Federal Aviation Administration

Roadmap for General Aviation Aging Airplane Programs

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List of Acronyms

AAI	Office of Accident Investigation
AC	Advisory Circular
ACO	Aircraft Certification Office
AD	Airworthiness Directive
AEA	Aircraft Electronics Association
AFS	Flight Standards Service
AIR	Aircraft Certification Service
AMT	Aviation Maintenance Technician
AOPA	Aircraft Owners and Pilots Association
ASI	Aviation Safety Inspector
ASTM	ASTM International
AVS	Aviation Safety
CAR	Civil Air Regulation
CFR	Code of Federal Regulations
COS	Continued Operational Safety
COSM	Continued Operational Safety Management
DAH	Design Approval Holders
DER	Designated Engineering Representative
EAA	Experimental Aircraft Association
FAA	Federal Aviation Administration
FAAST	Federal Aviation Administration Safety Team
FDR	Flight Data Recorder
FSDO	Flight Standards District Office
FY	Fiscal Year
GA	General Aviation
GAMA	General Aviation Manufacturers Association
IA	Inspection Authorization
NIAR	National Institute for Aviation Research
NTSB	National Transportation Safety Board
PAMA	Professional Aviation Maintenance Association
RAS	Risk Analysis Specification
SDR	Service Difficulty Report
SMS	Safety Management System
SMSG	Safety Management Steering Group
STC	Supplemental Type Certificate
TC	Type Certificate
TSO	Technical Standard Order

I. EXECUTIVE SUMMARY

In 1991, Congress mandated that the Federal Aviation Administration (FAA) establish an Aging Airplane Program. The focus of this program is age-related structural problems with airplanes used in public transportation. At the time, Congress specifically excluded the general aviation (GA) fleet of airplanes from the mandate.

However, the FAA determined that as the GA fleet continues to age, there is a concern about ensuring the continued airworthiness of the diverse GA fleet. The wide variety of designs and operational uses of the GA fleet presents unique challenges to both industry and regulators to ensure the continued safety of these airplanes.

The Small Airplane Directorate introduced various programs to address continued operational safety issues associated with the aging GA fleet. These programs include addressing structural issues on specific make and model airplanes, addressing aging airplane wiring concerns, and conducting research focused on aging concerns with small airplanes used in commuter service. Efforts like these have been successful.

However, the effects of aging on GA airplanes have continued to cause service difficulties, incidents, and accidents. In some cases, the effects of aging have caused primary component failures, and some of those failures have led to fatal accidents. As a result, the Small Airplane Directorate recognizes that we need to do more to address the effects of aging on GA airplanes.

To guide our future efforts in addressing the effects of aging on GA airplanes, the Small Airplane Directorate developed an FAA Aging GA Roadmap (Roadmap). This Roadmap will serve as a guide to proactively manage the overall airworthiness of aging GA airplanes. It will unite all aging small airplane initiatives under a single program for effective management of continued airworthiness issues.

The Roadmap will primarily focus on nonregulatory solutions. This boundary serves as a commitment by the FAA to seek enhanced guidance and processes recognized by industry as positive methods for managing the continued airworthiness of the aging GA fleet.

The Roadmap aligns with the broader effort underway within the Aircraft Certification Service (AIR) and Aviation Safety (AVS) to develop and implement a Safety Management System (SMS). Several people involved in the creation of the Roadmap have played key roles in Phases I, II, and III of AIR's SMS development effort. Through its extensive participation in AIR SMS, the Small Airplane Directorate has ensured that the Roadmap aligns with AIR SMS principals and design requirements. In addition, participation in AIR SMS has also allowed the Small Airplane Directorate to share the tools and techniques it has developed with the rest of AIR, and to help standardize the use of such tools in the future through robust SMS processes.

The four major focus areas of the Roadmap are:

- Proactive identification of safety concerns
- Data driven risk assessment and risk management
- Availability of data and parts
- Maintenance and inspection

In each area, education and training play a key role in achieving success.

The Roadmap introduces 12 initiatives (FAA-led and Aging Airplane Committee-led) that will address the four focus areas and their associated education and training needs. Several of the initiatives will extend into fiscal year (FY) 2008 and beyond. The table below outlines the Roadmap initiatives. Given sufficient resources, we will develop these initiatives in the fiscal years shown.

FAA-Led Initiatives	FY07	FY08	FY09 and beyond
1. Write Guidance for Fatigue Management of Older Airplanes	x	x	x
2. Develop Structural Life Limits Database	x	x	x
3. Develop Risk Assessment and Risk Management Methods	x	x	x
4. Support Development of ASTM Wiring Standard	x	x	
5. Conduct FAA "Educate and Train" Programs	x	x	x

Industry-Led Initiatives	FY07	FY08	FY09 and beyond
1. Define Term "Aging Aircraft"	x		
2. Assess Operation in More Aggressive Fatigue Spectra	x	x	
3. Improve Quality of Education and Training for Mechanics, Owners, and Operators	x	x	
4. Evaluate and Improve Repair Data Availability	x	x	
5. Evaluate and Improve Design Data Availability	x	x	
6. Evaluate and Improve Replacement Parts Availability	x	x	x
7. Improve the Service Difficulty Reporting Process	x	x	x

II. PURPOSE

The purpose of the Federal Aviation Administration (FAA) General Aviation (GA) Roadmap (hereon referred to as Roadmap) is to develop a plan to proactively manage the risks associated with the continued airworthiness and operation of the aging GA fleet. Though specific to the GA fleet, many of the initiatives and programs introduced in the Roadmap may be applicable to other categories of airplanes and rotorcraft. The Roadmap provides an overview of the respective projects, programs, and other initiatives the FAA and industry are planning and developing to improve overall airworthiness of the GA fleet. The Roadmap fits within the broader initiatives identified in the Aircraft Certification Service's (AIR) Safety Management System (SMS).

III. SCOPE

The Roadmap provides a framework for the FAA to use in addressing the wide spectrum of issues associated with the aging GA fleet. It promotes information sharing and collaborating between the FAA and industry trade groups, owner/operators, and design holders. The Roadmap augments and unites existing FAA programs that address specific continued safety issues associated with the aging GA fleet.

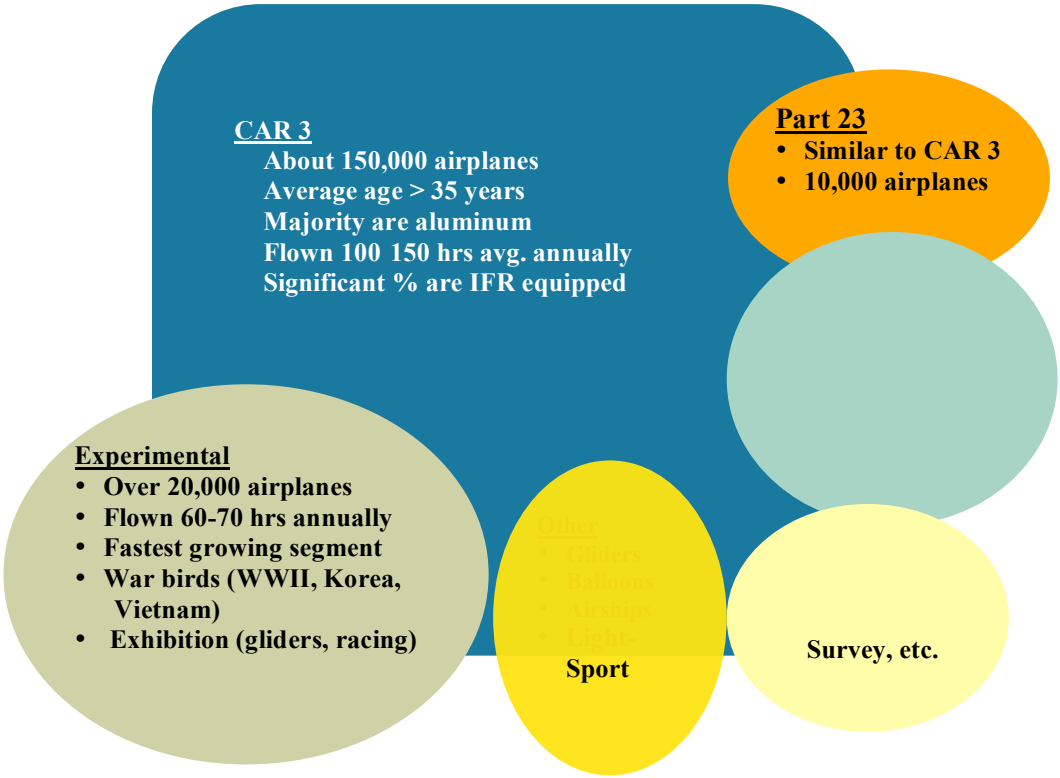
The Roadmap focuses in four major areas:

- Proactive identification of safety concerns
- Data driven risk assessment and risk management
- Availability of data and parts
- Maintenance and inspection

Each area contains important elements. In some cases, the elements in one area interlace with other areas. This Roadmap identifies those elements, states why they are important and what actions the FAA plans to address them. In all areas, education and training are the keys in achieving success.

IV. BACKGROUND

General Aviation Picture Today



The FAA is responsible for overseeing the continued airworthiness of more than 150,000 type-certificated GA airplanes over 30 years old. Most of these airplanes were designed to Civil Air Regulations (CAR) 3 standards established in the 1950s or earlier and were produced before the 1980s. A small portion of the fleet is designed to early design standards – Aero Bulletin 7a, CAR 4, and CAR 4a. Many are vintage airplanes designed or produced before World War II.

Many of the original type design holders for these airplanes are no longer in business. This absence creates extra burdens on the industry because much of the type design data critical to continued airworthiness issues is either not available or is incomplete. Without type design data, repair and alteration of these airplanes becomes more difficult at a time when the aging process has made it most important. The FAA recognizes that industry, in order to continue to maintain safe airplanes, needs additional programs and procedures to assist in this effort.

In 1991, Congress mandated that the FAA establish an Aging Airplane Program to focus attention on age-related structural problems with the air carrier fleet (14 Code of Federal Regulations (CFR) part 121 and part 135 operators). At that time, Congress specifically excluded the GA fleet of airplanes from the mandate. The Small Airplane Directorate remained involved in the Aging Airplane Program regulatory and policy action and began identifying aging issues that had potential to affect the GA fleet.

The Small Airplane Directorate began developing goals for addressing aging issues of the GA fleet. These include:

- Understanding the public expects aviation safety will continue to improve
- Moving from a reactive to a proactive approach to GA safety
- Developing risk assessment and risk management tools
- Addressing issues associated with longer life cycles than expected by the original design
- Developing aging airplane specific programs through FAA partnerships with industry
- Increasing safety information sharing within the GA industry
- Using advanced technology to develop better methods for aging inspections
- Optimizing existing resources available to address aging concerns
- Providing training and education resources for pilots, owner/operators, and maintenance personnel on aging airplane issues

In January 2000, the Small Airplane Directorate hosted an aging GA Summit Public Meeting. At the public meeting, participants provided a wide range of perspectives on issues affecting owner/operators of aging airplanes. The most notable accomplishments resulting from the meeting are the implementation of the Airworthiness Concerns Process and the formation of an ad hoc team. The ad hoc team produced the "Best Practices Guide for Maintaining Aging GA Airplanes" and made recommendations for enhancing safety in the continued maintenance and operation of vintage airplanes.

Despite these successes, important issues remain unresolved. In recent years, the GA community experienced several accidents attributable to aging issues within the fleet. With the growing number of GA airplanes experiencing age related failures, it is evident that a proactive approach is needed to offset the increasing risks of age related problems within the GA community.

In 2001, the Small Airplane Directorate established a Continued Operational Safety (COS) Branch responsible for Continued Operational Safety Management (COSM) activities. The COS branch includes a Supervisory Aerospace Engineer, Aerospace Safety Engineers, an Airworthiness Directive Coordinator, Technical Writer-Editors, a Service Difficulty Report Coordinator, and a Safety Recommendation Coordinator.

A team chartered in 2002 and led by the COS Branch developed and implemented a COSM Program for GA products. That team's actions resulted from the Aircraft Certification Service (AIR) Safety Management Steering Group (SMSG) Initiatives Roadmap. The SMSG Initiatives Roadmap was formed from the expected outcomes of the safety management goals of the AIR Strategic Plan.

The team produced the COSM Program Plan and updated the plan as issues emerged from the SMSG. The team revised the COSM Program Plan in January 2006. This Roadmap is an extension of the COS Branch team's work, but expanded and adjusted to address recent age-related issues and accommodate the current SMS vision.

The Appendix provides a more in-depth background of all Small Airplane Directorate COSM activity to date.

V. STAKEHOLDERS

An important aspect of the Roadmap is identifying the stakeholders involved. By identifying those affected by the increasing need for aging airplane actions, we can include them in developing solutions that will satisfy all interested parties. All stakeholders have specific responsibilities for continued operational safety of the industry.

a. FAA

Both AIR and Flight Standards Service (AFS) have strong commitments to aging airplane programs. It is imperative that both organizations unite in the leadership and oversight they provide to the GA community. Success depends on both AIR and AFS management committing resources to accomplish the goals outlined in the Roadmap.

As new airplane designs emerge, how those designs age will be a critical concern of the engineering process. AIR must provide the oversight to ensure the continued operational safety of a design remains intact as it ages. A critical airworthiness responsibility is oversight of the GA fleet and how it ages.

The Office of Accident Investigation (AAI) provides information on unsafe conditions and trends from accident investigations. This can be important in identifying issues that may require development of aging aircraft safety enhancements.

AFS provides oversight of the ongoing continued operational safety of all GA airplanes. It is important for Aviation Safety Inspectors (ASIs) to understand how important the aging process is as it relates to continued operational safety. Oversight of the industry by ASIs is critical in maintaining the safety of the expanding GA community.

Through education and training, AIR and AFS personnel must keep abreast of new technology and processes designed to complement aging airplane programs.

b. FAA Designees

Many owner/operators will modify, repair, inspect, and rebuild their airplanes as the GA fleet continues to age. The FAA Designee community provides the engineering expertise and data approval for these critical airworthiness functions. It is important for all designees to understand the growing concerns with aging.

A primary responsibility for all designees is continued education and training in their discipline. It is important for the designees to remain current as aging airplane technology and processes improve.

c. Industry Organizations

Industry organizations, such as the Aircraft Owners and Pilots Association (AOPA) and the Experimental Aircraft Association (EAA), represent interests in the GA community. They provide leadership to their constituents in matters concerning the continued safe use of GA products. Many of these organizations lead the industry in providing education and training to their members. Participation by these organizations with the FAA in developing aging airplane programs is a priority.

d. General Aviation Type Design Holders/Manufacturers

The type design holders and manufacturers of GA products invest both capital and human resources in our industry. It is imperative that they use their expertise and experience to develop programs intended to maintain the safe operation of their products. The expertise of the type design holder should lead to engineering solutions to aging airplane issues.

Representative organizations of the type design holders and manufacturers, such as the General Aviation Manufacturers Association (GAMA), provide additional expertise to aging airplane programs. These organizations often are the central voice for GA type design holders and manufacturers and should be an integral part of any aging GA program development and review.

e. General Aviation Type Clubs

Type clubs represent owner/operators of specific make and model airplanes. Type clubs keep their members aware of important information, both technical and non-technical. A few type clubs are even type certificate holders. Type clubs offer an excellent conduit for training and education to the GA community. The FAA continues work with type clubs to build a strong owner/operator base to support general aviation aging airplane programs.

f. Individual Owner/Operator

The ultimate customers of any aging airplane program are the owner/operators of the product. Any program that improves the safety of operating aging airplanes will benefit them directly. It is imperative for owner/operators to understand the need for aging airplane programs and the importance of participating in all aspects of the programs provided. Ongoing education and training provided by other stakeholders is critical to this group. Success of the Roadmap initiatives is dependent upon owner/operators understanding the importance of the initiatives in day-to-day operation of GA airplanes.

g. Vendors (Other Design Approval Holders)

Vendors provide the production and technical support of thousands of individual components used in the finished airplane product. These components age over time. It is important for this group to understand the aging process and develop programs to monitor and adjust the continued operational safety processes of their products. Research continues to indicate that system components are as critical in the aging process as structural items.

h. Maintainers/Modifiers

Additional customers of the aging airplane programs are the organizations and individuals that maintain and modify GA products. By definition, this group affects the daily airworthiness of our GA fleet. Any program developed to enhance the safety of these products through maintenance, inspection, or safety enhancements directly affects this group. It is important for this group to participate in developing maintenance and inspection related elements of the aging airplane effort. Representative organizations, such as the Aircraft Electronics Association (AEA) and the Professional Aviation Maintenance Association (PAMA), are included in this group. Representative organizations can be proactive in encouraging and validating the importance of education and training to maintenance and inspection personnel. The FAA should collaborate with these organizations to develop programs that will credit maintenance and inspection personnel with recurrent education and training credit towards the FAA's Aviation Maintenance Technician (AMT) Awards Programs.

i. Aviation Maintenance/Flight Training Organizations

Individual educators and training organizations play an important role in educating both pilots and maintenance personnel of the important role they play when dealing with older airplanes. Education is the driving force in convincing both pilots and mechanics about how important it is for them to participate in aging airplane programs. Improved understanding will form the foundation for success of each Roadmap initiative.

j. Repair/Modification Parts Suppliers

As aging airplane issues emerge, one area that requires particular attention is the availability of approved repair and modification parts. Owner/operators of aging GA airplanes may have trouble obtaining needed parts to maintain the airplanes in an airworthy condition because many type design holders no longer support older models or are no longer in business. Repair parts are a priority concern. As the airplane ages through use, parts wear out and will need replacement. Repair/modification parts suppliers will continue to play an important role in maintaining the airworthiness of older airplanes.

VI. THE ROADMAP

The Roadmap is a long-range plan to develop, implement, monitor, and improve the techniques and tools the FAA and industry use to address safety concerns within the GA community. The Roadmap will also serve as a tool for reviewing developed and implemented programs for their effectiveness. Continually improving these programs will play an important role in their long-term success.

The Roadmap aligns with the broader effort underway within AIR and AVS to develop and implement an SMS. One of AIR's SMS design requirements is that the SMS include tools and methods for making data driven decisions. Another key component of the AIR SMS is to help AIR focus its efforts where they will have the most safety impact. In developing the Roadmap, the Small Airplane Directorate ensured that it accounted for these and other AIR SMS principals.

Small Airplane Directorate personnel who participated in the creation of the Roadmap have also participated in AIR's SMS development effort. One Roadmap team member participated on the Integrated Safety Decisions and the Systems Design SMS teams during Phases I and II of SMS development. Another Roadmap team member is currently playing a key role on the Phase III Risk Analysis Specification SMS team, which is developing a specification for AIR that will enable objective risk analysis. In addition, the project lead for the Roadmap will soon participate on the Phase III Monitor Safety / Analyze Data SMS team, which will develop common tools and methods for AIR to use in managing the continued operational safety of certificated products.

Through its extensive participation in AIR SMS development, the Small Airplane Directorate has ensured that the Roadmap aligns with AIR SMS principals. In addition, the Small Airplane Directorate has been able to share the tools and techniques it has developed with the rest of AIR, and to help standardize the use of such tools in the future through robust SMS processes.

For any program to be successful, it is imperative to address both the FAA and industry interests. The FAA and industry are dedicated to safe operation of all GA products. The FAA is committed to oversight of safety by collaborating with industry.

In March 2006, the FAA held a second aging GA Public Meeting. The public meeting provided a forum for the GA community to present their perspectives regarding the aging airplane fleet. Several speakers provided insight into aging airplane concerns.

An outcome of the aging GA Public Meeting was the formation of seven committees chaired by industry leaders to support the FAA's plan to address GA aging airplane issues. These seven committees will focus on:

- Defining the term "aging aircraft"
- Operating in more aggressive fatigue spectra (operating near the limits of the product)
- Improving the quality of education and training for mechanics, and owner/operators
- Evaluating and improving repair data availability
- Evaluating and improving design data availability
- Evaluating and improving replacement parts availability
- Improving the SDR process

The Roadmap will primarily focus on nonregulatory solutions. This boundary serves as a commitment by the FAA to seek enhanced guidance and processes recognized by industry as positive methods for managing the continued airworthiness of the aging GA fleet. By focusing on voluntary solutions to safety and the economics of maintaining aging GA airplanes, we encourage majority participation in keeping the safety, utility, and value in aging GA airplanes.

Safety is the primary motivator for participating in aging airplane programs. Successful integration of aging airplane programs will occur much easier and with better results by building trust with all partners. Voluntary participation through education and training is the driving force of these programs.

The Small Airplane Directorate COS Branch developed the Roadmap based on considerable work done regarding GA aging airplane issues over the last few years. The Roadmap initiatives will be developed and implemented through coordination with AFS and other stakeholders.

Coordination with AFS is essential to develop specific aspects of the Roadmap that deal directly with aging airplane maintenance, inspection, and operations. By collaborating with AFS, AIR will expand the Roadmap initiatives, such as owner/operator and maintenance training as well as outreach specific to aging airplanes.

The success depends on available Aviation Safety (AVS) resources. AVS must allocate resources to the aging airplane programs developed through the Roadmap initiatives for them to be successful. The AVS business planning process allocates the needed resources.

The Small Airplane Directorate will update the Roadmap to document the evolution of aging airplane programs. Roadmap initiatives, in which AIR and AFS will work together with industry to develop and implement, contain the following elements.

- Objective – Is a short description of the issue or problem and what the task intends to do.
- End State – Describes the desired outcome.
- Current State – Explains how the issue or the problem is currently being addressed (or not addressed).
- Gap Analysis – What is missing between the current state and the end state?
- Implementation – Actions needed to get from the current state to the end state.
- Milestones – Key achievements and schedule for accomplishment.
- Key Stakeholders/Roles – Organizations, companies, and individuals needed to reach the end state, and what input or participation is needed from each.

Summary sheets efficiently capture the information above. Each summary sheet provides the objective's scope, goals, and activities. By formally documenting the program details and milestones, everyone involved with the initiative will be aware of progress and areas where additional work may be required. It is important that any initiative have details and timelines in place to ensure consistent progress by all participants. Some concepts are still in the formative stages and a summary sheet has not been developed. The Roadmap is a living document that records changes, including the initiative summaries.

The Roadmap initiatives are outlined below in three sections. The first section discusses FAA-led current and future efforts to mitigate the risks associated with aging airplanes. These initiatives form the core of the Roadmap, and we will draw upon them in the development of future business plan objectives. The second section outlines the efforts of the industry-led committees formed during the 2006 aging GA Public Meeting. These committees are in the process of defining recommendations that may become Roadmap initiatives in the future. The third section discusses additional potential future initiatives.

a. FAA-Led Initiatives

Five priority initiatives listed below are scheduled for activity in FY07. The level of activity planned for FY07 and future years is described in the initiative summaries that follow.

(1) Write Guidance for Fatigue Management of Older Airplanes
(2) Develop Structural Life Limits Database
(3) Develop Risk Assessment and Risk Management Methods
(4) Support Development of ASTM Wiring Standard
(5) Conduct FAA "Educate and Train" Programs

(1) Write Guidance for Fatigue Management of Older Airplanes

Engineering tools are being developed to assist in identifying safety concerns. These tools are critical in that they will allow proactive intervention into safety issues before incidents or accidents happen. The primary objective is to identify safety issues and develop data driven solutions before an accident.

The Small Airplane Directorate is leading an effort to write an Advisory Circular (AC) titled, "Structural Integrity Programs for Airplanes with Demonstrated Risk of Catastrophic Fatigue Damage." This AC will provide information and guidance for FAA Certification Engineers, type certificate (TC) holders, and owner/operators about actions needed for airplanes with such a risk. The AC will include guidance about inspection reporting, what to do when other cracks are found, and how to manage the risk of the model fleet.

The guidance will be written in three phases. Phase I (FY07/08) will document actions needed to address an unsafe condition and provide information for continued safe operation of the GA fleet. The FAA has reacted differently to several recent small airplane fatigue-related accidents and serious incidents. This first phase guidance compiles the lessons learned from dealing with those events to provide a consistent and comprehensive approach to addressing any fatigue related unsafe condition. It explains how to investigate the condition to determine the circumstances of the failure and assess the risk to airplanes of similar design. It also provides steps to take to evaluate how to resolve the condition properly. The steps address how to assess the viability of inspections and modifications, or if parts need to be replaced.

Phase II (FY08/09) will supply guidance about how to be more proactive with a model fleet when an unsafe condition is identified. Phase II will focus on how to evaluate the whole airplane structure beyond the actions defined in Phase I to address the unsafe condition location. This guidance will entail a process to develop a fleet fatigue management program, such as a Supplemental Structural Inspection Program.

Phase III (FY09/10) will supply guidance about strategies to proactively manage a fleet to minimize the risk of fatigue problems. Phase III is not yet defined, but will include techniques to monitor for precursors. The envisioned guidance will shape activities that stem from other FAA and Small Airplane Directorate initiatives, such as improvements to the Service Difficulty Report (SDR) System and maturing risk assessment and risk management methods. Past work, such as the Small Airplane Commuter Services Issues study and Small Commuter Airplane Catastrophic Precursor study summarized in the Appendix will also used.

Write Guidance for Fatigue Management of Older Airplanes Summary Sheet

Objective: Provide information to FAA engineers and inspectors, TC holders, and owner/operators about fleet management of airplanes at risk of fatigue. The guidance will explain how to assess unsafe conditions, what evaluations are needed to determine adequate inspections, modifications, or part replacements. It will also provide guidance about managing model-specific fleet-wide risk. It will provide guidance about assessing airplane risk (other than the unsafe condition location) and techniques for proactive monitoring for fatigue related precursors.

End State: AC that describes actions needed to manage airplane fleets with a demonstrated risk of catastrophic failure because of fatigue.

Current State: FAA, TC holders, and owner/operators react differently, and to varying degrees, to accidents or incidents. There is no guidance about specific actions needed to address fleet safety. Data needed for risk assessment is sometimes difficult to gather and risk management is not always consistent with expected levels of certitude.

Gap Analysis: No guidance exists for FAA engineers, inspectors, TC holders, owner/operators about steps needed to identify and address an unsafe condition, assess the risk to a model-specific fleet, or how to manage the risk.

Implementation: Write ACs that describe actions needed.

Milestones: Phase I: An AC that describes actions needed to address an unsafe condition, which will provide continued safe operation of the fleet. "AC 91-xx, Fleet Fatigue Management Programs for Airplanes with Demonstrated Risk of Catastrophic Fatigue Damage" is to be released for inter-directorate coordination by March 1, 2007. Planned to be available for public comment early in FY08 and published later in FY08.

Phase II: An AC that describes actions to assess the whole airframe, as well as the actions identified in Phase I for a specific unsafe condition, should be released for inter-directorate coordination during FY08.

Phase III: An AC that describes actions to recognize precursors to a potential unsafe condition should be drafted during FY09. This action builds on Phase I and Phase II guidance.

Write Guidance for Fatigue Management of Older Airplanes Summary Sheet (Continued)

Key Stakeholders: FAA: Engineers involved with aging airplanes from the Aircraft Certification Service (Small Airplane Directorate, Transport Airplane Directorate, Chief Scientist/Technical Advisor for Fatigue and Fracture), and an inspection specialist from Flight Standards will write the guidance. They will also advocate standardized use of the guidance by exposing affected Aircraft Certification engineers, Designated Engineering Representatives (DERs), TC holders, and owner/operators to its application.

FAA: AVS management plays an important role by supporting use of the guidance when addressing an unsafe condition. Management support will be especially important to counter TC holder or owner/operator resistance to produce technically adequate data or implement proactive fleet management concepts.

TC Holders and Owner/Operators: It is important for them to support the FAA by developing acceptable data following the guidance and recognizing needed actions may be costly.

(2) Develop Structural Life Limits Database

The Small Airplane Directorate has planned another initiative to determine which small airplane models have a fatigue life limit, a life limit extension, or a safety-by-inspection program.

In 1969, the FAA added a regulation to require life limits for new TCs. Since then, new TCs have been issued with life limitations. However, the FAA has never compiled that information into a database or a list of TCs with limitations.

In addition, authorities of other countries have issued limitations for airplane models certificated with no FAA limit (certificated before the 1969 regulation). Therefore, some models with no FAA limitations have limits in certain other countries (most notable are the United Kingdom and Australia). The FAA has never compiled this information into a database or list of TCs with foreign limitations.

Over the years, modifiers have engineered means to extend some of these mandatory limits. There is no consolidated list of this information.

The scope of these limitations varies from model to model. Some models may have a life limit on the entire airframe. Other limitations may apply only to certain components. Some models may have provisions for component replacement or for directed safety-by-inspection programs.

The Small Airplane Directorate can use the information above to help assess the risk to models with some form of limits. The information can be compared with SDR reviews and the demographic data for any specific model. If potentially high-risk models are identified, then the FAA will need to consider mitigating action. Development of this list fits well with one of the tasks associated with the risk assessment initiative described below. Explained in the "Develop Risk Assessment and Risk Management Methods" initiative below is a research project to build a demographic database that is scheduled to start in September 2006.

If resources are dedicated to this project, by the end of FY07 the Small Airplane Directorate expects a partial list of small airplane models with limitations. This timeframe fits well with the availability of airplane model demographics from the research project just mentioned.

Develop Structural Life Limits Database Summary Sheet

Objective: Knowledge of small airplane structural component life limits, life limit extensions, and safety-by-inspection programs mandatory in the United States or in other countries. Develop demographic data for any models with these limitations so risk assessments can be done.

End State: An FAA database of all FAA and foreign authority issued life limits, life limit extensions, and safety-by-inspection programs for small airplanes. This would include TCs for U.S. or foreign produced airplanes that do not have FAA limitations, but may have limitations mandated by some foreign authority. These limitations may be for specific parts, major components, or the entire airframe. They may be supplemental type certificates (STCs). Coupled with that is a demographics database for these same models that permits data-driven estimates of fleet size, number of high-time airplanes, those in commercial use, etc.

Current State: No document exists that contains a list of airplane models with life limits. No database exists from which model fleet demographics can be easily extracted. Information for any specific model with some life limit is attained by special searches of FAA TC data sheets and queries to other authorities. Demographic information is gathered in an ad hoc fashion and done inconsistently.

Gap Analysis: The current means of evaluating small airplane model-specific demographics is inconsistent and not practical for broad risk assessment and management of the fleet. Databases of life limits, demographics, and techniques to analyze such data are needed. The SDR database has limited use to determine if airplanes with limitations have fatigue related problems.

Implementation: Build a database of life limits, life limit extensions, and safety-by-inspection programs for small airplane models. Use this information with the demographics database to be developed under a research grant that is part of the "Develop Risk Assessment and Risk Management Methods" initiative also explained in this Roadmap. Examine the SDR database for fatigue problems for airplane models with limitations.

Milestones: Compile a list of small airplane models with life limits, life limit extensions, and safety-by-inspection programs.

Assess risk of large fleet models on the list by comparing limits with model demographics.

Brief European Authorities.

Establish a protocol for assessing the risk of all airplane models on the above list.

Key Stakeholders: FAA: Project Officers in the Small Airplane Directorate, Project Support Branch need to solicit needed information from applicable Aircraft Certification Offices (ACOs) and foreign authorities. The Small Airplane Directorate, COS Branch staff should be responsible for building, populating, and maintaining the database. The COS Branch engineers should ensure the research grant to develop demographic data includes information useful for assessing the risk to models with airworthiness limitations.

Foreign Authorities: We need cooperation from foreign authorities that have mandated airworthiness limitations to share their knowledge and data with the FAA.

TC Holders: Their knowledge regarding limitations on their models should be shared with the FAA to help us determine if any models are at high risk.

(3) Develop Risk Assessment and Risk Management Methods

An important aspect of proactive intervention is developing risk assessment tools. These tools are critical to enable a nonbiased review of data when a safety concern surfaces to determine what action is required to assure airworthiness. Information from these assessments is necessary for all parties (FAA, TC holder, and owner/operators) to agree on a solution to manage or mitigate the safety concern.

The Small Airplane Directorate prototyped a probabilistic method to assess and manage risk related to certain recent age-related safety concerns. It uses in-service failure and model (type design) demographic data to estimate the risk of failures to the rest of model fleet. This information is important in determining the severity of the concern, how fast to act, and how aggressive to mandate fleet compliance.

The concept was first applied to the Cessna 402 wing spar cracking concern. Its success helped quell a vocal owner/operators group and provided the justification for the FAA's airworthiness directives (AD) actions. A similar approach was used to help evaluate the risk associated with wing spar cracking of agricultural use airplanes (crop dusters). It helped the FAA determine safe-life limits for directed inspections and part replacement and justified the FAA AD actions.

Small Airplane Directorate engineers also used probabilistic tools to mitigate the risk associated with Raytheon Beech T-34 and Grumman-Frakes Mallard wing failures caused by fatigue cracking. Analysis results helped the FAA determine when and what to mandate, such as part replacement, modification, or repetitive inspections.

In FY07, the Small Airplane Directorate will continue to enhance these risk assessment tools. Engineers will apply probabilistic methods to actual in-service problems, as applicable. They will also continue to collaborate with the FAA Technical Center expert in this area. In addition to using the FAA Technical Center expert, they will work with that person to identify research tasks needed to enhance the method.

Using the AVS research requirements identification and prioritization process, a risk assessment and risk management research requirement has been identified. Some tasks previously funded will begin in FY07. The requirements scoped a long-range research plan that extends through FY12.

One research task is identified for FY07. The researchers will develop demographic data for the small airplane fleet. They will develop tools to query information stored in the FAA registry and use those tools to interrogate some selected models for specific model fleet data.

Other research tasks will be identified during FY07. The researchers will investigate probabilistic approaches to small airplane structural concerns. It is anticipated that previous research into fatigue testing, specific to small airplane construction and use, and the demographic database will complement the research in analytical methods.

Develop Risk Assessment and Risk Management Methods Summery Sheet

Objective: Standardized use of data driven risk assessment and risk management concepts for addressing small airplane safety concerns.

End State: ACOs apply risk assessment and risk management tools consistently to solve small airplane safety issues.

Current State: The Small Airplane Directorate uses the Airworthiness Concerns Process for all small airplane safety concerns. This process includes a primitive risk assessment. The Small Airplane Directorate has applied probabilistic data-driven risk assessment and risk management methods to solve some recent age related safety issues. Use of these methods is ad hoc and requires close cooperation between the ACO, the Small Airplane Directorate, and the FAA Technical Center engineers to gather relevant information, calculate risks, interpret data, and decide appropriate actions. Usable data is often not readily available and is resource-intensive to develop.

Gap Analysis: There are no standardized risk assessment tools for ACO engineers. There is no guidance regarding use of probabilistic analysis methods. Limited guidelines exist that tie risk levels to type of operation. There is little data readily available for risk assessments and it is usually difficult to find relevant information needed to develop usable data.

Implementation: The Small Airplane Directorate will continue expanding application of probabilistic risk assessment and risk management methods. Small Airplane Directorate engineers will work with the ACO engineers and consult the FAA Technical Center expert to determine an appropriate approach for solving specific problems that arise which can benefit from application of these methods.

The Small Airplane Directorate will coordinate with AVS contacts to ensure that progress made by the Small Airplane Directorate fits within the parameters of the AVS vision for risk assessment and risk management.

This initiative will benefit from a research program to develop small airplane probabilistic structural risk assessment. One project will build a demographic database for use with tools developed from other projects.

Milestones: Research grant to develop a demographic database will begin by September 2006.

Demographic database will be available for initial use by September 2007. Research grants to develop probabilistic risk assessment methods will begin by September 2007.

Develop Risk Assessment and Risk Management Methods Summery Sheet (Continued)

Note: Research intended to develop risk assessment tools has been funded and will begin in 2007. The plan for this research is to build on knowledge gained from existing materials and usage research. No milestones can be established for this research until the projects have been scoped. The funding plan for this program currently extends into 2012.

Key Stakeholders: FAA Small Airplane Directorate Engineers: Apply risk assessment methods to safety problems and instruct ACO engineers to gather data, calculate risk, and interpret results. They will also be responsible for monitoring the progress of the funded research program and keeping abreast of other risk assessment and risk management initiatives within AVS.

FAA Technical Center: Experts in probabilistic concepts should continue to advise Small Airplane Directorate engineers to help solve in-service safety issues. They will also be key in guiding the planned research to reach successful outcomes.

Small Airplane Directorate Management: Support engineering decisions to manage risk based on data driven risk assessments. Management support will also be needed to fund training once tools are developed.

ACO Engineers: Work with the Small Airplane Directorate staff to apply risk assessment and risk management tools uniformly to safety issues.

(4) Support Development of ASTM Wiring Standard

One of the early issues reviewed by the FAA regarding aging airplane concerns centered on wiring systems. Investigations by both the FAA and the National Transportation Safety Board (NTSB) cited aging wiring as being a factor in some accidents. The GA industry has not focused on a complete wiring standard. AC 43.13-1B has served as the standard, but it lacks much of the required detail.

The FAA has initiated a voluntary consensus standard effort to develop a set of standards for electrical wiring systems for normal, utility, acrobatic, and commuter category airplanes. These will provide standard technical guidance for the design, fabrication, maintenance, modification, inspection, and repair of wiring systems.

Industry participates in this effort and supports the use of consensus standards as a method to develop standards for airplane products. By using industry expertise, the set of standards being developed will encompass leading edge technology and will provide a method to ensure the standards are kept current as new technology emerges.

Support Development of ASTM Wiring Standard Summary Sheet

Objective: Develop a set of standards for electrical wiring systems for normal, utility, acrobatic, and commuter category airplanes. The standards will also provide technical material for maintaining and inspecting aging airplane wiring systems.

End State: A complete set of consensus standards developed for design, fabrication, modification, inspection, and maintenance of electrical systems installed on normal, utility, acrobatic, and commuter category airplanes.

Current State: ASTM F39 has issued one standard, F2490-05, "Standard Guide for Aircraft Electrical Load and Power Source Capacity Analysis".

ASTM F39 is near completion of the draft standard for "Design, Alteration and Modification". Once the draft is complete, it will be on the ballot for voting by the committee members.

ASTM F39 continues to solicit members from industry with a growing number of subject experts reviewing and making valuable technical additions to the effort.

An AFS-300 representative is reviewing ASTM F39 drafts.

Gap Analysis: ASTM F39 is meant to enhance the basic guidance contained in AC 43.13-1B, Chapter 11. The foundation of ASTM F39 is the AC to provide a seamless transition to the consensus standard.

Implementation: As ASTM F39 standards are approved, they are being introduced by Notice of Availability to the public through publication in the *Federal Register*.

Several industry members of ASTM F39 are planning internal training sessions once the set of standards is complete. One manufacturer is already training to the ASTM F39 F2490-05, "Load Analysis Standard."

Milestones: A consensus standard committee was formed to develop a set of electrical wiring system standards. This was done in December 2004.

A consensus standard development organization was selected to administer standards development. This was accomplished through public notification in the *Federal Register*. The ASTM was selected as the qualified candidate.

The first standard was issued in March 2006 by the issuance of the Notice of Availability for ASTM F2490-05, "Electrical Load Analysis."

Support Development of ASTM Wiring Standard Summary Sheet (Continued)

Issuing the standard for "Design, Alteration, and Modification." This is scheduled for ballot in FY06.

Issuing the standard for "Maintenance and Inspection." This is scheduled for ballot in FY07.

Key Stakeholders: FAA: The Small Airplane Directorate is the lead FAA organization, and its representative is a voting member, and a Committee Officer. The Small Airplane Directorate is coordinating review of all F39 drafts with AFS-300.

Industry Trade Organizations: Industry is represented by various organizations that represent specific areas of the aviation community, such as avionic repair stations, GA manufacturers, etc.

GA Product Manufacturers: Individual manufacturers of GA products participate on the committee.

Individual Operators: Several operators are represented as voting members. They provide input for the users of the products that will use the standards.

Vendors: Organizations that design and manufacture FAA-approved components for GA products participate on the committee.

Maintainers: Organizations that provide maintenance services that will use electrical standards for both maintenance and inspection participate on the committee.

(5) Conduct FAA "Educate and Train" Programs

In the past, the Small Airplane Directorate has been active in conducting educational outreach about small airplane aging issues. Engineers have participated in many AFS sponsored Inspection Authorization (IA) renewal seminars and pilot safety seminars, as well as DER seminars, technical conferences, public meetings, and other forums.

The Small Airplane Directorate intends to expand this education and awareness. The Small Airplane Directorate is committed to providing a session on aging airplanes at each DER seminar for the next two years. Engineers will speak at some IA seminars during FY07 and will support safety seminars when possible. Engineers will submit requests to hold sessions on aging GA at events such as Sun 'n Fun and AirVenture.

AVS will also continue to work with the representative groups such as PAMA, AOPA, EAA, AEA, and GAMA to begin developing a strategy to reach a broader audience of inspectors, mechanics, and owner/operators.

The Small Airplane Directorate will also explore other means of educating the GA community on the effects of aging, including the potential development of pamphlets or newsletters.

Conduct FAA "Educate and Train" Programs Summary Sheet

Objective: Greater awareness within the GA community of the safety risks associated with operating older airplanes and recommended actions to mitigate those risks.

End State: All stakeholders understand their role in keeping aging GA airplanes safe as they continue to age.

Current State: Knowledge base ranges from full awareness among many engineers, inspectors, and mechanics to some owner/operators who believe they can operate their airplane forever without additional maintenance. Some organizations do not believe that aging is a safety concern. Most representative organizations are on board with the issues, but some do not believe that aging is a priority safety concern. Education is limited to local seminars and forums. There is no formal training.

Gap Analysis: There is no program to develop or deliver education or training to needed constituencies. There is no plan on how to develop such programs or expand the outreach needed to educate affected parties of issues they need to know.

Implementation: Continue to present aging issues at local DER, IA, and pilot seminars, conferences, and forums. Work with representative organizations to develop an education and training plan. This should include syllabuses and training material for in-depth courses.

Milestones: During FY07, Small Airplane Directorate engineers will present aging issues at several DER, IA, and pilot seminars.

Develop an education and training plan in coordination with AFS and the representative organizations, such as AEA, AOPA, EAA, GAMA, and PAMA.

Key Stakeholders: FAA: Engineers and inspectors involved in continued operational safety of small airplanes. The AVS managers involved in supporting engineering evaluations and recommend actions.

TC Holders: They have the most knowledge about their designs. They can develop and make available information about continued airworthiness for their models.

Maintenance and Inspection Providers: They are the first line of defense against the effects of aging. They need to be aware of aging "symptoms," where to get generic and model specific information, and how best to correct safety concerns.

Conduct FAA "Educate and Train" Programs Summary Sheet (Continued)

Owner/Operators: They are ultimately responsible for maintaining the airworthiness of their airplane. They should be knowledgeable about generic aging effects and those specific to their model. They should recognize that as airplanes age they require more maintenance and are more costly to maintain.

Type Clubs: They are especially important for models that do not have an active TC holder. They can compile model specific age-related concerns (precursors) and act as a clearinghouse for owners to share information. They can develop libraries of safety enhancing field approvals.

Representative Organizations: They have the widest audience to enable education and training of their members. They can provide the means to reach out to members with everything from seminars at local events to Internet-based training courses.

b. Industry-Led Initiatives

Seven priority issues emerged from the March 2006 aging GA Public Meeting. Industry representatives chair each committee. The seven committees will make recommendations to:

(1) Define Term "Aging Aircraft"
(2) Assess Operation in More Aggressive Fatigue Spectra
(3) Improve Quality of Education and Training for Mechanics, Owners, and Operators
(4) Evaluate and Improve Repair Data Availability
(5) Evaluate and Improve Design Data Availability
(6) Evaluate and Improve Replacement Parts Availability
(7) Improve the Service Difficulty Reporting Process

The recommendations made by these committees may lead to specific objectives in future Roadmap revisions. At this stage, the FAA intends to continue working with these committees in FY07 and help them formulate proposals that will have a positive impact on the safety of aging GA airplanes.

(1) Define Term "Aging Aircraft"

Defining the term "aging aircraft" is an important step to determine the point in a type design's life where additional maintenance and inspection actions are critical to maintaining the airworthiness.

Define Term "Aging Aircraft" Summary Sheet

Objective: Define the term 'aging' when used to describe concerns pertaining to the continued airworthiness of an airplane. Provide a description that clearly identifies the point(s) in the operational life of an airplane when level and type of maintenance done needs to be addressed in a significantly different manner than when the airplane was new due to concerns with fatigue, corrosion, and deterioration, which could result in a catastrophic failure of the airplane.

End State: An understanding by all participants of the scope of work and types of concerns the joint FAA/Industry working groups are exploring.

Current State: Currently there are many different interpretations of what "aging aircraft" means. To some, this statement is condemnation of all airplanes older than a certain calendar date regardless of mechanical condition of the airplane. To others, this term refers to the amount of exposure an airframe has had to fatigue and corrosive environments.

Gap Analysis: A consensus from all participants on the joint FAA/Industry working groups as to what is meant by "aging aircraft."

Implementation: Implementation will be through publishing a definition for all working groups to use and by including discussion and definition of the term in any written reports from the joint FAA/Industry working groups.

Milestones: Draft definition provided to working group by August 18, 2006
Comments from working group by September 1, 2006
Teleconference to develop consensus by September 15, 2006
Final report to the FAA by September 29, 2006

Key Stakeholders: FAA and each of the working group leaders.

(2) Assess Operation in More Aggressive Fatigue Spectra

As airplanes age, consideration of the operations environment of the individual airplane becomes important in determining its structural health. Airplanes that have operated in more aggressive fatigue spectrums, or near their operational limits, such as air combat or acrobatics, will require scrutiny to structural concerns. Data becomes an important factor in determining the structural condition of the airplane.

Assess Operation in More Aggressive Fatigue Spectra Summary Sheet

Objective: Develop technical standards for the production, installation, and use of a flight data recorder (FDR) in part 23 airplanes.

End State: Participating airplanes have inexpensive data collection devices that record critical operational data used to evaluate maintenance requirements. The FAA revised AD process encourages adaptation to data capture by allowing owners/operators to adjust inspection intervals based on algorithms used to preserve an equivalent level of safety.

Current State: FDRs have not seen widespread use in GA applications. The development of inspection intervals in the AD process is "one size fits all" regardless of usage. A fatigue failure on a particular airplane used in severe loading spectra can have an adverse and unwarranted impact on owners/operators of the same type of airplane use in more benign operations. Current data limitations do not permit the segmentation of inspection intervals based on usage.

Gap Analysis: There are no existing standards for FDRs used in GA. FDRs of various designs have been tested in different private and public investigations. Procedures and methods to incorporate FDR outputs into the calculation of inspection intervals do not exist. There is no inherent motivation of an owner/operator to incur the expense of installing an FDR in the typical GA airplanes.

Implementation: Three developments must occur simultaneously. Develop technical standards for simplified FDRs to be used in 14 CFR part 23 installations. Develop AC materials that provide recommendations on installation and use of simplified FDR in part 23 airplanes. Develop engineering methods for segmenting inspection intervals in the development of ADs based on loading spectra obtained from installed FDRs.

Milestones: Appoint an oversight committee to monitor the project.

Develop website for public domain participation in the development of FDRs and application engineering. This site would permit contributors to download sections of the project for their own contributions and upload generated ideas.

Invite manufacturers, universities, and other process stakeholders to participate in the open source development of technical standards and procedures for GA FDR use.

Assess Operation in More Aggressive Fatigue Spectra Summary Sheet (Continued)

Oversight committee would monitor and incorporate contributions to develop necessary documents, such Technical Standard Order (TSO), ACs, and engineering procedures for assessment of inspection intervals. Maintain buy-in from the Small Airplane Directorate during the project development.

Publish TSO and necessary ACs pertinent to GA FDR installation and use.

Publish trade articles and make presentations at various industry outlets to keep interested parties informed on development.

Key Stakeholders: FAA, GAMA, AOPA, EAA, Type Clubs, universities, flight schools, owners/operators, and TC holders.

(3) Improve Quality of Education and Training for Mechanics, Owners, and Operators

Improving the quality and quantity of aging airplane education and training for mechanics and owner/operators will be a critical factor in achieving industry participation in aging airplane programs. Programs will enforce lessons learned from research and investigations regarding aging airplane issues. Both industry and the FAA will benefit from aging airplane specific training.

This industry-led committee is in its early stages and has not yet produced any summary sheets outlining its recommendations to the FAA. Work will continue on this committee into FY07, and the committee's recommendations are expected in November 2006.

(4) Evaluate and Improve Repair Data Availability

Availability of approved repair data is an airworthiness issue that requires action. With some older airplane designs, TC holders no longer provide adequate support or the TC holder is out of business. In those cases, the development of approved repair data becomes more difficult. Solutions to overcome these shortcomings are imperative.

This industry-led committee is in its early stages and has not yet produced any summary sheets outlining its recommendations to the FAA. Work will continue on this committee into FY07, and the committee's recommendations are expected in November 2006.

(5) Evaluate and Improve Design Data Availability

A similar issue to repair data availability is design data availability. Access to design data not only affects possible repair approvals, it is critical to modifications to enhance the safety aspects of a given model. Many TC holders no longer support older models, or in some cases, are no longer in business. This makes it very expensive to develop data required for repairs or alterations to the type design.

This industry-led committee is in its early stages and has not yet produced any summary sheets outlining its recommendations to the FAA. Work will continue on this committee into FY07, and the committee's recommendations are expected in November 2006.

(6) Evaluate and Improve Replacement Parts Availability

The need for replacement parts increases as the airplane ages. In order to keep the airplane airworthy, many parts require periodic replacement. As with design and repair data, unsupported type designs may suffer from lack of these critical parts. Industry needs to explore and evaluate methods to make available the necessary parts for older airplanes.

This industry-led committee is in its early stages and has not yet produced any summary sheets outlining its recommendations to the FAA. Work will continue on this committee into FY07, and the committee's recommendations are expected in November 2006.

(7) Improve the Service Difficulty Reporting Process

The FAA collects in-service data relating to malfunctions and discrepancies through the SDR system. Maintenance personnel, including repair stations, individual mechanics, and even FAA Airworthiness Safety Inspectors, voluntarily submit reports to the FAA. The FAA offers access to the SDR system as a method of learning more about service issues with specific airplane models. Improvement of this process will greatly benefit aviation safety.

Improve the Service Difficulty Reporting Process Summary Sheet

Objective 1: Ensure the SDR system is a part of a systematic, data-driven analysis by design approval holders and the FAA's safety oversight to ensure the continued operational safety of the GA fleet, especially addressing GA airplane aging issues.

End State: Both the FAA and TC holders review all SDR submissions. For orphaned TCs, the FAA would establish an internal agency process for assigning appropriate resources to ensure the analysis of SDR submissions. For existing and future applicants of type certificates, establish the necessary responsibilities under part 21 to evaluate SDR submissions.

Current State: At this time, the process for evaluating SDR submissions around industry is not standardized. It is not understood the type of resources needed by the FAA to address SDR submissions for orphaned airplanes.

Gap Analysis: Complete evaluation of the current practices and responsibilities of design approval holders for SDR submissions and their role in the FAA's safety oversight. Design approval holders' timely receipt of submitted reports. Evaluation and response to SDRs submitted for orphaned type certificates.

Implementation: Review existing practices and requirements of part 23 design approval holders (DAH) for analyzing SDRs and reporting to the FAA their findings on a frequent basis.

The FAA should determine the best way to accomplish continued operational safety support and analysis of SDR submissions for airplane TCs that lack an active TC holder (e.g. orphaned).

Review the latency between report submission and entry into the SDR database, specifically non-electronic submissions.

Evaluate the possibility of establishing a process for the FAA "forwarding" SDRs directly to the responsible DAH, as is the current practice of Transport Canada.

Milestones: [To be added and evaluated with FAA and industry.]

Key Stakeholders: Federal Aviation Administration
Industry organizations
Maintainers, individual mechanics, repair stations
Manufacturers

Improve the Service Difficulty Reporting Process Summary Sheet (Continued)

Objective 2: Expand the available "analyzed" SDR data to operators and mechanics to increase their use.

End State: SDR submissions based on a systematic, risk-based analysis are provided to the community to increase its use by the GA mechanic.

Current State: The main publication of analyzed SDR information is AC 43-16A. However, the tailoring and ability to search specific topics and obtain analyzed SDR data is limited. In addition, the topics contained in AC 43-16A are at the discretion of the FAA and not necessarily tailored toward aging issues.

Gap Analysis: The existence of readily available, analyzed SDR data for specific fleets in a useful format to GA mechanics targeting "aging aircraft" issues (e.g. fatigue and corrosion.) The existence of necessary data and information in an easily understood format to better target and enhance inspections of aging fleets.

Implementation: Evaluate the usefulness of creating a library of SDR make-model analysis to be hosted on-line by the FAA. The library would be targeted toward "aging fleet" make/models. This would facilitate GA mechanics' use of the data.

Review the process by which AC 43-16A topics are decided. Evaluate the possibility of tailoring publication of the AC toward specific make/model series (e.g. T-34) and "aging issues" to facilitate enhanced inspections.

Use the SDR System analysis to target inspection programs.

Milestones: [To be added and evaluated with FAA and industry.]

Key Stakeholders: Federal Aviation Administration
Airplane model specific type clubs
Industry organizations
Operators
Owners
Maintainers, individual mechanics, repair stations
Trainers
Manufacturers

Improve the Service Difficulty Reporting Process Summary Sheet (Continued)

Objective 3: Improve the rate of voluntary submission of SDR data .

End State: The GA community understands the value of submitting reports to the SDR System voluntarily and does so as part of normal operations and regular inspections when problems, especially those related to aging, are discovered.

Current State: Currently, the community does not fully understand the benefits of and use of the SDR System by the FAA or by manufacturers. Some groups view the submission of SDR System as risking exposure or enforcement, or that it just takes time to submit the report without seeing the direct benefit.

Gap Analysis: Knowledge within the community of the benefits and use of SDR submitted information. The motivation to submit SDRs, especially as part of regular inspections, is minimal.

Implementation: Recognizing the submission of Malfunction or Defect Reports for most GA mechanics and operators is voluntary, encourage the submission of reports through type club and operator organizations, especially following regular inspections.

Communicate to the community the critical role of the SDR System in the preventive management of continued airworthiness of airplanes and engines to motivate voluntary submission of reports.

Review the procedure for submission of an SDR and/or Malfunction or Defect Report following an accident or incident and whether the accident or incident data is included into the SDR System database.

Milestones: [To be added and evaluated with FAA and industry.]

Key Stakeholders: Federal Aviation Administration
Airplane model specific type clubs
Industry organizations
Owner/Operators
Maintainers, individual mechanics, repair stations
Trainers
Manufacturers

c. Future Initiatives – FY08 and Beyond

The Small Airplane Directorate COSM Program Plan (January 2005) and the March 2006 aging GA Public Meeting identified numerous ideas and concepts targeting the GA aging fleet concerns. Several of these concerns are being evaluated by the seven industry-led committees discussed previously. As actions are completed to address the top seven concerns expressed at the March 2006 aging GA public meeting, additional concerns expressed at that meeting will be considered. These additional concerns may lead to new aging airplane objectives and revisions to this Roadmap.

The FAA will continue to use public meetings and events (such as EAA AirVenture) as forums to review, discuss, and revise Roadmap initiatives. New initiatives will be discussed and scheduled for future implementation. It is important to maintain continuity with industry on aging airplane issues.

As discussed previously in this Roadmap, many of the FY07 initiatives continue into FY08 and beyond. These follow-on milestones will form an important part of our business plans for FY08 and future years.

(1) Proactive Identification of Safety Concerns

The Phase I effort to write an AC titled, "Structural Integrity Programs for Airplanes with Demonstrated Risk of Catastrophic Fatigue Damage" will be complete in FY08. Phases II and III are expected to be completed in subsequent years.

Resources dedicated to the initiative to determine which small airplane models have a fatigue life limit, a life limit extension, or a safety-by-inspection program, will continue into FY08. Once a reasonably complete and accurate database is established, the risk assessment using the demographic database is needed. This work may start in FY08 by looking at models that have large fleets and limitations. Beyond FY08, the work should continue with further investigation into all models with limitations.

(2) Data Driven Risk Assessment and Risk Management Methods and Guidelines

The research requirements described earlier that begin in FY07 extend through FY12. Funding for this research is reasonably secure but modest. Funding levels and success of the initial projects will determine what follow-on projects should be done. Funding levels and previous research results also determine completion schedules.

Results from the early research, such as the demographics study, will be ready for use in FY08. Initial results from the probabilistic tool research that will begin in late FY07 will not appear until early FY09.

(3) Training and Education

AIR will work with the newly formed FAA Safety Team (FAAST) representatives to coordinate training and education outreach programs.

Outreach regarding aging GA should never end. New ideas and concerns will continue to surface, which provide additional topics to discuss with those affected.

AIR will work with AFS to develop aging airplane education and training programs for maintenance and inspection personnel responsible for continued airworthiness of the GA fleet. Emphasis is on training that will qualify for the FAA's Aviation Maintenance Technician (AMT) Awards Program for both technicians and employers. The success of the AMT Awards Program will improve acceptance of the need for aging airplane education and training programs.

Beyond FY07, the Small Airplane Directorate intends to continue to provide education and awareness via sessions at DER, IA and pilot safety seminars, and other venues.

The Small Airplane Directorate will also continue to work with representative groups such as PAMA, AOPA, EAA, AEA, and GAMA to develop training syllabuses and educational materials to reach a broader audience of inspectors, mechanics, and owner/operators.

(4) Carbon Monoxide Research and Policy Development

The Small Airplane Directorate is coordinating with AFS for research on carbon monoxide in GA airplanes, which is an NTSB safety concern. Research will focus on methods to detect sources of carbon monoxide. Research should include how maintenance and inspection personnel can detect and correct carbon monoxide problems.

The Small Airplane Directorate is working with the Los Angeles ACO to develop policy to streamline the installation approval of TSO-certified carbon monoxide detectors currently available to the GA community.

VII. SUMMARY

As stated in the Purpose section, the Roadmap's primary goal is to drive proactive action to mitigate risks associated with the growing numbers of aging GA airplanes. The FAA and industry continue to work together to evaluate and implement programs to make the aging airplane fleet safe. The Roadmap is the formal on-going plan to manage these risks.

The four primary focuses of the Roadmap are:

- Proactive identification of safety concerns
- Data driven risk assessment and risk management
- Availability of data and parts
- Maintenance and inspection

Numerous initiatives will begin in FY07. The initiatives will begin to address the primary focuses of the Roadmap. Some initiatives will be ongoing into FY08 and beyond.

The Roadmap will be the tool to track and update progress made in all areas of aging airplane program development. It is critical to the success of the aging airplane program to include the participation of all aspects of the GA community.

In the end, this Roadmap should help the FAA, along with other key stakeholders, meet the public's expectations of continued improvement in GA safety. Improvements in GA safety will play a key role in continuing to foster the growing and vibrant interest in GA.

Appendix

Background Information for Aging Airplane Safety Management

The Federal Aviation Administration (FAA) is active in addressing the issues of aging structures, systems, and wiring, both independently and working with industry. Some of the key steps that the FAA and industry have taken to address this challenge include:

- **Small Airplane Directorate Continuing Operational Safety Management (COSM) Program Plan:** A Small Airplane Directorate-led team was chartered in 2002 to produce a Continued Operational Safety (COS) Program in response to expectations of the Aircraft Certification Service (AIR) Safety Management Steering Group (SMSG) Initiatives Roadmap. The Safety Management Systems (SMS) team has since replaced the SMSG.

  The COSM Program Plan introduced multiple initiatives to address the safety management of the growing fleet of aging general aviation (GA) airplanes. They include:

  - Service Difficulty Report (SDR) focal in each Aircraft Certification Office (ACO)
  - Airworthiness Directive (AD) guidelines
  - 14 Code of Federal Regulation (CFR) part 23 safety standards prioritization
  - Improving working relationship with Flight Standards Service (AFS)
  - Formation of a team to develop a framework for vintage airplane COS processes

  Gap analyses of attributes needed for effective COS of civil airplanes:

  - Data collection and analysis
  - Risk assessment and management
  - FAA oversight
  - Support during certification
  - Support in service

- **2000 GA Summit:** In early 2000, the Small Airplane Directorate held a GA Summit Public Meeting. Participants included representatives from virtually all corners of the GA community, i.e., owner/operators, mechanics, type clubs, and representative organizations. The FAA and representatives from these groups formed a GA "ad hoc team" to address issues raised at the meeting. A summary of concerns included:

  - SDRs
  - ADs
  - FAA Form 337, "Major Repair, Major Alteration, Field Approval"
  - Use of the "Historical Category" or "Owner Maintained"
  - Easing the approval of safety improvements
  - Reduced FAA resources
  - More summit meetings
  - Education of the FAA
  - Data availability
  - Maintenance

- **Airworthiness Concerns Process:** Implementation of the Small Airplane Directorate's Airworthiness Concerns Process was a key step in the FAA's proactive approach to its small airplane COS program. Using this process, the FAA coordinates small airplane in-service safety concerns with manufacturers, owner/operators, industry associations, and type clubs. It applies a risk management approach to help resolve these issues in the most appropriate manner.

- **GA "ad hoc team":** Through this GA ad hoc team and other public venues, the FAA is communicating the need for industry involvement to avoid serious age-related safety problems. We have highlighted their importance in:

  - ✔ Maintenance
  - ✔ Reporting service difficulties
  - ✔ Providing updated continued airworthiness instructions
  - ✔ Exploring alternative methods for maintaining vintage airplanes and materials parts distribution

- **"Best Practices Guide for Maintaining Aging General Aviation Airplanes":** The FAA worked with the GA industry ad hoc team to develop this guide. It includes tips for researching an airplane's records and maintenance history, a checklist of items to inspect on older airplanes beyond those of a normal annual inspection, and a description of the role type clubs should take regarding maintenance and inspection of aging airplanes. The FAA funded, produced, and distributed the document. The information included is a collaborative effort of industry, type clubs, and the FAA. In September 2003, the FAA mailed 140,000 copies of this guide to registered airplane owners, FAA Flight Standard District Offices (FSDOs), and industry associations, such as Experimental Aircraft Association (EAA) and Aircraft Owners and Pilots Association (AOPA).

- **Framework for Safety Enhancing Recommendations for the Continued Maintenance and Operations of Vintage Airplanes:** The FAA worked with the GA ad hoc industry team to write a framework for implementing two initiatives for enhancing the safety and improving the maintenance and operations of vintage airplanes.

  The first initiative is to improve the quality of vintage airplane field approvals. This would encourage type clubs to develop libraries of common field approvals for their particular model airplane. The type clubs would populate these libraries with field approvals that meet current FAA standards. These libraries would enhance safety and efficiency by gathering information about already-approved field approvals applicable to maintaining vintage airplanes. These type club libraries would be resources for vintage airplane owner/operators in need of a repair or alteration. To complement the type club libraries, a similar FAA library would further streamline the approval process. An FAA centralized library of already-approved field approvals would provide an excellent source of information for FAA Aviation Safety Inspectors (ASIs), airplane mechanics, and airplane owner/operators looking for safety-enhancing improvements. It would also promote consistency and standardization of alterations to and repairs of older airplanes. A field approval "primer" will provide guidance for good field approval data packages.

The team outlined a second initiative and it is described in the next item.

- **Aging GA Airplanes Advisory Circular (AC)**: The FAA is currently developing an AC to streamline efforts to maintain the safety of old or out-of-production GA airplanes. In many cases, original parts or materials used in these airplanes are no longer available. This AC will provide guidance for substantiating part or material substitutions, including descriptions of data needed to gain FAA-approval. The guide will contain procedures intended to avoid redundant efforts when performing field approvals for similar substitutions on subsequent airplanes. This guidance will help airplane owners and ASIs expedite these field approvals through FSDOs.

  It will explain what steps are needed to document the applicability of substituting parts or materials that are not "exact" and "approved" replacements. (Examples include circuit breakers, batteries, alternator belts, wheels, brakes, and standard parts.) In many cases, approved replacement parts are no longer available for vintage airplanes. In other cases, newer, but not specifically approved for a particular vintage model, parts make the airplane safer. This guidance will make parts selection easier and should expedite the field approval process when needed. Some materials or material forms used to manufacture vintage airplane original parts are no longer available or practical for reproduction to the original design data. Newer materials, or alternate forms, may increase safety because they are stronger, easier to fabricate, or less susceptible to cracking, corrosion, or deterioration. (Examples are machinings instead of castings, new compounds for hoses, fabric, and wood glue.)

- **Data Driven Risk Assessment and Risk Management Techniques:** The Small Airplane Directorate has used a probabilistic method to assess and manage risk related to several recent age-related safety concerns. The Small Airplane Directorate worked with an FAA Technical Center expert to develop a method that uses in-service failure and model (type design) demographic data to estimate the risk of failures to the rest of model fleet. This information is important in determining the severity of the concern, how fast to act, and how aggressive fleet compliance should be.

  The Cessna 402 spar cracking concern first used the concept. It validated Cessna's deterministic-based evaluation and provided solid evidence that the FAA should aggressively mandate fleet modification. The results of the analysis helped quell a vocal owners group and provided the justification for the FAA's AD actions.

  A similar approach to help evaluate the risk associated with wing spar cracking of agricultural use airplanes (crop dusters) was used. Several Air Tractor models are experiencing premature cracking. The probabilistic method helped the FAA determine safe limits for directed inspections and part replacement and justified the FAA AD actions. Similar cracking problems also exist with Thrush models and have been addressed the same way. The results of the risk assessment form the justification of pending proposed AD actions.

Small Airplane Directorate engineers also used probabilistic tools to mitigate the risk associated with Raytheon Beech T-34 and Grumman-Frakes Mallard wing failures caused by fatigue cracking. Analysis results helped the FAA determine when to mandate needed actions, i.e., part replacement, modification, or repetitive inspections.

- **AC 23-13A, Fatigue Fail-Safe, and Damage Tolerance Evaluation of Metallic Structure for Normal, Utility, Acrobatic, and Commuter Category Airplanes:** The FAA recently revised this AC. It provides information and guidance applicable to fatigue, fail-safe, and damage tolerance evaluations of metallic structure in small airplanes. It consolidated several policy documents regarding small airplane fatigue the FAA has written over the last several years. It updated and incorporated a technical report from the early 1970s that explains an acceptable fatigue safe-life analysis method. All small airplane fatigue related policy is now contained in this AC.

- **Aging Airplane Research and Development:** In 2001, the FAA began a series of research grant initiatives with the National Institute for Aviation Research (NIAR) at Wichita State University.

  The first grant addressed the need for engineering data suited to evaluate the effects of metal fatigue on small airplane structures. Fatigue tests of aluminum specimens typical of small airplane construction are being tested. The first phase developed the fatigue life predictive methodology and established baseline material fatigue data. The second phase studied the local geometry effect on the fatigue life and developed load spectra for GA usage. The third phase is evaluating the affects of a range of GA usage. Specimens will be tested with "normal" usage and "severe" usage profiles. The effect of full-scale test components will also be studied. Results from this research will improve the predictive capability for assessing the fatigue tolerance of new designs and help address fatigue related in-service concerns.

  The second grant began in 2002 and evaluated the physical effects of aging on high-time airplanes. Four high-time small airplanes (2 Cessna 402's, 1 Piper Navajo, and 1 Raytheon Beech 1900) were inspected using non-destructive and destructive techniques. The research assessed the airplane structure, wiring, mechanical and electrical systems, and the quality of maintenance performed. Several structural and wiring anomalies were found. This research will help identify early indicators of potentially unsafe effects of aging. Inspecting for these "precursor" conditions can be added to routine inspections for aging airplanes in the future.

  The grant's flexibility enabled NIAR to examine a pair of high-time Beech T-34 wings and wreckage from a T-34 accident caused by metal fatigue. Destructive examination of those structures helped determine additional critical areas of those models.

  A third grant will begin in late 2006. It will produce demographic information about the GA fleet. Existing databases will be examined and queried to provide data regarding individual make/ model fleet sizes, year of manufacture, and type of operation.

The Small Airplane Directorate is sponsoring research into developing a probabilistic risk based method for evaluating structure susceptible to fatigue. This research will begin in 2007. This research objective includes utilizing the material characteristics and fleet demographics developed from the research explained above.

The Small Airplane Directorate also helps sponsor research applicable to broader aspects of airplane aging. New inspection methods, widespread fatigue damage, usage studies, and aging wiring research projects focus on large transports. However, results often apply to small airplanes also and the Small Airplane Directorate has leveraged that research to benefit small airplane safety also.

- **ASTM Wiring Standard Initiative:** ASTM International has formed committee F39 to develop a voluntary consensus standard for GA wiring systems. The Small Airplane Directorate initiated this effort to address the concerns of aging wiring systems throughout the GA fleet. The intent of this effort is to provide a set of wiring standards that will allow the continued operational airworthiness of wiring systems from design, fabrication, inspection, and maintenance aspects. Industry is responding positively to this effort and actively contributes to the ongoing development of the standards.

- **Streamlined Installation of Safety Enhancements:** The GA ad hoc team addressed streamlined FAA-approval of safety enhancements, such as modifications to install shoulder harnesses or updated electrical systems. The FAA continues to issue policy to promote installation of these types of safety-enhancing technologies including use of the Approved Model List Supplemental Type Certificate (STC) process.

- **Cooperative Efforts to Address Safety Concerns:** The FAA worked closely with the GA community to address age related wing/spar fatigue in Cessna 402's, Beech T-34's, Boeing (North American) T-6's, Air Tractor, Thrush, Grumman Mallard, and American Champion series airplanes.

- **Small Airplane Commuter Services Issues Study:** The study identified the top service-related issues on part 23 airplanes utilized in commuter operations. The focus was on eight production models representing the part 23 commuter fleet. The most revealing information from this study indicated a dramatic change in commuter fleet makeup. The fleet is changing from older design airplanes with little or no mandatory structural inspection programs to more modern design airplane models. The increase of part 25 regional jet airplanes has left the part 23 airplanes making up less than 25 percent of the airplane models and less than 10 percent of the fleet capacity.

- **Small Commuter Airplane Catastrophic Precursor Study:** The study formulated the Small Airplane Directorate operating guidelines for determining precursor criteria and monitoring for them. It found that procedures for determining small airplane catastrophic accident precursor criteria, means to identify the precursors, and processes for monitoring them exist, but are not well defined. Several documents provide guidance and technical information related to proactive approaches to monitoring safety concerns.

he study found that the FAA Certification Offices, TC holders, and owner/operators already have some of these best practices in place. However, they are not used as consistently and as proactively as they should be. The study's guidelines addressed "process" as well as precursors and their criteria. The study identified the SDR system as a proactive tool. However, it is underutilized because of lack of data and its database query capability.

The study's report contains guidance for determining precursor criteria for small airplane structures, wiring, and systems. It also contains generic structural, wiring, and systems precursors. It identified the process used to develop Supplemental Structural Inspection Documents and Corrosion Prevention and Control Programs as good practices to use to identify precursors. Improved Instructions for Continued Airworthiness can be a proactive means of monitoring safety concerns by documenting how to inspect for precursors.

- **Small Airplane Precursor Criteria for Electronic/Electrical Systems:** The Small Airplane Directorate reviewed SDRs for electrical and electronic service issues. The reports were evaluated to determine the primary failure condition. Precursor criteria were identified for each failure condition. The report utilized a large amount of research data from the Aging Airplane Research and Development programs through NIAR at Wichita State University.