**	$ 268,620**	$	$	$	$ 2,200,188
02	$ 1,288,344	$ 138,354	$	$	$	$ 1,426,698
03	$ 1,686,402	$ 161,281	$	$	$	$ 1,847,683
04	$ 1,417,608	$ 143,944	$	$	$ 17,932,000*	$19,493,552
Total	$ 6,323,922	$ 712,199	$	$	$ 17,932,000*	
GRAND TOTAL						**$ 24,968,121**

*Includes $15,000,000 up-front for Non Recurring Engineering (NRE) support costed up front.
**Cost of bringing staffing up to 00 authorized as well as training new hires.

OPTION 3 INCREASED STAFFING (FY01-FY04)

Alternative B
Costs to achieve the AVN Production Plan under this alternative:

- Delay aircraft modernization funding beyond FY04
- Utilize currently equipped new NAS aircraft complete new NAS work
- Utilize currently equipped old NAS aircraft complete old NAS work
- Add aircraft ops costs due to increase in flight ops hours (en route)

OPS				F&E		
	Staffing	Training	A/C Ops	Automation	A/C Equip	Total
01	$ 1,931,568*	$ 268,620*	$	$	$	$ 2,200,188
02	$ 1,288,344	$ 138,354	$	$	$	$ 1,426,698
03	$ 1,686,402	$ 161,281	$ 610,887	$	$	$ 2,458,570
04	$ 1,417,608	$ 143,944	$ 789,802	$	$	$ 2,351,354
Total	$ 6,323,922	$ 712,199	$1,400,689	$	$	
GRAND TOTAL						**$ 8,436,810**

*Cost of bringing staffing up to 00 authorized as well as training new hires.

OPTION 4 STAFFING AND AUTOMATION (OPTIONS 2 AND 3)

Alternative A

Costs to achieve the AVN Production Plan under this alternative require modernization of the "old NAS" flight inspection aircraft in order to meet the growing LNAV/VNAV needs.

	OPS			**F&E**		
	Staffing	**Training**	**A/C Ops**	**Automation**	**A/C Equip**	**Total**
01	$ 1,783,193**	$ 249,243**	$	$ 2,429,000	$	$ 4,461,436
02	$ 679,838	$ 79,059	$	$ 3,410,000	$	$ 4,168,897
03	$ 534,992	$ 40,320	$	$ 571,000	$ 17,932,000*	$19,078,312
04	$ 418,721	$ 41,127	$	$ 200,000	$ 5,494,400	$ 6,154,248
Total	$ 3,416,744	$ 409,749	$	$ 6,610,000	$ 23,426,400	
GRAND TOTAL						**$ 33,862,893**

*Includes $15,000,000 for Non Recurring Engineering (NRE) support costed up front.
**Cost of bringing staffing up to 00 authorized as well as training new hires.

OPTION 4 STAFFING AND AUTOMATION (OPTIONS 2 AND 3)

Alternative B

Costs to achieve the AVN Production Plan under this alternative:

- Delay aircraft modernization funding beyond FY04
- Utilize currently equipped new NAS aircraft complete new NAS work
- Utilize currently equipped old NAS aircraft complete old NAS work
- Add aircraft ops costs due to increase in flight ops hours (en route)

	OPS			**F&E**		
Staffing		**Training**	**A/C Ops**	**Automation**	**A/C Equip**	**Total**
01	$ 1,783,193	$ 249,243	$	$ 2,429,000	$	$ 4,461,436
02	$ 679,838	$ 79,059	$	$ 3,410,000	$	$ 4,168,897
03	$ 534,992	$ 40,320	$ 610,887	$ 571,000	$	$ 1,757,199
04	$ 418,721	$ 41,127	$ 789,802	$ 200,000	$	$ 1,449,650
Total	$ 3,416,744	$ 409,749	$1,400,689	$ 6,610,000	$	
GRAND TOTAL						**$11,837,182**

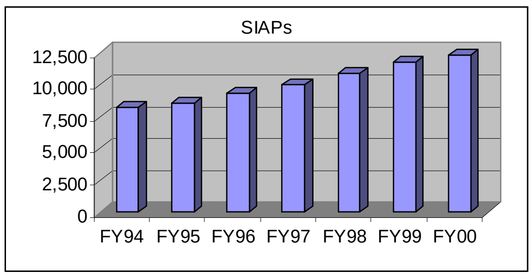
9. APPENDIX A: Fact Sheet

PUBLIC USE AIRPORTS & RUNWAY INFORMATION

AIRPORT TYPE	# OF AIRPORTS	# OF RWY ENDS
• PART 139 Runways	576	2,516
• Public Use Paved Runways ≥ 5000 Ft.	780	3,120
• Public Use Paved Runways < 5000 Ft.	1,300	3,380

NAS
• 29 million square miles • 5,000 flights/day • 2 million passengers/day • 12,300 SIAPs

NAS GROWTH
SIAPs Existing in the NAS



GPS Approach Procedures: **2,756**

Non Precision Approach VDAs: **1,790**

Amendments required to existing SIAPs

FY 98 **1,389**
FY 99 **1,724**
FY 00 **1,941** (estimate)

Obstacle Evaluation analysis completed

FY 99 **26,000**
FY 00 **30,000** (estimate)

NOTAMs issued for existing SIAPS

FY 98 **1,392**
FY 99 **2,778**
FY 00 **3,136** (estimate)

Flight Procedures Staffing (Including Regions)
On Board

FY 95: **135**
FY 00: **122**

US Flight Inspection Fleet

New NAS Aircraft
• Challenger CL-601-3R's: **3** • Lear 60: **6**

Old NAS Aircraft
• BAE 125-800's (USAF): **6** • Beechcraft 300: **18**

AVN Minimum Funding for Maximum Production (Found in Option # 4)
Approximately $3 Million/year (FY01-FY04)

10. APPENDIX B: Web Site Example

http://www.mmac.jccbi.gov/avn/iap/

APPENDIX B: Web Site Example (Continued)

http://www.mmac.jccbi.gov/avn/iap/

#	AIRPORT TYPE	RUNWAY LEGNTH	REGIONAL LOCATION	AIRPORT NAME	LOCATION/CITY	ST	ARPT IDENT	RWY #	AIR CARRIER RISK LEVEL
1	A		GL	GREATER ROCKFORD	ROCKFORD	IL	KRFD	1	HIGH
2	A		GL	GREATER PEORIA REGIONAL	PEORIA	IL	KPIA	4	HIGH
3	A		GL	CHICAGO-O'HARE INTERNATIONAL	CHICAGO	IL	KORD	4R	LOW
4	A		GL	KENT COUNTY INTERNATIONAL	GRAND RAPIDS	MI	KGRR	8R	MED
5	A		GL	PORT COLUMBUS INTERNATIONAL	COLUMBUS	OH	KCMH	10L	HIGH
6	A		GL	TOLEDO EXPRESS	TOLEDO	OH	KTOL	7	HIGH
7	A		GL	RAPID CITY REGIONAL	RAPID CITY	SD	KRAP	32	HIGH
8	A		GL	OUTAGAMIE COUNTY	APPLETON	WI	KATW	3	HIGH
9	A		GL	CENTRAL WISCONSIN	MOSINEE	WI	KCWA	8	HIGH
10	A		GL	AUSTIN STRAUBEL INTERNATIONAL	GREEN BAY	WI	KGRB	6	HIGH
11	A		NM	ASPEN-PITKIN COUNTY/SARDY FIELD	ASPEN	CO	KASE	15	HIGH
12	A		NM	WALKER FIELD	GRAND JUNCTION	CO	KGJT	11	HIGH
13	A		NM	SPOKANE INTERNATIONAL	SPOKANE	WA	KGEG	3	HIGH
14	A		NM	SPOKANE INTERNATIONAL	SPOKANE	WA	KGEG	21	HIGH
15	A		SO	WILMINGTON INTERNATIONAL	WILMINGTON	NC	KILM	17	HIGH
16	A		SO	WILMINGTON INTERNATIONAL	WILMINGTON	NC	KILM	35	HIGH
17	A		SW	FOUR CORNERS REGIONAL	FARMINGTON	NM	KFMN	25	HIGH
18	A		SW	DALLAS LOVE FIELD	DALLAS	TX	KDAL	13L	HIGH
19	A		SW	DALLAS LOVE FIELD	DALLAS	TX	KDAL	13R	HIGH
20	A		SW	DALLAS LOVE FIELD	DALLAS	TX	KDAL	31L	HIGH
21	A		SW	DALLAS LOVE FIELD	DALLAS	TX	KDAL	31R	HIGH
22	A		SW	VALLEY INTERNATIONAL	HARLINGEN	TX	KHRL	17R	HIGH
23	A		SW	VALLEY INTERNATIONAL	HARLINGEN	TX	KHRL	35L	HIGH
24	A		SW	LUBBOCK INTERNATIONAL	LUBBOCK	TX	KLBB	17R	MED
25	A		SW	LUBBOCK INTERNATIONAL	LUBBOCK	TX	KLBB	26	MED
26	A		SW	LUBBOCK INTERNATIONAL	LUBBOCK	TX	KLBB	35L	MED
27	A		WP	TUCSON INTERNATIONAL	TUCSON	AZ	KTUS	11L	HIGH
28	A		WP	GRAND CANYON NATIONAL PARK	GRAND CANYON	AZ	KGCN	3	MED
29	A		WP	SAN DIEGO INTERNATIONAL-LINDBERGH FIELD	SAN DIEGO	CA	KSAN	9	
30	A		WP	SAN DIEGO INTERNATIONAL-LINDBERGH FIELD	SAN DIEGO	CA	KSAN	27	
31	A		WP	RENO/TAHOE INTERNATIONAL	RENO	NV	KRNO	16R	HIGH

11. APPENDIX C: TERMS

Form 8260-2	Radio Fix and Holding Data Record
Form 8260-3	ILS-Standard Instrument Approach Procedure
Form 8260-5	Standard Instrument Approach Procedure
Form 8260-7	Special Instrument Approach Procedure
Form 8260-9	Standard Instrument Approach Procedure Data Record
Form 8260-10	8260-5 Continuation Sheet
Form 8260-15	Departure procedure/Takeoff Minimums
Form 8260-16	Transmittal of Airways/Route Data
Form 8260-22	MLS-Standard Instrument Approach Procedure
FAA order 8200.1A	US Standard Flight Inspection Manual
FAA order 8260.3	US Standard for Terminal Instrument Procedures
FAA order 8260.19C	Flight Procedures Airspace
FAA order 8260.38A	Civil Utilization of Global Positioning System
FAA order 8260.45	Terminal Arrival Area (TAA) Design Criteria
FAA order 8260.48	Area Navigation (RNAV) Approach Construction Criteria
AC 20-129	Airworthiness Approval of Vertical Navigation (VNAV) for use in the US NAS and Alaska
AC 20-130A	Airworthiness Approval Navigation or Flight Management Systems Integrating Multiple Navigation Sensors
AC 90-94	Guidelines for Using Global Positioning System Equipment for the IFR En Route and Terminal Operations and for Non-Precision Instrument Approaches in the US NAS
ADS-B	Automatic Dependant Surveillance-Broadcast
AF TERPS	Air Force TERPS
AFIS	Automatic Flight Inspection System
AFS	Flight Standards Service
AHRS	Attitude Heading Reference System
ARINC 424	Aeronautical Radio inc.
ASAC	Airspace Safety Analysis Corporation
ASIS	Aviation Standards Information System
ATA	Air Traffic Airspace Management Program Office
ATCS	Airport Traffic Control Specialists
ATCT	Airport Traffic Control Tower
ATS	Air Traffic Services
AVN	Aviation Systems Standards
AVR	Regulation and Certification Office
CAST	Commercial Aviation Safety Team
CNS	Communications, Navigation, and Surveillance
COTS	Commercial Off The Shelf
DA	Decision Altitude
DADC	Digital Air Data Computer
DOD	Department Of Defense
DME	Distance Measuring Equipment
EMS	Emergency Medical Service

ESV	Expanded Service Volume
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FAF	Final Approach Fix
FAR	Federal Aviation Regulation
FAWP	Final Approach Way-Point
FMS	Flight Management System
FPA	Flight Path Angle
FPO	Flight Procedure Office
GPS	Global positioning System
IAPA	Instrument Approach Procedures Automation
IAPS	Integrated Avionics Processor System
IFR	Instrument Flight Rules
LNAV	Lateral Navigation
MAWP	Missed Approach Way-Point
MDA	Minimum Decent Altitude
NAS	National Airspace System
NASR	National Airspace System Resources
NATA	National Air Transportation Association
NFDC	National Flight Data Center
NGS	National Geodetic Survey
NOS	National Ocean Service
NOTAM	Notice To Airmen
NTSB	National Transportation safety Board
OE	Obstacle Evaluation
RNP	Required Navigation Performance
RNAV	Area Navigation
RNP	Required Navigation Performance
RTCA	Radio Technical Commission for Aeronautics, inc.
SC	Special Committee
SIAP	Standard Instrument Approach Procedure
SID	Standard Instrument Departure
TERPS	Terminal instrument Procedures
USAF	United States Air Force
VDA	Vertical Decent Angle
VGSI	Visual Glide-slope Indicator
VNAV	Vertical Navigation
WAAS	Wide Area Augmentation System