# Federal Aviation Administration

# Safer Skies:
# Focused Safety Agenda

## General Aviation

## Weather Joint Safety Implementation Team

Final Report

**March 1, 2000**

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## Appendices

# Executive Summary

The Safer Skies Focused Safety Agenda (Safer Skies) was launched in April 1998 in response to a White House initiative. In response to the National safety goal for accident reduction, the General Aviation (GA) Industry and the FAA developed a goal of 363 fewer fatal GA accidents over the 8-year period from 2000 to 2007. The GA goal assumes an annual growth in GA activity of 1.6% per year. If GA activity exceeds the assumed growth rate, the goal should be reviewed in light of the actual activity increases. In addition, the goal assumes that the programs recommended will be implemented as described in this Final Report and the supporting appendices, including the timing and resource commitments provided.

The GA Industry began working with the FAA on Safer Skies in early 1998. This collaborative effort identified the major causes of GA fatal accidents and then chartered two teams to address the top-priority causes: controlled flight into terrain (CFIT) and weather. Inadequate weather decision making accounts for one-quarter to one-third of the accidents. To meet the GA Safer Skies goal, weather-related accidents must be reduced substantially.

In April 1999, the GA Weather Joint Safety Analysis Team (JSAT) (with 15 FAA and five Industry members) reached consensus and issued its Final Report, identifying the "root causes" of fatal GA weather accidents and recommending prioritized "interventions" to mitigate them. The JSAT Report was approved by the Joint Steering Committee (JSC), of FAA, NASA and GA Industry members.

The GA Weather Joint Safety Implementation Team (JSIT) was chartered to recommend cost-effective programs to address the interventions of the JSAT Final Report. This JSIT Report is the consensus product of an intensive two-year, data-driven effort involving 25 FAA, NASA, and National Weather Service (NWS) offices, represented by 30 individuals, and six GA Industry associations. The JSIT recommends the accomplishment of specified Government/Industry programs to accomplish **three principal system improvements**.

1. **Provide more accurate and precise graphical depictions of the location of weather hazard areas, through improved weather forecasts, pilot weather reports, and weather observations. Effectively deliver this information to pilots on the ground and in the air, to controllers, FSS specialists, and dispatchers.**

2. **Provide scenario-based weather training and testing, and improve guidance and operations materials on weather decision making.**

3. **Minimize regulatory impediments to proper weather decision making and weather hazard reporting by pilots.**

## JSIT Program Recommendations

The JSIT recommends implementation programs that address 16 of the 20 JSAT interventions. Implementation programs are not recommended for four of the JSAT interventions. The potential safety benefits of these four interventions may fall outside the scope of weather-related accidents, or the interventions may be considered later when the advancement of technology enables a more favorable cost/benefit ratio or a quicker reduction in fatal accidents.

The JSIT endorses the conclusions listed in the JSAT Final Report, particularly Conclusion K, which recognizes the deficiencies in GA accident data.

Each of the programs that the JSIT recommends is listed beneath the JSAT Recommendations that it supports. All 20 programs involve FAA action and 16 involve Industry action as well. The JSIT recommends 21 Implementation Programs, prioritized according to the JSAT Final Report. Of the 20 Programs, 12 (all of the JSAT Recommendation 1 items) are listed as priority items in the National Aviation Weather Initiatives report, issued by the FAA, NASA, NWS, NTSB, and DOD in February 1999.

**JSAT Recommendation 1.** Provide better information to pilots on the location and severity of weather hazard areas, and better methods of using weather information to make safe decisions on how and when to make a flight.

**Supporting JSIT Programs:**

- JSIT Program 1: Modify NWS programs to expand and accelerate the production of operational, accurate and precise new weather forecast graphics showing the location of weather hazard areas.
- JSIT Program 2: Continue the program to provide operational approvals for these products.
- JSIT Program 3: Modify the program for automatic downlink of weather data from aircraft to include high utilization, low-altitude GA operators.
- JSIT Program 4: Improve the collection, data basing, and dissemination of pilot weather reports (PIREPs)
- JSIT Program 5: Continue the RTCA Select Committee evaluating the March 1999 Certification Task Force recommendations for avionics certification improvements, and implement its recommendations expeditiously.
- JSIT Program 6: Continue the implementation of the FIS weather data link system.
- JSIT Program 7: Improve the weather information available to controllers, including access to the new weather forecast graphics, and enhance pilot/controller communication procedures to improve GA aircraft weather avoidance.
- JSIT Program 8: Develop a new model flight information manual for use by GA pilots for assessing weather risks and avoiding or coping with weather hazards.

- JSIT Programs 9 and 10: Improve the Automated Flight Service Station (AFSS) system through better FSS specialist training and access to new equipment and advanced weather graphics; implement the recommendations of the November 1999 FAA “GA Summit” on Flight Services.

**JSAT Recommendation 2.** Provide new weather training materials and programs to disseminate them.

**Supporting JSIT Program:**

- JSIT Program 11: Develop scenario-based weather decision training and testing for pilots and instructors.

**JSAT Recommendation 3.** Develop new mountain and low altitude airspace communications, navigation and surveillance (CNS) infrastructure, procedures, and information of hazardous weather.

**Supporting JSIT Programs:**

- JSIT Program 12: Provide guidance on mountain weather information and procedures.
- JSIT Program 13: Install new weather sensors in heavily used mountain passes.
- JSIT Program 14: Explore the use of private-sector communications systems for ATC in mountainous areas.
- JSIT Programs 15 and 16: Provide lower minimum en route altitudes using GPS-defined routes to reduce exposure to icing conditions, and expedite implementation of GPS approaches into smaller airports and heliports.

**JSAT Recommendation 4.** Improve technology for rotorcraft and small airplane weather operations.

**Supporting JSIT Program:**

- JSIT Program 18: Accelerating NASA’s synthetic vision program, which uses GPS and a terrain data base to provide pilots a depiction of nearby terrain on a cockpit display.

**JSAT Recommendation 5.** Remove regulatory impediments to weather safety, improve certification processes, and implement services to encourage voluntary installation of aircraft systems to make small aircraft more weather tolerant.

**Supporting JSIT Programs:**

- JSIT Program 17: Encourage pilots to file more PIREPs of weather hazards by overcoming their fear of enforcement through better pilot education; and encourage installation of automatic electronic weather data reporting equipment by adopting a policy that precludes their use in enforcement. [Note: This program was moved from Recommendation 3.]

- JSIT Program 19: Revise the use of “VFR-Not-Recommended” and the definition of “icing” in pilot weather briefings to effectively warn pilots of unsafe conditions.
- JSIT Program 20: Continue the FAA program to evaluate the use of a standby attitude indicator in lieu of a rate-of-turn indicator as a back-up flight instrument.

- **JSAT Conclusion K**: Accident report data deficiencies were identified by the JSAT and the JSIT. The FAA and NTSB should develop methods of improving the collection and analysis of GA accident data, for all types of GA accidents.

## Principal Changes from Current Programs

**FAA**

- Accelerate the operational use of new graphical weather forecasts for use by pilots (pre-flight via computer and in-flight via data link), controllers, dispatchers, and FSS specialists.
- Provide additional controller training and equipment for improved collection and dissemination of PIREPs, and for use of new weather–hazard, forecast graphics.
- Provide additional FSS specialist training for enhanced weather avoidance guidance to pilots, coupled with access to new weather forecast graphics and new equipment to display weather and aircraft positions.
- Develop scenario-based weather decision training and testing for pilots.
- Create new mountain and low-altitude operation programs to provide better mountain-pass weather observations, communications in remote areas, guidance on mountain-flying methods, and additional GPS-defined routes.

**NWS**

- Produce new operational weather forecast graphics, including improvements in the system for creating and evaluating new forecasts.
- Support FAA in FSS specialist training improvements.

**Pilot/operator organizations (AOPA, EAA, HAI, NBAA, NATA)**

- Publicize new FAA weather programs.
- Publish articles to educate pilots on pilot/controller communications, new training programs, actual use of PIREPs in enforcement actions, etc.

**Training Organizations (AOPA ASF, EAA NAFI)**

- Develop and conduct training seminars based on new weather products, new FSS services, new ATC capabilities, and new pilot/controller communications, and new scenario-based weather decision making.

**Manufacturing Organizations (GAMA, SAMA) and Manufacturers**

- Develop, certify, and produce avionics for weather data link and display, and synthetic-vision systems.
- Develop, install, operate and maintain the weather data-link system.

**Note:** The **NASA Aviation Safety Program** contributes significantly to the Safer Skies goal. While the JSIT has recommended no changes in the NASA programs, it does recommend the continuation of these programs as currently planned and budgeted.

## Additional Resource Requirements

For the six-year period FY2000 to FY2005, the implementation programs summarized in this report estimate total resources required. For FY2000 and FY2001, the JSIT determined the required additional full time equivalent employees (FTEs) and additional contract dollars (all expenses other than FAA staff) over the amounts planned and budgeted as of October 1, 1999. The JSIT recognizes that finding the resources to implement these programs will not be easy, and may require offsets in other programs.

The JSIT believes that the additional resource requirements in FY2000 and FY2001 (i.e., over the planned and budgeted amounts) best describe the budgetary impact of the changes necessary to achieve the Safer Skies goal. Most of the additional Government resources needed are from the FAA. The weather forecast program cost of JSAT Recommendation 1 should be shared between the FAA and NWS. Limited additional funding is recommended from NASA. Most GA Industry resources are from weather data-link service providers and avionics manufacturers, and pilots/operators who purchase avionics.

## Additional FAA Resource Requirements in FY2000 and FY2001

**JSAT Recommendation 1**. Improve information on weather-hazard areas. Programs 1 – 10

Four of the 10 supporting programs involve no additional FTEs or contract dollars in FY2000, and six of the 10 programs involve no additional resources in FY2001. However, these programs do require a continuation of current programs at budgeted levels.

FY2000

- Additional resources will be required to provide better training and equipment to FSS personnel in all of the Automated Flight Service Stations. These resources will be determined through a review of available staffing at each AFSS. These resources are necessary for expert weather interpretation for low-time pilots and pilots flying in areas unfamiliar to them.
- Another significant resource increase (which should be shared between the FAA and NWS) is for improved weather forecasts, which requires an additional 6 FTEs and $1.5M in contract dollars.
- The other programs requiring additional funds in FY2000 are PIREP system and ATC procedure improvements, which combined will cost an additional 4 FTEs and $0.53M contract dollars.

FY2001

- The FSS system improvements require additional FTEs,. Increased staffing requirements are for continuing training and are needed for the remainder of the program period, through 2005.
- Improved weather forecasts require the most significant additional contract dollars, $6.5M, and 6 additional FTEs are necessary. Through 2005, the additional FTEs and contract dollars required for this item continue at or below this level.
- Improved PIREPs require an additional 3.5 FTEs and $0.53M contract dollars.

**JSAT Recommendation 2.** Improve weather decision-making training and testing. Program 11

FY2000: No additional FTEs; additional $0.75M contract dollars. (Note: This is the amount that was planned for weather training in FY2000, but was transferred to general salary accounts).

FY2001: No additional FTEs; additional $1.3M contract dollars.

**JSAT Recommendation 3.** Improve mountain and low-altitude flying capabilities. Programs 12 – 16

FY2000: Additional 25 FTEs and $5.1M contract dollars. This recommendation requires this level of additional resources because little is being done to address mountain and low-altitude weather accidents. Low-altitude airplane and rotorcraft operations (e.g., offshore oil, Alaska) have always been a lower priority than other operations, and generally have not been addressed. However, they support important commercial general aviation applications and should be addressed at the recommended levels.

FY2001: Additional 16.5 FTEs and $3.4M contract dollars. The resource requirements are less than in FY2000 because some tasks should be completed in the first year's effort.

**JSAT Recommendation 4.** Improve synthetic-vision technology. Program 18

FY2000: No additional FTEs; additional $0.15M contract dollars.
FY2001: Additional 1 FTE and $0.3M contract dollars.

**JSAT Recommendation 5.** Mitigate regulatory impediments. Programs 17, 19, 20

FY2000: Additional 1.5 FTEs and $0.1M contract dollars. This recommendation would have the most immediate impact on accidents because it would be fully implemented in FY2000.
FY2001: Additional 1 FTE; no additional contract dollars.

### GA Industry Resources: FY2000 and FY2001

**Flight Information Services Data-Link System (FISDL) Providers**.
- Installation, operation/maintenance of the weather data-link system: $22M.

**Avionics Companies: FISDL equipment.**
- FISDL avionics development and certification: $16M.

**Pilot and Operator Organizations: training and education.**
- Four articles each in seven national GA magazines: $0.42M
- 2 organizations will each provide one set of weather seminars covering new weather safety programs: $0.83M.

**Aircraft Owners, Operators, and Pilots: avionics purchases.**
- Voluntary, benefits-driven avionics purchases for weather data link and GPS routes and approaches: $28M.

## Conclusions

**Interdependence of Recommendations.** Many of the recommended programs are interdependent. Their effectiveness depends on the extent to which the various elements of these programs, and other closely related programs, are implemented. The implementation of any of these programs would reduce the probability of fatal GA weather accidents. However, the combined implementation of many of the recommended programs greatly increases their effectiveness. The combined effect of the recommended programs is estimated to achieve the Safer Skies goal because the programs address all major accident root causes.

**Matching Specific Programs to Accident Reduction Statistics.** Numerical reductions in fatal GA weather accidents can not be matched to each JSIT program recommendation due to program interdependence, differences between NTSB accident categories and JSAT root cause categories, and multiple root causes of accidents addressed by JSIT programs.

**Dual Effect of Communications: Safety and Enforcement/Liability.** Communications between pilots and controllers or weather briefers may have both safety and enforcement or liability impacts; the balance must be shifted toward safety improvement. Improvements must be made in the use of the "VFR Not Recommended" statement in weather briefings. Additionally, improve pilots' understanding of the relationship between PIREPs, emergency declarations, refusal of ATC clearances, and enforcement proceedings.

**Endorsement of JSAT Conclusions.** The JSIT reviewed and endorses each of the conclusions reached by the JSAT:

A. The FAA weather information and dissemination system must undergo fundamental changes to better support the flight planning needs of GA pilots.
B. Intuitive graphical depictions of weather hazard areas made available directly to pilots are the most effective form of decision support for most weather hazards.
C. Many of the JSAT Recommendations have been included in previous studies.
D. Interventions must be implemented as high priority in order to achieve the goals of the Safer Skies Agenda.
E. ASRS information should be used in developing and assessing the effectiveness of interventions.
F. Significant reduction in fatal accidents requires an implementation process with accountability elements.
G. Producing more stringent rules related to weather will not increase safety.
H. Currently required pilot training hours are adequate.
I. The Root Cause Analysis process revealed that descriptors (e.g., "get-home-itus", and "get-there-itus", "pilot error") are not sufficient to determine the underlying causes of the weather accidents.
J. JSAT lessons learned (contained in Appendix J of the JSAT Report).
K. Accident report data deficiencies (addressed in Program 21).

# JSIT Member Organizations and Representatives
# Statement of JSIT Consensus

The representatives of the organizations listed below have reached consensus that the recommendations of the General Aviation Weather Joint Safety Implementation Team (JSIT) contained in this report are highly effective and feasible, will provide substantial safety benefits compared to the cost of implementation, and are appropriate responses to the recommended interventions of the GA Weather Joint Safety Analysis Team.

| Member Organization | Representative(s) |
|---|---|
| **Federal Aviation Administration (FAA)** | |
| Regulations and Certification | |
| Flight Standards Service (AFS 800, AFS 400, AFS 600) | Sue Gardner, Ruth Grasel, Hooper Harris, Bob Kopecky |
| Aircraft Certification Service (Rotorcraft Directorate, AIR-130, ANC ACO) | Henry Armstrong, Kevin Bridges, Jim Chudy |
| Office of Aviation Medicine (CAMI) | Kurt Joseph |
| Office of Accident Investigation | Joe Mooney |
| Air Traffic | |
| Flight Services (ATP 300) | Monica Bradford, Lynda Hobbs, Daphne Jefferson |
| Aviation Weather (ARW 2, ARW 100, ARW 200) | Fred Gibbs, FAA Chair; Dr. Frances Sherertz, FAA Chair; Steve Chenault, Richard Young |
| Spectrum Management | Don Nellis |
| Research and Acquisition | |
| Research | George Greene |
| Aviation Weather Research (AUA 430) | Dave Sankey, Jim Sheets |
| Communications, Navigation, Surveillance | Pete Hwoschinsky, Steve Fisher, Stephen Teager |
| Office of Chief Counsel | James Tegtmeier |
| System Safety | Mike Lenz |
| | |
| **National Weather Service (NWS)** | |
| Aviation Weather Program | Dorothy Haldeman |
| Aviation Weather Center | Jim Henderson |
| | |
| **National Aeronautics and Space Administration (NASA)** | |
| Aviation Safety Program | Ron Colantonio |
| | |
| **FAA Employee Unions** | |
| National Air Traffic Controllers Association (NATCA) | Calvin Smith |
| National Association of Air Traffic Specialists (NAATS) | Walter Pike, Dan Petlowany |
| | |
| **GA Industry** | |
| Aircraft Owners and Pilots Association (AOPA) | Bruce Landsberg, John Steurenagle |
| Experimental Aircraft Association (EAA) | Richard Weiss |
| Helicopter Association International (HAI) | Glen Rizner |
| National Air Transport Association (NATA) | Ric Peri |
| National Business Aviation Association (NBAA) | Doug Carr |
| Small Aircraft Manufacturers Association (SAMA) | Paul Fiduccia, Industry Chair |

## A. Introduction

## A. Problem Statement

In order to lower the fatal accident rate in aviation, it is critical to address the causes of accidents involving General Aviation (GA), which comprise more than 90% of the aircraft in the United States. Inadequate pilot decision making regarding weather is a major cause of GA accidents, and over 80% of weather-related accidents are fatal. The societal cost of the approximately 200 annual fatalities in GA weather accidents is over $500 million[1].

## B. Solution: Fatal Weather Accident Reduction

In response to the National goal for accident reduction, the GA Industry and FAA have agreed on an aggressive goal of reducing the number of fatal GA accidents during the years 2000 to 2007, as set forth below[2]. This goal is stated in terms of absolute fatal accident numbers rather than fatal accident rates because of difficulties in determining GA utilization rates. The projected fatal accidents and annual goal are based on an assumed annual growth in GA activity of 1.6% per year.

**Annual General Aviation Performance Targets**

| YEAR | PROJECTED FATAL ACCIDENTS *Without interventions* | ANNUAL GOAL *with Safer Skies interventions* |
|---|---|---|
| ***2000*** | 391 | 379 |
| ***2001*** | 397 | 379 |
| ***2002*** | 404 | 379 |
| ***2003*** | 410 | 374 |
| ***2004*** | 417 | 368 |
| ***2005*** | 424 | 362 |
| ***2006*** | 430 | 356 |
| ***2007*** | 437 | 350 |
| ***8-year Total*** | 3310 | 2947 |

Projected Savings through Safer Skies Interventions:

> **Lives** - The goal provides a reduction of 363 fatal accidents over the eight-year period as a result of Safer Skies programs. At an average of 1.8 fatalities per fatal accident, this equates to a reduction in 653 fatalities over that eight-year period.

[1] Id.
[2] General Aviation Long Term Goal, Safer Skies Program.

**Dollars -** The FAA has set the current economic loss due to one aviation fatality at $2.7 Million, or almost $5 Million per GA accident (not including hull loss, costs of accident investigation, etc.) Achieving the goal of the Safer Skies Interventions would result in economic savings of $1.8 Billion over eight years.

## C. Goal and Objective

**Goal**: Contribute significantly (30%) to the GA Safer Skies fatal accident reduction goal by reducing GA fatal weather accidents by 110 over the eight-year period between 2000 - 2007. The 30% goal is based on the approximate ratio of fatal weather accidents to total fatal accidents in GA in a typical year.[3] If the actual increase in GA activity exceeds the assumed 1.6% per year growth rate, the accident reduction goal should be reviewed in light of activity increases. It is likely that GA activity will increase due to the programs recommended in this Report.

**Objective:** Produce a set of implementation programs that together would achieve the 30% fatal-accident reduction goal in a cost-effective manner, while maintaining or improving the capacity, utility, efficiency, and affordability of GA operations.

## D. Background

### 1. Safer Skies: A Focused Safety Agenda

The goal of the Safer Skies initiative is to significantly reduce fatal accident rates in civil aviation. In early 1998, the GA Industry and FAA worked together to identify the leading causes of fatal GA accidents. After reviewing National Transportation Safety Board (NTSB) statistics, six major categories were identified for intensive analysis. Weather accidents were identified as one of the leading causes of GA fatalities, and were recognized as an obvious area for improvement. Data indicate that between one-quarter and one-third of fatal GA accidents are weather-related.[4]

The Joint Steering Committee (JSC), comprised of the members of the GA Coalition (GAC), FAA and NASA, was formed to oversee the GA portion of the Safer Skies initiative. The JSC adopted the Joint Safety Analysis Team (JSAT)/Joint Safety Implementation Team (JSIT) process, which is a two-step, data-driven approach to reducing accidents. First, a team of FAA and Industry participants (i.e., a JSAT) was chartered to analyze accident reports, identify the root causes of accidents, and develop prioritized interventions to prevent accidents resulting from these causes. Second, another Government and Industry team (i.e., a JSIT) developed and evaluated detailed implementation plans for the interventions.

The process resulted in a prioritized list of programs that must be undertaken by both Government and Industry to achieve the FAA's Safer Skies fatal-accident reduction goal in the most cost-effective manner.

### 2. GA Weather JSAT

[3] AOPA Air Safety Foundation, Nall Report 1998, p. 8.
[4] Safety Review, General Aviation Weather Accidents, AOPA ASF, 1996.

The JSC chartered the GA Weather Joint Safety Analysis Team (JSAT) to analyze the root causes of fatal, GA weather accidents and recommend interventions that could be implemented together by the Government and GA Industry.

The JSAT was composed of 20 FAA and GA Industry members selected for their organizational affiliation, operational experience, and technical expertise. The JSAT reviewed all 151 fatal, GA weather accidents that occurred in 1995. Twenty-two accidents were selected for "root cause" analysis because they were representative of all GA weather accidents and had sufficient accident report data to perform a thorough analysis.

The JSAT issued its Final Report in April 1999. This report contained a total of 20 interventions and recommended five intervention strategies, which are listed in order of priority in Section III[5]. The GA Weather JSAT Final Report in Appendix I provides a description of the interventions associated with each intervention strategy.

### 3. GA Weather JSIT

The JSC chartered the GA Weather JSIT to develop programs that could be used to implement the JSAT interventions. The GA Weather JSIT Charter is in Appendix C. The JSIT was composed of 36 members selected both for their affiliation with the organizations that would be responsible for implementing the JSAT interventions, and their technical expertise with these interventions. The JSIT members, who are listed at the front of this report, include management and technical staff from the following entities:

- FAA, NWS and NASA
- NATCA and NAATS
- AOPA, EAA, HAI, NATA, NBAA, and SAMA

The GA Weather JSIT Final Report is the result of an intense, five-month effort, involving from one-quarter to all of the time of team members during this period.

[5] GA Weather JSAT Report, Executive Summary.

## II. Scope and Method

### A. Scope

The scope of JSIT activity was based on the interventions recommended by the GA Weather JSAT. Some of the GA Weather JSAT and GA CFIT JSAT interventions were similar, so responsibility for these interventions was assigned to either the GA Weather JSIT or GA CFIT JSIT. The table in Appendix E shows the GA Weather JSAT and GA CFIT JSAT interventions that were assigned to the GA Weather JSIT.

### B. Method

#### 1. Implementation Plans

The JSIT organized the JSAT interventions into 23 different "projects." Projects were assigned to work groups consisting of Government and Industry organizations. Assignments were based on expertise in the area of the intervention, and work groups authored at least one implementation plan (IP) for each project. Each IP is numbered according to the nomenclature used in the JSAT Report (e.g., 3-1a or 4-1c, etc.). Appendix E provides a list of JSIT projects, along with the respective work groups responsible for each IP.

The programs recommended in this report are based on the IPs contained in Appendix H. Each IP contains three major sections:

- Section I contains a description of current programs that relate to a JSAT intervention. This description was used to determine if the current program would adequately address an intervention. In some cases, the JSIT recommended simply to continue the current program, with the same deliverables, milestones, schedule and budget.

- Section II contains the details of necessary program modifications, where the current program does not adequately address the JSAT intervention, and includes additional deliverables and required resources, revised milestones, and/or accelerated schedules.

- Section III contains the details of new programs required, including milestones, schedules, and resource requirements.

The IP also provides the following information:

- Program effectiveness and feasibility
- Current programs relative to particular JSAT interventions
- Program performance goals and indicators
- Plan and execution requirements

- Program risks and risk mitigation

The IPs were used by respective JSIT work groups to make recommendations to the JSIT. The IPs also were used by the JSIT to review a respective work group's recommendation. The IPs provide detailed directions that will guide the

FAA, NWS, NASA, and Industry groups as they implement JSIT recommendations that are designed to achieve the Safer Skies accident-reduction goal. Of course, these recommendations must first be accepted by the JSC, and by FAA, NWS, NASA, and Industry management.

## 2. Implementation Plan Summaries

Respective JSIT work groups also prepared an Implementation Plan Summary (IPS) to provide a concise summary of the information needed by the JSIT to decide whether a particular IP should be recommended as a program in this Report, and if the IP should be modified from the version recommended by the work group. The IPSs, included in Appendix G, consist of:

- A JSAT intervention summary that describes the intervention using exact language from the GA Weather JSAT Final Report, and provides an explanation of the intervention
- A JSIT implementation summary that recommends actions by specific parties (e.g., Government, Industry), and defines the resource requirements associated with an IP

## 3. Evaluation

The evaluation of each IPS by the JSIT considered:

- The effectiveness of the IP in reducing fatal, GA weather accidents, compared to the cost
- The technical feasibility of the IP.
- Whether another IP would address the same problem at a lower cost or with less technical risk
- Whether the IP would be effective in reducing accidents before the end of the Safer Skies initiative (i.e., 2007)
- Various options for implementing IPs, with the most cost-effective selected
- Voluntary, benefits-driven equipage was assumed in assessing effectiveness.

The IPs recommended for implementation in this Report are a consequence of the JSIT evaluation. The JSIT voted on each work group recommendation, and revised the IPS as necessary to achieve JSIT consensus. The evaluation also identified several IPs that presently could not be recommended by the JSIT because of the above considerations.

### 4. Creation of Implementation Programs

After recommending IPs for implementation, the JSIT grouped related IPs into single implementation programs for ease of understanding. Section III lists these programs, using the priority order established by the JSAT Final Report.

The two terms in the resource tables at the end of each program are defined as follows:

- "Contract $" means contract dollars, i.e., any payments to contractors for support services, to vendors for equipment, and all other expenses other than FAA employee costs.

- "X + Y" means: "X" dollars or FTEs are already contained in the FY2000 or FY2001 budget plans of the agency as of 10/1/99, and "Y" dollars or FTEs would be required in addition to the budgeted amounts in order to accomplish the implementation program. For the years FY2002 – FY2005, the number represents the total contract dollar or FTE requirements to perform the required action.

Appendix D summarizes the resources required for the implementation programs, both by fiscal year, and by Government agency and Industry sector. This summary includes any reprogramming necessary in FY2000 and 2001.

The implementation programs listed in Section III provide an overview of the actions recommended by the JSIT. The reader is strongly encouraged to examine the IPSs in Appendix G because they provide a comprehensive description of each program and serve as the basis for the JSIT recommendations. The reader is also encouraged to examine the IPs in Appendix H because they provide the analysis of existing programs that the JSIT has recommended continuing and the details of the program modifications or new programs to address JSAT interventions.

## III. Recommended Implementation Programs

### A. ***JSAT Recommendation 1*. Provide better information to pilots on the location and severity of weather hazard areas, and better methods of using weather information to make safe decisions on how and when to make a flight.**

The JSAT Report States:

> *The greatest proportion of fatal, GA weather accidents can be eliminated by implementing the functional group of interventions contained within this recommendation as a group.*
>
> *Recommendation 1 supports strategic decision making in avoiding weather hazard areas by providing pilots with accurate and precise graphical weather products and improved methods of disseminating weather information. This recommendation also improves pre-flight briefings and en route advisories for pilots who use a phone, radio, personal computer, or a data link and moving-map display system. Improving PIREPs and weather information for controllers supports tactical decision-making. The "model" Flight Operations Manual further enhances pilot decision making by providing recommendations and guidance for the use of weather information.*
>
> *The data indicate that providing pilots with better information on the location and severity of weather hazard areas would have a greater impact on preventing accidents than would increased pilot training using existing weather data. Accordingly, interventions to improve flight training were grouped into the second priority recommendation.*

In the previous paragraph, the word “data” refers to 22 accident reports that were determined to be representative of GA fatal weather accidents and were the subject of a detailed root cause analysis by the JSAT. The highest priority interventions, ranked by effectiveness and feasibility, provide pilots with improved information on weather hazard areas.

This JSAT Recommendation contains 7 interventions, which are listed along with the supporting implementation programs recommended by the JSIT.

1. ***JSAT Intervention 3-1. Produce, and make operational, graphical weather information products that show how and when flights can be made safely.***

**Program 1: Operational, graphic weather hazard area forecasts**

This JSAT intervention is the basis for several other JSIT program recommendations. More accurate and precise weather forecasts of weather hazard areas, presented in graphical format to maximize understanding by pilots (including in-flight and under stress), are required to maximize the safety benefits of several other high- priority programs, including:

- Improved FSS briefings
- Improved weather information for controllers
- The FIS weather data-link system
- Improved mountain-area communications and weather guidance

The concept of showing pilots how and when their destination can be reached safely, rather than telling them that their proposed flight is not recommended, represents a fundamental shift in the delivery of weather briefings.

The JSIT determined that this implementation program would be highly effective in reducing fatal accidents, especially when combined with related programs. The benefits of the program would far exceed its costs; hence, the program would make a substantial contribution to Safer Skies fatal-accident reduction goals. The additional cost over currently planned expenditures necessary to bring improved forecasts to pilots would be paid if such forecasts resulted in only two fewer GA, fatal accidents per year.

The JSIT notes that the additional funding required for the recommended program is already within the FAA's Aviation Weather Research program's budget request for FY2001. In addition, the funding also appears to be consistent with the NWS intent to increase its priority for aviation weather. The "Resources" table for this program lists "FAA and NWS" as the source for the additional investment required because the JSIT believes that FAA and NWS management should decide how the program funding will be allocated between them.

The JSIT also notes that approval of the full funding request of the Aviation Weather Research program has been recommended by the FAA's Research, Engineering and Development Committee for the last several years. Likewise, the process of expediting the evaluation of experimental forecast products for operational status is strongly supported by Industry, most recently during the annual Friends/Partners in Aviation Weather meeting of the FAA, NWS and Industry held at the NBAA convention in October, 1999. Finally, the JSIT notes that the DOD also is interested in improved aviation weather forecasts, and could be an additional source of funding for some of these activities.

| | |
|---|---|
| **Program 1** | Operational, graphic weather hazard area forecasts |
| **JSAT Interventions 3-1a – c, and e** | • Provide real-time automated graphical forecasts<br>• Increase accuracy and precision of products<br>• Accelerate operational use of products<br>• Fund flight verification of products<br>• Fully fund FAA Aviation Weather Research Program |
| **JSIT IP(s)** | FAA - NWS:<br>• Accelerate the development of accurate and precise operational area forecasts, in graphical format, showing weather hazard areas: reduced visibility, icing, convection and turbulence.<br>  • Ceiling and visibility: combine observations, historical statistics, and forecast model output into a new graphical area forecast of IMC conditions.<br>  • Icing: invest in a network of ground-based millimeter wave radar to detect icing conditions at critical sites.<br>  • Convection: high-resolution forecast models corrected by frequent NEXRAD observations<br>  • Turbulence: higher resolution forecast model to permit improved turbulence prediction.<br>• Develop automated terminal area guidance forecasts at 3900 airports scheduled to have GPS approaches.<br>• Create an aviation weather database (AWD) as the foundation for forecast development and assessment.<br>• Create a real-time assessment of aviation forecast models for feedback to developers and forecasters.<br>• Support interagency-Industry, next generation, high resolution, aviation forecast model. |
| **Performing Organizations** | AUA-400, ARW-100<br>NWS-AWC<br>NASA-AvSP |
| **Lead Organization** | NWS-OM14 |

**Resources**

FAA and NWS (to be allocated by FAA and NWS Senior Management)

| | **FY2000** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **Total** |
|---|---|---|---|---|---|---|---|
| **FTE** | 7 + 6 | 7 + 6 | 13 | 13 | 13 | 13 | 76 |
| **Contract $** | 3.7M + 1.5M | 2.4M + 6.4M | 9M | 8M | 6.5M | 6.5M | 44M |

NASA

| | **FY2000** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **Total** |
|---|---|---|---|---|---|---|---|
| **FTE** | 7 + 0 | 7 + 0 | 5 | 4 | 4 | 0 | 27 |
| **Contract $** | 1.5M + 0 | 1.7M + 0 | 1.6M | 1.8M | 2M | 0 | 8.6M |

**Program 2: New weather products, operational approvals**

The full safety benefits of better weather forecasts would be realized if the FAA issued operational approvals for use of such forecasts. These approvals also would provide an additional incentive for voluntarily equipping with weather, data-link avionics.

| | |
|---|---|
| **Program 2** | New weather products, operational approvals |
| **JSAT Intervention 3-1g** | Issue generic approvals by FAA Flight Standards for use of new weather products |
| **JSIT IP(s)** | FAA<br>• Develop AIM and AC guidance for pilots in the use of advanced weather products.<br>• Produce inspector guidance for approval of use of advanced weather products for commercial operators.<br><br>Industry<br>• Publish revisable user guidance for products. |
| **Performing Organizations** | AFS-400, AFS-200, AFS-800, ARW-200 |
| **Lead Organization** | AFS-400 |

**Resources**

FAA

| | **FY2000** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **Total** |
|---|---|---|---|---|---|---|---|
| **FTE** | 1.5 + 0 | 1.5 + 0 | 0 | 0 | 0 | 0 | 3 |
| **Contract $** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Industry: Publication actions.

There are nine Programs that involve an Industry publication action -- this Program, plus Programs 4, 7, 8, 12, 13, 17, 19, and 20. There are seven principal GA pilot/operator publications, by AOPA, EAA, HAI, NBAA, NATA, Flying, Plane and Pilot. It is assumed that each of these publications will average four articles addressing the JSIT Programs, at $15K per article, for a total cost of $0.42M.

**Program 3: GA automatic downlink of weather data**

Equipping high-utilization, GA aircraft operating at altitudes below 10,000 feet with humidity sensors and data links would vastly increase the quantity of atmospheric humidity data at low altitudes, where virtually all atmospheric moisture is found. This additional data, when assimilated into forecast models, would offer large improvements in the accuracy of weather forecasts used by all sectors of the economy. Hence, the JSIT recommends an implementation program that would obtain atmospheric humidity data at altitudes below 10,000 feet. This function is termed an Electronic Pilot Report, or E-PIREP.

| **Program 3** | GA automatic downlink of weather data |
|---|---|
| **JSAT Interventions 3-1d and f** | • Accelerate funding for flight verification program to confirm validity of new experimental weather products.<br>• Provide FAA radio spectrum and funding for automatic weather data collection expanded to GA aircraft. |
| **JSIT IP(s)** | FAA<br>• Expand the current transport E-PIREP program to include GA aircraft, under current MDCRS management.<br>• Define GA E-PIREP system/architecture including number and location of participating aircraft.<br>• Reserve additional FAA spectrum for E-PIREPs.<br>• Define incentives for aircraft operator to equip.<br>• Develop and fund a system to equip aircraft, including STCs, purchase, installation, and maintenance.<br>• Develop and deploy necessary ground infrastructure, possibly using current weather data link systems.<br><br>NWS<br>• Expand model input to accept GA data.<br>• Assist in defining model input requirements and architecture for data collection.<br>• Determine US economic benefit from GA data through improvement in forecast model accuracy.<br><br>NASA<br>• Continue funding GA E-PIREP Industry cooperative agreement and sensor development for the next 5 years.<br>• GA E-PIREP Architecture Definition Study<br>• GA E-PIREP Cost/Benefit Analysis<br>• GA E-PIREP User Incentive Study<br>• Weather model sensitivity analysis via NWS<br><br>Industry<br>• Associations assist in developing participant incentives.<br>• Manufacturers develop avionics. |
| **Performing Organizations** | ARW-100, AUA-400, AND-300<br>NASA AWIN<br>NWS FSL |
| **Lead Organization** | ARW-100 |

## Resources

FAA

| | FY2000 | FY2001 | FY2002 | FY2003 | FY2004 | FY2005 | Total |
|---|---|---|---|---|---|---|---|
| **FTE** | 1 + .5 | 1 + .5 | 1.5 | 1.5 | 1.5 | 1.5 | 9 |
| **Contract $** | 1M + .5M | 1M + .5M | 1.5M | 1.5M | 1.5M | 1.5M | 9M |

NWS

| | FY2000 | FY2001 | FY2002 | FY2003 | FY2004 | FY2005 | Total |
|---|---|---|---|---|---|---|---|
| **FTE** | 1 + .5 | 1 + .5 | 1 + .5 | 1 + .5 | 1 + .5 | 1 + .5 | 9 |
| **Contract $** | .75M + .05M | 750K + 165K | .915M | .915M | .915M | .915M | 5.49M |

NASA

| | FY2000 | FY2001 | FY2002 | FY2003 | FY2004 | FY2005 | Total |
|---|---|---|---|---|---|---|---|
| **FTE** | .25 + 0 | .25 + 0 | .25 | .25 | .25 | .25 | 1.5 |
| **Contract $** | 250K + 0 | 250K + 350K | 250K | 250K | 250K | 250K | 1.85M |

Note: DOD is a member of the National Aviation Weather Program Council, which coordinates all aviation weather efforts of the US Government. As such, DOD would have an interest in the improvement of weather forecast models that would result from E-PIREPs, and could be an additional funding source. However, the DOD was not a member of the JSIT, and has not been involved in the preparation of this implementation program.

Industry: It is assumed that FAA, NWS or NASA would fund the avionics development and certification costs for the required equipment.

FAA: The cost estimates do not include avionics development, installation, operation or maintenance, but only includes engineering work to determine how to accomplish electronic data downlink by GA aircraft.

1. ***<u>JSAT Intervention 3-2</u>. Improve the PIREP collection / dissemination system with a common database for controllers, pilots, FSS specialists and dispatchers.***

Program 4**: Improve PIREP system to warn pilots of weather hazards and improve forecasts.**

This program recognizes the importance of PIREPs to weather safety. Frequently, PIREPs are the only reliable data on weather hazards, and will remain so until the accurate and precise graphical forecasts of JSIT Program 1 are in place. In addition, PIREPs are the primary method for forecasters to assess the quality of their forecasts, and for new, automated graphical weather products to be evaluated and improved. In a December 2, 1999 letter to FAA (ATP-300) from the Director of the NWS Aviation Weather Center, the importance of PIREPs to improve aviation weather forecasts was described as well as a proposal to improve the use of PIREPs for this purpose.

| | |
|---|---|
| **Program 4** | Improve PIREP system to warn pilots of weather hazards and improve forecasts. |
| **JSAT Intervention 3-2** | • Encourage more controller involvement in PIREPS by creating simple methods of PIREP entry, retrieval and dissemination by controllers.<br>• Develop common PIREP database for controllers and FSS specialists.<br>• Provide FSS specialists with display of aircraft position overlaid with weather graphics.<br>• Enable GA access to airline PIREP information.<br>• Procedural changes for more PIREPs.<br>• Dedicated PIREP broadcast frequency in each terminal area. |
| **JSIT IP(s)** | FAA<br>• Extensive and comprehensive recurrent training for all controller options on the PIREP system.<br>• Enable short-term “fast file” of PIREPs by controllers to FSS, and data base entry by FSS.<br>• Develop long-term controller automation, with one-key PIREP entry.<br>• Provide access to new NWS graphical products to controllers and FSS specialists.<br>• Education of GA pilots on PIREP submissions.<br>• Get airlines on common FAA PIREP database.<br>• Provide nationwide frequency for PIREP summary broadcasts in terminal areas.<br>• Provide FSS specialists with a display for aircraft position in relation to weather phenomenon and special use airspace, and lost aircraft orientation.<br>• Improve FSS communications network to accept weather graphics and aircraft position data.<br>• Include these in flight instructor training curricula.<br><br>Industry |

| | |
|---|---|
| | • Publish articles on these improvements and GA PIREP submission and retrieval methods. |
| **Performing Organizations** | ATP-300, ATP-100, ATP-200, ARW-200, ATA-100, ATA-400, ARU-300, AUA-400, Fort Worth AFSS.<br>AOPA, EAA, HAI, NATA, NBAA |
| **Lead Organization** | ATP-300 |

**Resources**

FAA Training

| | FY2000 | FY2001 | FY2002 | FY2003 | FY2004 | FY2005 | Total |
|---|---|---|---|---|---|---|---|
| **FTE** | .3 + .7 | .3 + .7 | .7 | .7 | .7 | .7 | 4.8 |
| **Contract $** | .0 | 0 | 0 | 0 | 0 | 0 | 0 |

FAA Equipment

| | FY2000 | FY2001 | FY2002 | FY2003 | FY2004 | FY2005 | Total |
|---|---|---|---|---|---|---|---|
| **FTE** | 4 + 0 | 4 + 0 | 06 | 0 | 0 | 0 | 14 |
| **Contract $** | 0 | 0 | 1M | 0 | 0 | 0 | 1M |

Does not include cost of one-key controller data entry.

Industry publishing: See Program 2 for total Industry resources required for publication actions for all Programs requiring a publication action.

3. ***JSAT Intervention 2-1. Improve certification to accelerate the equipage of GA aircraft with low-cost avionics for data-link display of weather graphics.***

**Program 5: Improve avionics certification**

Because two other implementation program recommendations involve avionics (FIS and EPIREPS), the JSIT recommends the continuation of current activities associated with implementation of the RTCA Task Force 4 recommendations.

| | |
|---|---|
| **Program 5** | Improve avionics certification |
| **JSAT Intervention 2-1b** | Implement the recommendations from RTCA Task Force 4 on Certification, to reduce avionics prices through reduced certification costs and delays |
| **JSIT IP(s)** | FAA<br>• Continue the currently planned program to use RTCA as a forum to evaluate the Task Force recommendations for an implementation decision, develop implementation plans, and develop implementation schedules.<br><br>Industry<br>• Continue the planned support for RTCA Select committee, Steering Committee, and Working Groups. |
| **Performing Organizations** | AVR<br>AOPA, EAA, GAMA, SAMA |
| **Lead Organization** | AVR |

**Resources**
The RTCA committees have not yet developed their work plans and terms of reference and the resources for implementation of this program are not yet known. The resources shown below are estimates to support the effort

FAA

| | FY2000 | FY2001 | FY2002 | FY2003 | FY2004 | FY2005 | Total |
|---|---|---|---|---|---|---|---|
| **FTE** | 5+0 | 5+0 | 0 | 0 | 0 | 0 | 10 |
| **Contract $** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Industry

| | FY2000 | FY2001 | FY2002 | FY2003 | FY2004 | FY2005 | Total |
|---|---|---|---|---|---|---|---|
| **FTE** | 5+0 | 5+0 | 0 | 0 | 0 | 0 | 10 |
| **Contract $** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**4. *JSAT Intervention 3-3. Expedite implementation of the Flight Information Service (FIS) program to provide a national weather data-link system.***

**Program 6: Expedite implementation of weather data link system**

Providing new weather hazard graphics directly to pilots, via data link for cockpit display relative to current position and route of flight, is one of the most effective methods of facilitating better decisions to avoid weather hazard areas. Industry is currently beginning the funding of the ground infrastructure to provide weather data to appropriately equipped aircraft, as well as the avionics development and certification costs.

The JSIT determined that adequate levels of equipage for effective accident reduction would result from voluntary, benefits-driven equipage of FIS avionics. This conclusion is based on an analysis of:

- FAA data on GA voluntary equipage with LORAN and GPS avionics, including on avionics of cost comparable to multi-function navigation and weather display systems – IFR-approved GPS navigators.
- Industry data on sales of multi-function navigation and communication avionics with the capability to display weather graphics.
- Multiple new product introductions of cockpit displays that integrate GPS navigators with weather from on-board radar and data link, traffic from on-board sensors and data link, and terrain warnings from data bases.
- Trade show announcements of portable weather data link receiver-displays at prices comparable to portable GPS moving map units, coupled with FAA and Industry data on portable GPS sales.

Although the rate of equipage with these avionics is not expected to equal that of portable GPS units, the cost-benefit ratio on FAA resources for the Flight Information Services Data Link (FISDL) program is expected to be very high because the program implementation resources are almost totally paid by Industry.

Voluntary, benefits-driven equipage can be accelerated by providing FAA guidance materials and regulatory benefits for equipped aircraft and having Industry advise the pilot/operator Industry of these benefits (see Program 2 above).

Program 6 resulted from combining JSAT Intervention 3-3, the primary intervention regarding FIS implementation, with JSAT Interventions 2-1a and c, which also were related to FIS implementation.

| | |
|---|---|
| **Program 6** | Expedite implementation of weather data link system |
| **JSAT Interventions**<br>**2-1a and c**<br>**3-3a and b** | • Implement the FIS system with free basic services to provide an incentive to equip with avionics to use FIS system: 2-1 a<br>• Create other benefits as incentives for pilots to equip for and use FIS. 2-1 c<br>• Expedite implementation of the Flight Information Services (FIS) system with two service providers to Provide weather hazard area graphics and text to pilots in flight, with implementation by June 2000. 3-1 a and b |
| **JSIT IP(s)** | FAA<br>• Continue efforts to develop and publish AIM guidance for selecting from various providers of weather data.<br>• Continue efforts to make regulatory changes that provide benefits from FIS use.<br>• Develop and refine operational and aircraft certification guidance for the use and installation of FIS equipment in civil aircraft.<br>• Evaluate application of FIS technologies against the existing regulatory structure, amend regulations as required.<br><br>NASA AvSP<br>• Evaluate enhancements to FIS products, delivery and use.<br>• Characterize, model and demonstrate decision-making processes using FIS.<br><br>Industry<br>• Service providers, develop, install, operate, and maintain the FIS system infrastructure.<br>• Avionics companies, develop and certify FIS avionics<br>• Pilot/operator groups, advise pilot Industry of existence and proper use of FIS system.<br>• Manufacturers develop training and operational guidance.<br>• NASA CRA signatories participate in activities above (NASA AvSP).<br>• Associations provide information concerning FIS in journal publications, safety seminars, training and informational materials.<br>• Training organizations, prepare training materials on the new weather products.<br>• Weather product producers, create new products based on the new Government products.<br>• Aircraft owner/operators: equip with necessary avionics. |
| **Performing Organizations** | AND-500, AFS-400, ARW-200, AIR-100, ASR-100<br>NASA AvSP<br>ARNAV, Honeywell, AOPA, AOPA ASF, EAA, GAMA, HAI, NBAA, NATA, SAMA |
| **Lead Organization** | AND-500 |

| | |
|---|---|
| | ARNAV, Honeywell |

**Resources**

FAA

| | FY2000 | FY2001 | FY2002 | FY2003 | FY2004 | FY2005 | Total |
|---|---|---|---|---|---|---|---|
| **FTE** | 2 + 0 | 2 + 0 | 0 | 0 | 0 | 0 | 4 |
| **Contract $** | $1.44M +0 | $1.27M+0 | 0 | 0 | 0 | 0 | 2.71M |

NASA

| | FY2000 | FY2001 | FY2002 | FY2003 | FY2004 | FY2005 | Total |
|---|---|---|---|---|---|---|---|
| **FTE** | 6 + 0 | 6 + 0 | 6 | 6 | 6 | 0 | 24 |
| **Contract $** | $1.44M+0 | $1.27M+0 | $1.5M | $1.6M | $1.7M | 0 | 7.51 |

Industry Service Providers

| | FY2000 | FY2001 | FY2002 | FY2003 | FY2004 | FY2005 | Total |
|---|---|---|---|---|---|---|---|
| **FTE** | +41 | +31 | +26 | +21 | +21 | +21 | 161 |
| **Contract $** | 11M | 11M | 4M | 4M | 4M | 4M | 40M |

Note: These resources do not include substantial investments by other FIS providers, such as Echo Flight and Air Cell, which are not contractually engaged with FAA to provide FIS services.

Avionics Manufacturers

| | FY2000 | FY2001 | FY2002 | FY2003 | FY2004 | FY2005 | Total |
|---|---|---|---|---|---|---|---|
| **FTE** | +0 | +0 | 0 | 0 | 0 | 0 | 0 |
| **Contract $** | 8M | 8M | 4M | 1M | 1M | 1M | 23M |

**5. *JSAT Intervention 4-1. Improve ATC weather information knowledge and dissemination, and develop procedures for handling aircraft that are not weather- tolerant (i.e., not equipped to avoid or cope with weather and are of relatively low performance to climb above or fly around it).***

**Program 7: ATC weather training, equipment and procedures**

Pilots, especially in IFR operations, use information provided by ATC specialists to make weather-related decisions. This information includes the identification and location of weather hazards along a route, and methods of deviating from a clearance to avoid weather hazards once they are identified (including the declaration of an emergency). The lack of timely weather information is a problem, especially for pilots of small airplanes without on-board storm avoidance equipment, ice-protection systems, and the performance to avoid or tolerate weather hazards.

| **Program 7** | ATC weather training, equipment and procedures |
|---|---|
| **JSAT Intervention 4-1** | • Improve ATC weather training, equipment and procedures<br>  • Provide controller recurrent training for special handling of small aircraft.<br>  • Develop controller tools that provide pilots with better weather hazard information.<br>  • Provide procedures for special handling of aircraft that are not weather-tolerant. |
| **JSIT IP(s)** | FAA<br>• Modify controller recurrent training to implement new weather policy, including better understanding of weather limitations of small aircraft, and a refresher of currently available procedures, such as IFR clearances below MEA /MSA and preplanning for aircraft requiring a reentry into the IFR system after canceling IFR on an approach.<br>• Enhance controller displays so that weather hazards are easier for en route and terminal controllers to identify, understand, and disseminate.<br>• Change AIM and FAAO 7110.65 and related documents to allow pilots to use the term “Immediate” as it is currently used by controllers.<br>• Implement the FAA “Aviation Weather Policy” as currently drafted; and reinforce controller responsibilities for assisting small aircraft in jeopardy due to weather.<br><br>Industry<br>• Educate pilots on best practices for use of available procedures to quickly get the clearances and clearance amendments they need for safe operations, including use of the word “immediate”.<br>• Educate pilots on need for them to make clear to controllers their problem that is leading to a request for clearance or amendment, or alternative, including use of the word “unable” for any situation that would put the pilot in jeopardy. |

| | |
|---|---|
| | • Educate pilots on what actions are actually taken when emergencies are declared to address pilot perceptions of automatic enforcement actions. |
| **Performing Organizations** | ATP-100, ATP-300, AFS-400, AFS-800, ASY-300, ARA, AAF, ARW-200, ATX-100, AMA-500<br>NATCA<br>AOPA, AOPA ASF, EAA, NBAA, HAI |
| **Lead Organization** | ATP-100 |

**Resources**

FAA

| | **FY2000** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **Total** |
|---|---|---|---|---|---|---|---|
| **FTE** | 5.1 + 0 | 2 + 0 | | | | | 7.1 |
| **Contract $** | 0 | 0 | | | | | 0 |

**Note:** Does not include cost of incorporating advanced weather functionality into DSR and STARS. FTEs from existing staffing.

Industry publishing: See Program 2 for total Industry resources required for publication actions for all Programs requiring a publication action.

**6. *JSAT Intervention 1-3. Develop a "model" Flight Operations Manual for assessing weather risks and avoiding or coping with weather hazards.***

**Program 8: Model Flight Operations Manual**

Pilots operating under Parts 121, 125, and 135 are required to use a Flight Operations Manual (FOM) that assists them in assessing the risks of a particular operation, including various types of weather hazards. Many corporate flight departments operating under Part 91 also utilize a FOM. However, most pilots operating under Part 91 do not have an FOM to assist them in making the appropriate decision about a flight that may encounter known weather hazards.

| | |
|---|---|
| **Program 8** | Model Flight Operations Manual |
| **JSAT Intervention 1-3** | Develop a "model" Flight Operations Manual to assist pilots in assessing weather risks and avoiding or coping with weather hazards. |
| **JSIT IP(s)** | FAA<br>• New program to develop a flight operations manual that contains decision models and weather-related materials that help the pilot determine a “weather-risk index”. The manual also will contain established best practices for making weather decisions.<br><br>NWS<br>• Support FAA activities.<br><br>NASA AvSP<br>• Support FAA activities.<br><br>Industry<br>• Develop and publicize training programs. |
| **Performing Organizations** | AFS-800, ARW-200, AAM, AFS-400, AND-500<br>NWS<br>NASA AvSP |
| **Lead Organization** | AFS-800 |

**Resources**

FAA

| | **FY2000** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **Total** |
|---|---|---|---|---|---|---|---|
| **FTE** | 1.5 + 0 | 1.5 + 0 | 1.5 + 0 | 1.5 + 0 | 1.5 + 0 | 1.5 + 0 | 9 |
| **Contract $** | + .1M | + .05M | .05M | .05M | .05M | .05M | .35M |

Industry: There are four programs that involve Industry training actions: This program and Programs 11, 15, and 16. The JSIT estimates that two training organizations will each produce one seminar covering all four programs, and will distribute the seminars to 200 locations each. Total cost $0.83M over two years.

**7. *JSAT Intervention 3-4. Improve the FSS system, including DUATS, FSS equipment and weather briefings.***

**Program 9: Improve FSS specialist training**

The JSIT determined that this program would benefit safety significantly. In response to a JSAT recommendation, an FAA office (ATP-300) organized a five-day GA Summit on Flight Services in November, 1999. At the conclusion of the Summit, the 75 attendees -- FAA HQ, regional, and local management, the FSS specialists union (NAATS), and the major user groups -- reached unanimous agreement on actions to improve pilot weather briefings. The Summit attendees endorsed all of the actions for improving the FSS system that the JSIT had developed previously. The JSIT later adopted other Summit recommendations that were within its scope. Appendix F lists all GA Summit recommendations, including those in the following JSIT program recommendation.

| **Program 9** | Improve FSS specialist training |
|---|---|
| **JSAT Intervention 3-4a** | Improve FSS specialist training to:<br>• Advise pilots on the time that a weather hazard area will move into a planned flight route and the probability of the weather hazard will exist in a specific time period.<br>• Describe the location of weather hazard areas relative to the proposed route of flight and ground reference points that pilots can easily identify (e.g., VORs),<br>• Suggest alternative flight routes, altitudes, and times that are appropriate for pilot and aircraft capability, and weather and terrain characteristics,<br>• Provide only the information that is specific to a flight and interpretation of weather hazards, and emphasize the importance of FSS Specialist training, enhanced by computer-based tutorials and reinforced by Air Traffic Bulletins.<br>• Emphasize the importance of FSS Specialist training, enhanced by computer-based tutorials and reinforced by Air Traffic Bulletins. |
| **JSIT IP(s)** | FAA<br>• Provide advanced aviation weather training to all FSS specialists and supervisors, which will increase their knowledge base.<br>• Update and require Pilot Weather Briefing (PWB) course providing refresher and recurrent training every two years.<br>• Provide training in customer service to all specialists and supervisors to improve the communications with the general aviation Industry.<br>• Provide ground school type training to all specialists and supervisors who are not pilots, to enhance the understanding of aircraft performance and the pilot capabilities and needs.<br>• Increase the required number of “tape-talks” to one per quarter to increase quality control of services at FSS facilities. |

| | |
|---|---|
| | • Assess and determine the delivery method for training and quality assurance at each AFSS.<br>• Provide on-going training to FSS specialists and supervisors on new weather products as they become available through FISDL, ADDS and other sources. Additionally, the 2-year recurrent PWB course must be modified to include techniques for briefing pilots using these products.<br><br>NWS<br>• Enhance National Weather Service staff at FAA Academy to develop and staff a Quality Control Office.<br>• Incorporate into the training curricula the two NASA decision-aid tools described below.<br><br>NASA AvSP<br>• Continue Weather Avoidance Using Optimization as a decision aid program.<br>• Continue Aviation Weather Awareness and Reporting enhancement program. |
| **Performing Organizations** | ATP-300, ARW-200, ASY-300, ATX-100, AAT-200<br>NAATS<br>NWS<br>NASA AvSP |
| **Lead Organization** | ATP-300 |

**Resources**

FAA

| | **FY2000** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **Total** |
|---|---|---|---|---|---|---|---|
| **FTEs** | 1.3 + 0 | 1.3 + 0 | 1.3 | 0 | 0 | 0 | 3.9 |
| **Contract $** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Note: FTEs may come from existing staffing..

NASA

| | **FY2000** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **Total** |
|---|---|---|---|---|---|---|---|
| **FTEs** | .25 + 0 | .25 + 0 | .25 + 0 | 0 | 0 | 0 | .75 |
| **Contract $** | .62M + 0 | .62M + 0 | .62M + 0 | 0 | 0 | 0 | 1.86M |

NWS

| | **FY2000** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **Total** |
|---|---|---|---|---|---|---|---|
| **FTEs** | 1 +0 | 1 + 0 | 1 | 1 | 1 | 0 | 5 |
| **Contract $** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Program 10: Improve FSS equipment**

Program 10 is closely associated with Program 9, and must be implemented with it to address the JSAT intervention that calls for improving the FSS system. It would provide improved equipment to enable the FSS specialist to maximize the value of his weather decision support to pilots.

| | |
|---|---|
| **Program 10** | Improve FSS equipment |
| **JSAT Intervention 3-4b** | Improve FSS equipment:<br>• Provide a link between the FSS weather display and the home computer displays of pilots to create an interactive briefing system that enables both the pilot and the FSS specialist to view the same weather graphics.<br>• Accelerate the implementation of advanced weather graphics for FSS specialists.<br>• Enable FSS specialists to access information from airline dispatch centers and meteorology departments (e.g., new convective weather products now used for collaborative decision making purposes). |
| **JSIT IP(s)** | FAA<br>• Provide approved new weather graphics for FSS specialists through intranet or internet connection to NWS Aviation Digital Data System (ADDS) and FAA Flight Information Services Data Link (FISDL) weather graphics.<br>• Enable FSS specialists and pilots to view same weather graphics during weather briefing through use of ADDS.<br>• Provide FSS Specialists with enhanced work stations.<br>• OASIS program is intended to address this issue, but lower cost methods are recommended in the interim. The follow-on ATP-300 GA Summit meeting scheduled for January 2000 should review the OASIS program and recommend changes to the program or alternate solutions if necessary.<br>• FAA HQ should reestablish the minimum functional requirements for FSS-contracted weather products and necessary displays and communications.<br>• Fully fund the FAA aviation weather research program to provide needed new weather forecast products over ADDS, including taking experimental products to operational status, and make them available for FSS specialists. (See intervention 3-1) |
| **Performing Organizations** | ATP-300, AUA-400, ARU-300, ATP-400 |
| **Lead Organization** | ATP-300 |

**Resources**

FAA – Short-term ADDS Access

| | **FY2000** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **Total** |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FTEs** | 8 | 0 | 0 | 0 | 0 | 0 | 8 |
| **Contract $** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

FAA – Long-term OASIS

| | **FY2000** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **Total** |
|---|---|---|---|---|---|---|---|
| **FTE** | 9 + 0 | 9 + 0 | 9 | 9 | 9 | 9 | 54 |
| **Contract $** | 34M + 0 | 28.1M +0 | 17.1M | 17.1M | 16.6M | 16.6M | 129.5M |

Note: This was the OASIS budget on 10/1/99.

**B. JSAT Recommendation 2.** ***Improve weather training materials and programs to disseminate them.***

The JSAT Report States:

*Recommendation 2 provides for better training of pilots to avoid and cope with weather hazards through improved training materials and enhanced continuing education programs to disseminate such materials.*

1. ***JSAT Intervention 1-1. Improve training materials, with updated practical guidance on weather hazard risk assessment, avoidance, and recovery.***

2. ***JSAT Intervention 1-2. Improve flight instructor and pilot continuing education programs on weather hazards and decision making.***

**Program 11: Weather related airmen certification, training, and testing**

Program 11 combines these two JSAT interventions together to create a new weather decision-making program, which is based on scenario-based training and testing, and best achieves these interventions.

Although the training interventions (i.e., 1-1 and 1-2) are part of the second-priority JSAT recommendation, the JSIT determined that Program 11 would be highly cost-effective because it enables the programs associated with the first-priority JSAT recommendation to maximize GA, fatal-accident reduction.

| **Program 11** | Weather related airmen certification, training, and testing |
|---|---|
| **JSAT Interventions**<br>**1-1**<br>**1-2** | • Pilot training materials<br>• Pilot and flight instructor continuing educational programs |
| **JSIT IP(s)** | FAA<br>• Develop and implement scenario-based weather training and testing to develop pilot weather judgment and decision making skills, including:<br>  • Flight Instructor Refresher Clinic<br>  • Flight Review<br>  • CFR part 141 Approved Schools<br>  • Instrument Proficiency Checks<br>  • Knowledge Testing<br>  • Pilot Examiner Standardization Team<br>  • Practical Test Standards<br>• Update weather related ACs.<br>• Reinstate Exam-O-Gram Program.<br>• Establish a weather-training site on the FAA's home page, with the above information and links to other Government and Industry weather information web sites.<br>• Inform pilots of these new training aids.<br>• Continue and complete the combined private/instrument license training and testing.<br><br>Industry |

| | |
|---|---|
| | • Develop and incorporate the updated Government products described above into training programs for dissemination to GA pilot groups. |
| **Performing Organizations** | AFS-800, AFS-400, AFS-600, ARW-200, AAM-500, AND-500<br>NWS-OM14<br>NASA<br>AOPA ASF, EAA, NBAA, HAI, NAFI. |
| **Lead Organization** | AFS-800 |

**Resources**

FAA

| | **FY2000** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **Total** |
|---|---|---|---|---|---|---|---|
| **FTE** | 1.15 +0 | 1.25 +0 | 1.25 | 1.25 | 1.25 | 1.25 | 7.4 |
| **Contract $** | 0 + .75M | 0+1.3 M | .75M | 1.275M | .75M | .75M | 5.575M |

NWS

| | **FY2000** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **Total** |
|---|---|---|---|---|---|---|---|
| **FTE** | 0 + .125 | 0 + .125 | .125 | .125 | .125 | .125 | .75 |
| **Contract $** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

NASA

| | **FY2000** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **Total** |
|---|---|---|---|---|---|---|---|
| **FTE** | 0 + .125 | 0 + .125 | .125 | .125 | .125 | .125 | .75 |
| **Contract $** | .5M | .4M | .1M | .1M | .1M | 0 | 1.2M |

Industry: See Program 8 for total Industry training resources.

### C. *JSAT Recommendation 3. Develop mountain and low-altitude airspace communications, navigation and surveillance (CNS) infrastructure, procedures, and information of hazardous weather.*

Some of the mountain-flying implementation programs are highly interdependent. These programs provide better weather observations, provide communication systems to get this information to pilots, and provide guidance on weather-information sources and criteria.

#### 1. *JSAT Intervention 5-1 d and e. Develop enhanced operational procedures for mountain operations.*

**Program 12: Weather information sources and safety criteria for mountain operations.**

Many pilots who routinely fly in flatland areas are unaware that mountain operations present unique weather hazards for small aircraft operations. This implementation program would provide guidance on avoiding these hazards to pilots inexperienced with mountain operations.

| | |
|---|---|
| **Program 12** | Weather information sources and safety criteria for mountain operations. |
| **JSAT Intervention 5-1d** | Provide guidance for pilots on the best weather information sources and criteria for determining the impact on mountain operations. |
| **JSIT IP(s)** | FAA<br>• Survey existing weather and other types of surveillance systems, identifying what each system is capable of detecting, and to what specificity it can measure.<br>• Develop matrix of mountain area weather hazards and measurable phenomenon to which that hazard is associated.<br>• Provide guidance to the flying public through modification of existing AIM and AC guidance, and development of new guidance materials.<br>• Update knowledge tests and practical test standards to incorporate sensor/criteria application to mountain flying.<br><br>Industry<br>• Support survey efforts by providing subject matter experts from different mountain flying communities.<br>• Develop revisable training materials, seminars and journal publication articles. |
| **Performing Organizations** | AFS-400, AFS-600, ANC-ACO, ARW-200, AAL-200, AFS-200, ARW-200<br>AOPA, EAA, NATA |
| **Lead Organization** | AFS-400 |

**Resources**

FAA

| | FY2000 | FY2001 | FY2002 | FY2003 | FY2004 | FY2005 | Total |
|---|---|---|---|---|---|---|---|
| **FTE** | + 3.5 | + 1.5 | 0 | 0 | 0 | 0 | 5 |
| **Contract $** | + .1M | 0 | 0 | 0 | 0 | 0 | .1M |

Industry publishing: See Program 2 for total Industry resources required for publication actions for all Programs requiring a publication action.

**Program 13: Install weather sensors in mountain passes**

One of the causes of mountain weather accidents is the lack of weather observations in critical mountain passes. Video technology makes practical the collection of such observations. When coupled with weather data link systems, their direct display in the cockpit can further increase their effectiveness.

| | |
|---|---|
| **Program 13** | Install weather sensors in mountain passes |
| **JSAT Intervention 5-1e** | Place AWOS units or remote TV cameras in critical mountain passes. |
| **JSIT IP(s)** | FAA<br>• Continue the currently appropriated, budgeted, and planned program in Alaska.<br>• Determine to which passes in the contiguous U.S. this program should be expanded.<br>• Provide additional funding and resources to expand the program to the contiguous U.S.<br><br>Industry<br>• Publicize and educate the pilot Industry about the proper use of this data. |
| **Performing Organizations** | ANI-700, AAL-500, AFS-400 |
| **Lead Organization** | ANI-700 |

**Resources**

FAA

| | **FY2000** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **Total** |
|---|---|---|---|---|---|---|---|
| **FTE** | + 4 | + 2.5 | 2.5 | 0 | 0 | 0 | 9 |
| **Contract $** | 1.7M | 0 | 0 | 0 | 0 | 0 | 1.7M |

Note: Additional resources to expand this program to the contiguous U.S. have not been determined.

Industry publishing: See Program 2 for total Industry resources required for publication actions for all Programs requiring a publication action.

1. ***JSAT Intervention 5-2. Exploit new CNS systems in mountainous areas to improve pilots' ability to fly safely below freezing levels or cloud bases.***

**Program 14: Use private sector communications systems for ATC**

New private-sector communication systems, such as LEO satellites, could provide pilots in mountainous areas with another communication link to FSS and ATC systems.

| | |
|---|---|
| **Program 14** | Use private sector communications systems for ATC |
| **JSAT Intervention 5-2a** | Expand the area of effective air-ground communications through the use of new private sector communications systems (e.g., air cellular, LEO satellite) that can be linked to ATC |
| **JSIT IP(s)** | FAA<br>• Investigate and define criteria for approval of private sector spectrum for aviation uses.<br>• Make available the flight test plan used in the low-cost avionics, test bed program (GlaStar) for FIS data transmission and coverage performance.<br>• Make criteria, including technical requirements, available through Advisory Circular, Handbook Bulletin, Aeronautical Information Manual, or Technical Standard Order, as appropriate.<br><br>NASA<br>• Characterize technical performance of existing and next generation communication technologies and systems including private sector communications systems. |
| **Performing Organizations** | AFS-400, AND-500, ASR-100, ATO-400, AIR-100<br>NASA WINCOMM |
| **Lead Organization** | AFS-400 |

**Resources**

FAA

| | **FY2000** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **Total** |
|---|---|---|---|---|---|---|---|
| **FTE** | + 8 | + 6 | 5.5 | 5 | 0 | 0 | 24.5 |
| **Contract $** | + 1M | + 1.6M | 1M | 1M | 0 | 0 | 4.6M |

NASA

| | **FY2000** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **Total** |
|---|---|---|---|---|---|---|---|
| **FTE** | 5 + 0 | 8 + 0 | 9 | 10 | 10 | 0 | 42 |
| **Contract $** | 2.1M + 0 | 2.3M + 0 | 2.4M | 3.1M | 3.1M | 0 | 13M |

**Program 15: Operational criteria that provide lower minimum en route altitudes using GPS**

In some areas, minimum en route altitudes could be lowered significantly by defining routes based on GPS rather than VOR; hence, aircraft could operate below the freezing level more often. This program involves Industry development of "cost-effective" IFR en route GPS receivers and operator purchases of "sufficient quantities" of these avionics. The terms "cost effective" and "sufficient quantities" are undefined. The intent is that the operational value of the avionics compared to their installed costs would be sufficient to encourage equipage. It is expected that avionics will be produced at various prices for different segments of GA, with no one price defining affordability.

| | |
|---|---|
| **Program 15** | Operational criteria that provide lower minimum en route altitudes using GPS |
| **JSAT Intervention 5-2b** | Exploit new communications, navigation and surveillance systems in mountainous areas to improve the ability of pilots to safely fly below the freezing level or cloud bases. |
| **JSIT IP(s)** | FAA<br>• Use existing Satellite Operational Implementation Team (SOIT) Vertical Flight Working Group (VFWG) resources to establish a GPS stand alone special route development process.<br>• Accomplish rulemaking and procedural changes to implement a GPS route structure for the entire NAS, with emphasis on mountainous area criteria development and implementation.<br>• Implement WAAS expeditiously<br><br>Industry<br>• Operators apply for special GPS route authorization.<br>• Avionics manufacturers develop cost effective IFR en route GPS receivers and operators acquire them in sufficient quantities to provide access to new routes.<br>• Associations/groups develop revisable training materials, seminars and journal publication articles. |
| **Performing Organizations** | AFS-400, AFS-200, AFS-800, AVN-100, ARM-100 |
| **Lead Organization** | AFS-400 |

**Resources**

FAA

| | FY2000 | FY2001 | FY2002 | FY2003 | FY2004 | FY2005 | Total |
|---|---|---|---|---|---|---|---|
| **FTE** | 1 + 4 | +1 | 1 | 1 | 1 | 1 | 10 |
| **Contract $** | .2M+ .8M | +.3M | .3M | .3M | .3M | .3M | 2.5M |

Note: These resources also support the infrastructure development in Program 14 above. They do not include WAAS implementation.

Industry: See Program 8 for total Industry training resources.

***3. JSAT Intervention 7-4. Expedite implementation of GPS approaches into smaller airports and heliports.***

**Program 16: Rotorcraft IFR procedures improvements**

The use of IFR operations based on terrestrial navigation systems often reduces safety margins for rotorcraft in typical low-level operations. Rotorcraft safety can be increased by using GPS-based departure and approach procedures.

| **Program 16** | Rotorcraft IFR procedures improvements |
|---|---|
| **JSAT Interventions 7-4a, b and c** | • Accelerate publication of precision and non-precision IFR GPS "standalone" approaches to eliminate situations where VFR transitions must be made between an airport with an approach and the actual destination in low visibility conditions.<br>• Establish low level departure procedures that allow departures in the direction of the route to avoid creating a fuel-critical situation later in the flight.<br>• Issue a rule establishing alternate airport minimums for rotorcraft. |
| **JSIT IP(s)** | FAA<br>• Use existing Satellite Operational Implementation Team (SOIT) Vertical Flight Working Group (VFWG) to establish a Vertical Flight GPS Roadmap, Concept of Operations.<br>• Complete WAAS testing and criteria development for helicopters.<br>• Complete FAR 91helicopter alternate airport rulemaking.<br>• Resolve aircraft certification, procedure and heliport design criteria for IFR precision approaches.<br>• Expand helicopter efforts to include small airport/GA airplane operations.<br><br>Industry<br>• Provide input to FAA infrastructure development efforts.<br>• Operators apply for IFR authorization/qualification.<br>• Avionics manufacturers develop cost effective IFR WAAS GPS approach receivers for new procedures<br>• Associations/groups develop revisable training materials, seminars, and journal publication articles. |
| **Performing Organizations** | AFS-400, AND-500, ACT-300, AAS-300<br>AHS, HAI, operators and manufacturers |
| **Lead Organization** | AFS-400 |

**Resources**

FAA

| | **FY2000** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **Total** |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FTE** | 6.5 + 5.5 | 6.5 + 5.5 | 12 | 12 | 12 | 12 | 72 |
| **Contract $** | 2.65 + 1.5M | 2.65 + 1.5M | 4.15M | 4.15M | 4.15M | 4.15M | 24.9M |

Industry: See Program 8 for total Industry training resources.

***4. JSAT Intervention 6-1. Encourage pilots to make hazardous weather reports by providing immunity from enforcement.***

**Program 17: Avoid pilot non-filing of PIREPs because of fear of enforcement**

Pilots may not file PIREPs of hazardous weather because of fears that such information could precipitate an enforcement action against them. For example, the JSAT analysis revealed that pilots operating airplanes without ice-protection equipment would not file a PIREP of moderate icing conditions.

| | |
|---|---|
| **Program 17** | Avoid pilot non-filing of PIREPs because of fear of enforcement |
| **JSAT Intervention 6-1** | Encourage pilots to make hazardous weather reports by providing immunity from enforcement. |
| **JSIT IP(s)** | FAA<br>• Develop articles explaining that PIREPs are not used to initiate enforcement actions.<br>• Determine the impact on enforcement actions for unauthorized flight in IMC or icing conditions if PIREP information from the pilot would be excluded from evidence, and if small, adopt policy not to use PIREP information as evidence in enforcement actions, and then publicize this fact to pilots.<br>• Adopt a policy, or initiate a rule change if necessary, so that automatic, electronic PIREPs (data link transmission to the ground of weather data for assimilation into the forecast models and for retransmission to pilots) would not result in the initiation of, or as evidence in, enforcement actions.<br><br>Industry<br>• Publish magazine articles explaining under what circumstances and how PIREPs are used in enforcement action against pilots. |
| **Performing Organizations** | AFS-800, AFS-200, AGC, AFS-400, ASY-300<br>AOPA ASF, EAA, NATA, NBAA |
| **Lead Organization** | AFS-800 |

**Resources**

FAA

| | FY2000 | FY2001 | FY2002 | FY2003 | FY2004 | FY2005 | Total |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FTE** | +.25 | 0 | 0 | 0 | 0 | 0 | .25 |
| **Contract $** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Industry publishing: See Program 2 for total Industry resources required for publication actions for all Programs requiring a publication action.

**C. <u>JSAT Recommendation 4</u>. *Improve technology for rotorcraft and small airplane weather operations.***

The JSAT Report States:

*Recommendation 4 provides safety improvements that are technology-based, some of which will have a larger impact on accidents after the 10-year period because there will be a longer lead-time to implementation.*

1. ***JSAT Intervention 2-3. Increase R&D for on-board systems, such as forward-looking icing and turbulence detectors, which help pilots identify and cope with weather hazards.***

**Program 18: Synthetic Vision – Virtual VMC in IMC**

The JSAT intervention that called for an increase in R&D for on-board systems was divided into two categories before being analyzed by the JSIT.

- Systems currently designed only for transport category aircraft: high technical risk, high resources required for success for transports, high additional resources for application to GA, and long time delay until substantial introduction into GA fleet for effective accident reduction. These programs include SOCRATES, ACLAIM (now the Turbulence Detection LIDAR program), AOS, and RAR. **These projects were recommended for reconsideration at a later time because of the delay in potential effectiveness in reducing GA accidents. (See Section IV).**

- A system currently designed for GA as well as transport category aircraft and likely affordable by a significant portion of the GA fleet within the Safer Skies period. The Synthetic Vision Program (which uses GPS, detailed terrain databases, and a color-graphics cockpit display to show the pilot an outside-the-window view of VMC conditions – providing virtual VMC in IMC conditions. This intervention is described in the following implementation program **The JSIT believes that this intervention would have a large impact on fatal VFR-into-IMC accidents associated with CFIT and loss of control, due to weather and non-weather causes.**

| | |
|---|---|
| **Program 18** | Synthetic Vision – Virtual VMC in IMC |
| **JSAT Intervention 2-3e** | Affordable synthetic vision. |
| **JSIT IP(s)** | NASA<br>• Continue developing a certifiable GA system by 2004.<br><br>FAA<br>• Develop an operational concept.<br>• Develop and certify air traffic and flight procedures.<br>• Develop methods to certify avionics and databases.<br><br>Industry<br>• Avionics manufacturers participating in NASA program.<br>• Publish articles about synthetic vision. |
| **Performing Organizations** | ARW-100, AAR, ATP, AFS-400, AFS-200, AFS-800, AIR-100<br>NASA AvSP<br>Avionics manufacturers participating in NASA program |
| **Lead Organization** | NASA AvSP |

**Resources**

FAA

| | **FY2000** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **Total** |
|---|---|---|---|---|---|---|---|
| **FTE** | .5 + 0 | .5 + 1 | 3.5 | 3.5 | 3.5 | 3.5 | 16 |
| **Contract $** | + .15M | + .3M | .5M | .5M | .5M | .5M | 2.45M |

NASA

| | **FY2000** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **Total** |
|---|---|---|---|---|---|---|---|
| **FTE** | 15 + 0 | 15 + 0 | 15 + 0 | 15 + 0 | 15 + 0 | 7 + 0 | 82 |
| **Contract $** | 5.3M + 0 | 6.6M + 0 | 5.9M + 0 | 6M | 6M | 3M | 32.8M |

Industry (NASA Program Cost Share)

| | **FY2000** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **Total** |
|---|---|---|---|---|---|---|---|
| **FTE** | | | | | | | |
| **Contract $** | 2M + 0 | 2M + 0 | 2M | 2M | 2M | 1M | 11M+0 |

Industry Avionics Development Cost

| | **FY2000** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **Total** |
|---|---|---|---|---|---|---|---|
| **FTE** | | | | | | | 0 |
| **Contract $** | | | | 5M | 5M | | 10M |

Industry publishing: See Program 2 for total Industry resources required for publication actions for all Programs requiring a publication action.

**C. *JSAT Recommendation 5. Remove regulatory impediments to weather safety, improve certification process, and implement services to encourage voluntary installation of aircraft systems to make small aircraft more weather-tolerant.***

**1. *JSAT Intervention 6-2. Define use of "VFR not recommended" and "known and forecast" icing in ways that are operationally useful to pilots***

**Program 19: Definitions of "VFR not recommended" and "known icing"**

The misuse and overuse of the statement "VFR not recommended" by FSS weather briefers has resulted in the statement's ineffectiveness. The JSIT recommends several changes to insure that this warning is used when it applies specifically to conditions along the route at the time of flight. In addition, FSS briefings should focus on how and when the flight can be made safely.

The definition of known and forecast icing is currently defined by enforcement cases in ways that are not operationally useful to pilots.

| **Program 19** | Definitions of "VFR not recommended" and "known icing" |
|---|---|
| **JSAT Intervention 6-2** | • Define the use of "VFR not recommended" to avoid over use of this term, resulting in its lack of effectiveness as a warning.<br>• Define the use of "known and forecast icing" in a way that are operationally useful to pilots. |
| **JSIT IP(s)** | FAA:<br>• Provide more accurate and precise area forecasts of IMC conditions to FSS briefers. See Program 1.<br>• Make several improvements in FSS specialist training, including increased knowledge of pilot needs. See Program 7.<br>• Direct briefers to understand pilot experience over the route of flight before making the VNR recommendation, including training to do this. See Program 7.<br>• Direct briefers to first inform pilots of the location and timing of IMC conditions over the pilot's proposed route and time of flight, and then make the VNR statement if warranted for that route and time. Then query the pilot for his alternative or suggest an alternative route or time for the trip when IMC conditions are not forecast. See Program 7.<br>• Re-assess the usefulness of VNR no later than 12/31/04, and if it is still not effective, then delete the VNR statement from briefings.<br>• Continue the efforts of the in-flight Icing group to properly define "known and forecast icing conditions".<br><br>Industry<br>• Develop and publish articles that recommended best practices for obtaining briefings from FSS briefers and |

| | |
|---|---|
| | other approved weather sources, including providing briefers with information on pilot experience over the proposed route of flight and proposed alternative routes and times. |
| **Performing Organizations** | ATX, AMA, AFS-800, AFS-200, AGC, AFS-400, ASY-300, ATO-300, ARW-200<br>NAATS<br>AOPA, EAA, NATA, NBAA |
| **Lead Organization** | ATX, AMA |

**Resources**

FAA

| | FY2000 | FY2001 | FY2002 | FY2003 | FY2004 | FY2005 | Total |
|---|---|---|---|---|---|---|---|
| **FTE** | +0 | +0 | 0 | 0 | 0 | 0 | 0 |
| **Contract $** | +0 | +0 | 0 | 0 | 0 | 0 | 0 |

Industry publishing: See Program 2 for total Industry resources required for publication actions for all Programs requiring a publication action.

1. ***JSAT Intervention 2-2. Streamline approval processes to encourage installation of equipment that enables pilots to retain control in IMC and icing***

**Program 20: Standby attitude indicator**

Flight safety could be improved by permitting the substitution of a standby attitude indicator for the required rate-of-turn indicator when the primary attitude indicator fails.

| | |
|---|---|
| **Program 20** | Standby attitude indicator |
| **JSAT Intervention 2-2b** | Approve a proposed rule revision to allow the substitution of a non-tumbling, standby attitude indicator for a gyroscopic, rate-of-turn indicator. |
| **JSIT IP(s)** | FAA<br>• Analyze safety equivalence of an electric standby attitude indicator vs. a rate-of-turn indicator.<br>• Identify potential exemption holders and secure applications.<br>• Process applications.<br>• Track and study safety trends of exemption holders.<br>• If appropriate, initiate rulemaking to revise 14 CFR 91.205(d)(3).<br><br>Industry<br>• Make application for exemption.<br>• Provide cost effective, electric, standby, non-tumbling attitude indicators installable in existing aircraft fleet and current production aircraft.<br>• Publish information for the flying public concerning the use of the standby attitude indicator in lieu of the rate-of-turn indicator, including human factors. |
| **Performing Organizations** | AFS-400, AFS-800, ARM-100, AAM-100, AAR-100, AAM-100 |
| **Lead Organization** | AFS-400 |

**Resources**

FAA

| | **FY2000** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **Total** |
|---|---|---|---|---|---|---|---|
| **FTE** | +1.5 | +1 | .5 | 0 | 0 | 0 | 3 |
| **Contract $** | + .1M | 0 | 0 | 0 | 0 | 0 | .1M |

Industry publishing: See Program 2 for total Industry resources required for publication actions for all Programs requiring a publication action.

## F. JSAT Conclusion K: GA Accident Data Should Be Improved

### Improved GA accident data

The GA Weather JSAT Final Report noted several deficiencies in the collection of GA accident data, which hampered and, in some cases, prevented the determination of accident root causes. The JSIT concluded that the collection of accident data must be improved significantly in order to monitor the effectiveness of Safer Skies programs.

| **Program 21** | Improved GA accident data |
|---|---|
| **JSAT Conclusion K, Appendix K** | • Increase the qualifications for and training of the NTSB persons who input the NTSB reports into the database, to improve their ability to interpret the cases and summarize them.<br>• Perform quality control checking of accident reports and databases.<br>• Provide better instructions to investigators on the types of information to gather for the record in weather cases so that all relevant data is recorded. |
| | • |
| | |
| | |

## IV. JSAT Interventions Not Recommended

The JSIT concluded that the following JSAT interventions did not provide sufficient safety benefits to be included in an implementation program. The interventions and the explanation for not recommending implementation follow.

| Intervention | Reason for Not Recommending Implementation |
|---|---|
| 2-2a: Streamline certification of wing leveler auto pilots | Certification cost is not a significant barrier to marketing wing-levelers or auto pilots. Affordable wing-levelers and auto pilots exist in the market. Efforts to improve certification will be more productive if applied broadly through the Certification Task Force 4 recommendations and Select Committee efforts. |
| 2-1c: Apply Advisory Circular 23.1309-1C to reduce the cost of approved ice-protection systems for single-engine airplanes | This AC may be applied now. Certification cost is not a significant barrier to marketing ice protection systems. Efforts to improve certification will be more productive if applied broadly through the Certification Task Force 4 recommendations and Select Committee efforts. |
| 2-3a, b and c: Develop on board sensors for icing, turbulence, etc. | Several programs are underway to provide system for transport category aircraft. Assuming these programs would be successful for such aircraft (and they have high technical risk), program modifications would be required to produce products for GA applications. Resources for such |

| | |
|---|---|
| | program modification would be in the range of $6M per year, relatively large compared to higher priority interventions. These programs are several years away from a product for transport aircraft, and are even further from application to GA. It appears that there is little likelihood of an impact on GA accidents within the 10-year time frame of the Safer Skies Agenda. |
| 4-2a, b, and c: Implement systems to provide graphical display of traffic information for use when ATC frequency must be abandoned to gather weather information | Other recommended programs, such as FIS data link, an improved FSS system, improved controller weather information, and improved pilot controller communications, would sufficiently address the purpose of the intervention as to reducing weather accidents. However, implementation of low-cost traffic display systems may be a cost-effective intervention for reducing GA mid-air accidents, but this is outside the GA Weather JSIT's charter. |

## V. Conclusions

### A. Interdependence of Implementation Plans

Many of the recommended implementation programs are interdependent. Hence, their effectiveness depends on the extent to which the elements of each program are actually implemented. For example, the program that provides improved weather forecasts is interdependent in that:

- It contains "foundation" elements, such as the aviation database, that must be implemented in order to produce the required quality of forecast graphics.
- It contains forecasts that serve as the basis for other forecasts.

The effectiveness of implementation programs also depends on the extent to which other, closely related programs are actually implemented. For example:

- The forecast program depends on improvements in the PIREP and automatic, electronic PIREP systems to verify the new forecasts.
- The effectiveness of FSS improvements and the FIS data-link system depend in large part upon improved weather forecasts.
- All of these programs are enhanced by improved guidance materials and weather training and testing.

Although the implementation of a single program would reduce fatal, GA weather accidents, the coordinated implementation of all programs will be much more effective and far more likely to achieve the Safer Skies fatal-accident reduction goal. This is especially true for the programs that are designed to improve weather forecasts and the FSS system because these programs are depend upon the implementation of several other programs.

### A. Matching a Specific JSIT Program Recommendation to Accident Reduction Statistics

Specific JSIT program recommendations can not be matched to a numerical reduction in fatal, GA weather accidents for the following reasons.

**1.** The interdependence discussed above couples the effectiveness of a specific intervention to other interventions based upon the extent to which the other interventions are implemented.

**2.** The NTSB and FAA accident database categories do not reveal several of the root causes that were identified by the JSAT. Hence, the NTSB statistics cannot be directly related to these root causes or their interventions. In addition, there are major deficiencies in the collection, analysis, and categorization of data associated with GA accidents. The JSIT recommends addressing these deficiencies through improved GA accident data collection.

**3.** Almost all of the accidents examined by the JSAT had multiple root causes, and a single intervention directed at one of the causes could have prevented most of the accidents. For example, many accidents studied had the following root causes:

- Inadequate information presented to the pilot on the location or severity of weather hazard areas;
- Inadequate FSS interpretation of the meaning of available information;
- Inadequate pilot training on assessing the risks associated with weather hazards;
- Inadequate pilot training on avoiding or exiting weather hazard areas; and,
- Inadequate aircraft systems for avoiding or tolerating the hazard.

Specific interventions do not map directly to the avoidance of specific accidents. Rather, the goal of JSIT program recommendations is to lower the probability of a fatal weather accident by eliminating each major root cause.

**1.** Some JSAT interventions address multiple root causes of accidents, directly or indirectly. For example, facilitating electronic PIREPs (automatic downlink of weather information such as temperature and humidity) by GA aircraft:

- Applies directly to the root cause of lack of knowledge of current weather conditions because, by providing a rich source of PIREPs on current conditions, the ability of pilots to make decisions to avoid weather hazard areas is enhanced;
- Applies indirectly, but more broadly, by improving the accuracy and precision of NWS computer forecast models through the inclusion of much more atmospheric data, especially low-altitude water content; and
- Applies indirectly, but more broadly, by enabling the producers of weather products to verify and improve their forecast products.

**1.** Some JSAT interventions apply to several different types of accidents (e.g., VFR-into-IMC, thunderstorm, etc) . For example, efforts to improve the methods of making weather forecasts by establishing a PIREPs database, an aviation weather database, and a real- time forecast verification program

apply to ceiling and visibility forecasts (addressing VFR into IMC cases), convection forecasts (affecting thunderstorm cases), and icing forecasts, etc. There is no way to specify these benefits by type of accident, unless one assumes a pro-rata reduction according to the incidence of each type of accident.

For these reasons, the programs recommended by the JSIT should each be viewed as reducing the probability of a fatal GA accident, by an amount that is not quantifiable at the program level.

## C. Dual Effect of Communications: Safety vs. FAA Enforcement and Liability Interests

The JSIT spent a considerable amount of time discussing safety impediments caused by the dual effect of some weather communications between pilots and controllers. These communications can have the effect of reducing fatal, GA weather accidents. However, these communications also can be used by the FAA for enforcement actions, or to address FAA liability concerns. The JSIT reached the following conclusions:

### 1. VFR Not Recommended (VNR)

The VNR issue involves the application of this statement for FAA liability protection, and the perceived overuse of the statement has resulted in its lack of effectiveness as a warning. However, the JSIT also recognized that proper use of the statement ensures that pilots understand weather conditions are unsuitable for VFR flight. The JSIT agreed that the present system is “broken”, but there was considerable discussion of whether it could be fixed or should be abolished. The JSIT decided to recommend actions that could “fix” the use of this term, and to revisit the issue after these remedial actions were implemented. The term would be abolished if it continued to be used ineffectively as a warning after the remedial actions had been implemented.

### 2. Icing PIREPs

Pilots in non-ice certified aircraft who are in icing conditions greater than “trace’, or pilots of known-ice certified aircraft who are in severe icing conditions, may not provide information on icing conditions to ATC because of fear that this information could result in an enforcement action. The JSIT considered recommending immunity from enforcement to encourage PIREPs of icing conditions. However, the JSIT concluded that educating pilots that PIREPs by themselves are not used to initiate enforcement actions would substantially address the purpose of the intervention. This would eliminate the need for rulemaking to provide immunity from enforcement in such situations.

### 3. Declaring an Emergency or Refusing a Clearance

Pilots who fear that their statements will be used for enforcement purposes may be reluctant to declare an emergency or refuse a clearance to get an alternative altitude or routing quickly when in icing conditions beyond their capabilities, or remain outside icing conditions,. The JSIT discussed whether some form of immunity was appropriate given these circumstances.

When declaring an emergency, pilots consider the conflicting policies of improving the safety of an operation versus the potential for precipitating an enforcement action. The JSIT agreed that the present situation was “broken”, but disagreed on whether it could be fixed short of granting pilots immunity from enforcement actions.

The JSIT recommends programs to educate pilots on effectively communicating to controllers the reason for a clearance change request and the degree of urgency in the request. The JSIT also recommends education for pilots and controllers on pilots’ use of the word “immediate” in requesting a clearance amendment to indicate that an emergency may be imminent if the current situation continues.

**D. Endorsement of JSAT Conclusions**

The JSIT has reviewed and endorses each of the conclusions, A – K, reached by the JSAT in its Final Report:

A. The FAA weather information and dissemination system must undergo fundamental changes to better support the flight planning needs of GA pilots.
B. Intuitive graphical depictions of weather hazard areas made available directly to pilots are the most effective form of decision support for most weather hazards.
C. Many of the JSAT Recommendations have been included in previous studies.
D. Interventions must be implemented as high priority in order to achieve the goals of the Safer Skies Agenda.
E. ASRS information should be used in developing and assessing the effectiveness of interventions.
F. Significant reduction in fatal accidents requires an implementation process with accountability elements.
G. Producing more stringent rules related to weather will not increase safety.
H. Currently required pilot training hours are adequate.
I. The Root Cause Analysis process revealed that descriptors (e.g., “get-home-itus”, and “get-there-itus”, “pilot error”) are not sufficient to determine the underlying causes of the weather accidents.
J. JSAT lessons learned (contained in Appendix J of the JSAT Report).
K. Accident report data deficiencies (addressed in Program 21).

# Appendix A

## Acronym Glossary

| | |
|---|---|
| AAAS | American Association for the Advancement of Science |
| AAWU | Alaskan Aviation Weather Unit |
| AC | Advisory Circular |
| ACARS | Aircraft Communications Addressing and Reporting System |
| ACLAIM | Coherent LIDAR for Advanced In-Flight Measurements |
| ACO | Aircraft Certification Office (FAA) |
| AD | Aviation Database |
| ADDS | Aviation Digital Data Service |
| ADM | Aeronautical Decision Making |
| ADS-B | Automatic Dependent Surveillance-Broadcast |
| AFOS | Automation of Field Operations and Services |
| AFSS | Automated Flight Service Station |
| AFTN | Air Force Television Network |
| AFWA | Air Force Weather Agency |
| AGATE | Advanced General Aviation Transport Experiments |
| AGFS | Aviation Gridded Forecast System |
| AGL | Above Ground Level |
| AIM | Aeronautical Information Manual |
| AIRMET | Airmen's Meteorological Advisory (WA) |
| AIV | Aviation Impact Variables |
| ALDARS | Automated Lightning Detection and Reporting System |
| ALPA | Airline Pilots Association |
| A-MOS | Automated Model Output Statistics |
| AMS | American Meteorology Society |
| ANBURS | Alphanumeric Backup Replacement System |
| AOB | Aviation Operations Branch |
| AOPA | Aircraft Owners and Pilots Association |
| AOS | Aerospace Operations Program (NASA) |
| APA | Allied Pilots Association |
| APST | Aviation Products and Services Team |
| ARAM | Aviation, Range, and Aerospace Meteorology |
| ARINC | Aeronautical Radio, Incorporated |
| ARSI | Atmospheric Research System, Incorporated |
| ARTCC | Air Route Traffic Control Center |
| ASB | Aviation Support Branch |
| ASC | Aviation Services Coordinator |
| ASD | Aircraft Situation Display (ARINC) |
| ASF | AOPA Air Safety Foundation |
| ASIST | Aviation Safety Investment Strategy Team (NASA) |
| ASOS | Automated Surface Observing System |
| ASRS | Aviation Safety Reporting System (NASA) |
| ATA | Air Transport Association |
| ATC | Air Traffic Control |
| ATCSCC | Air Traffic Control System Command Center |
| ATIS | Automated Terminal Information System |
| ATPAC | Air Traffic Procedures Advisory Committee |
| AUA | Air Traffic Systems Development |
| AVARS | Aircraft Vertical Acceleration Reporting System |
| AVN | Aviation Model (forecast tool) |
| AvSP | Aviation Safety Program (NASA) |
| AWC | Aviation Weather Center |
| AWIN | Aviation Weather Information |
| AWIPS | Advanced Weather Interactive Processing System |
| AWOS | Automatic Weather Observation System |
| AWR | Aviation Weather Research |
| BAMS | Bulletin of the American Meteorological Society |
| BLM | Bureau of Land Management |

| | |
|---|---|
| BPAA | Business Pilots Aircraft Association |
| BUFR | Binary Universal Format for data Records |
| C&V | Ceiling and Visibility |
| CAeM | Commission for Aeronautical Meteorology |
| CAFTI | Committee on Analysis and Forecast Techniques Implementation |
| CANAM | Canadian/American |
| CAPS | Center for Analysis and Prediction of Storms |
| CASC | Central Administrative Support Center |
| CAT | Clear Air Turbulence |
| CBI | Computer-Based Instruction |
| CCFP | Collaborative Convective Forecast Product |
| CCTV | Closed Circuit Television |
| CD | Compact Disc |
| CDB | Computing Development Branch (NCEP) |
| CDM | Collaborative Decision Making |
| CDMnet | Collaborative Decision Making Network |
| CFI | Certified Flight Instructor |
| CFIT | Controlled Flight into Terrain |
| CFO | Chief Financial Officer |
| CFR | Code of Federal Regulations |
| CGEN | Convective SIGMET Generation |
| CIT | Convection-Induced Turbulence |
| CNS | Communications, Navigation, Surveillance |
| COBEL | Column modeling of the heat budget and cloud dynamics |
| COMET | Cooperative program for Operational Meteorology, Education, and Training |
| CONUS | Continental United States |
| CRA | Cooperative Research Agreement |
| CRDA | Collaborative Research and Development Program |
| CRH | Central Region Headquarters |
| CSI | Conditional Symmetric Instability |
| CSI | Critical Success Index |
| CSTAR | Collaborative Science, Technology, and Applied Research |
| CWA | Center Weather Advisory - CWSU |
| CWSU | Center Weather Service Unit |
| D-ATIS | Digital Automatic Terminal Information System |
| DBNET | Distributed Brokered Networking |
| DC | District of Columbia |
| DCP | Document Change Procedure |
| DDS | Domestic Data Service |
| DIFAX | Digital Facsimile |
| DOD | Department of Defense |
| DSR | Display System Replacement |
| DTC | Data Transformation Corporation |
| DUAT | Direct User Access Terminal |
| EAA | Experimental Aircraft Association |
| EC | Environment Canada |
| EFAS | En Route Flight Advisory Service |
| EFF | Experimental Forecast Facility |
| E-FIS | Electronic Flight Instrument System |
| EMC | Environmental Modeling Center |
| E-PIREPS | Electronic Pilot Reports |
| EPRI | Electric Power Research Institute |
| EPSCoR | Experimental Program for the Stimulation of Competitive Research |
| EPV | Equivalent Potential Vorticity |
| Eta | Greek letter, describes a constant height coordinate model system |
| ETOPS | Extended Twin Engine Operations Over Water |
| F&E | Facilities and Equipment |
| FA | Area Forecast |
| FAA | Federal Aviation Administration |
| FAA/AWR | Federal Aviation Administration/Aviation Weather Research Division |
| FAA/ARW | Federal Aviation Administration/Aviation Requirements B Weather group |
| FAAO | FAA Order |
| FAR | Federal Aviation Regulation |
| FAR | False Alarm Ratio |

| | |
|---|---|
| FAWS | Flight Advisory Weather Service |
| FBO | Fixed Base Operator |
| FD | Winds and Temperatures Aloft Forecasts |
| FIAS | Flight Information Advisory Service |
| FIR | Flight Information Region |
| FIS | Flight Information Services |
| FISDL | Flight Information Services Data Link |
| FMS | Flight Management System |
| FNMOC | Fleet Numerical Meteorology and Oceanography Center |
| FOM | Flight Operations Manual |
| FOQA | Flight Operations Quality Assurance |
| FOUS | Forecast Output United States |
| FSDO | Flight Standards District Office (FAA) |
| FSL | Forecast Systems Laboratory |
| FSS | Flight Service Station |
| FSU | Florida State University |
| FTE | Full Time Equivalent |
| FTP | File Transfer Protocol |
| FTW | Fort Worth, TX |
| FVT | Forecast Verification Tool |
| FY | Fiscal Year |
| GA | General Aviation |
| GAAPC | General Aviation Action Plan Coalition |
| GAC | General Aviation Coalition |
| GAMA | General Aviation Manufacturers Association |
| GAI | Global Atmospherics, Incorporated |
| GAWP | Graphic Aviation Weather Product |
| GDS | GeoMet Data Services |
| GEMPAK | General Environmental Meteorological Package (programming language) |
| GFDL | Geophysical Fluid Dynamics Laboratory (ERL) |
| GOES | Geostationary Operational Environmental Satellite |
| GPS | Global Positioning System |
| GSA | General Services Administration |
| GTE | General Telephone and Electric |
| GUI | Graphical User Interface |
| HI | Hawaii |
| HIWAS | Hazardous In-Flight Weather Advisory Service |
| HPC | Hydrometeorological Prediction Center |
| HQ | Headquarters (FAA) |
| HUD | Housing and Urban Development, U.S. Department of |
| IATA | International Air Transport Association |
| ICAO | International Civil Aviation Organization |
| IDS | International Data Service |
| IFFDP | International Flight Folder Documentation Program |
| IFR | Instrument Flight Rules |
| IIDA | Integrated Icing Diagnostic Algorithm |
| IIFA | Integrated Icing Forecast Algorithm |
| IFIPDT | In-Flight Icing Product Development Team |
| ILS | Instrument Landing System |
| IMC | Instrument Meteorological Conditions |
| IOC | Initial Operating Capability |
| IOS | Integrated Operational Services |
| IP | Implementation Plan |
| IPS | Implementation Plan Summary |
| IR | Infrared |
| ISCS | International Satellite Communications System |
| ISE | In-Flight Service Enhancement |
| ITFA | Integrated Turbulence Forecast Algorithm |
| ITWS | Integrated Terminal Weather System |
| ITT | Information Technology Team |
| JMA | Japanese Meteorological Agency |
| JRC | Joint Resources Council (FAA) |
| JSAT | Joint Safety Analysis Team |
| JSC | Joint Steering Committee |

| | |
|---|---|
| JSIT | Joint Safety Implementation Team |
| KCFB | Kansas City Federal Building |
| KMARD | Kansas Modernization and Restructuring Demonstration |
| KSA | Knowledge, Skills, and Abilities |
| KSU | Kansas State University |
| KU | University of Kansas |
| LAN | Local Area Network |
| LDADS | Local Data Acquisition and Dissemination System |
| LDM | Local Data Manager |
| LEO | Low Earth Orbiting (satellites) |
| LIDAR | Light Detection and Ranging |
| LIFR | Limited Instrument Flight Rules |
| LINUX | UNIX-like computer operating system |
| LIVV | Lifted Index Vertical Velocity |
| LLP | Lightning Location and Protection |
| LLWAS | Low-Level Wind Shear Alert System |
| LOT | Local Office Team |
| LPATS | Lightning Position and Tracking System |
| MARD | Modernization and Restructuring Demonstration |
| MATT | Managed and Accelerated Technology Transfer |
| MBRFC | Missouri Basin River Forecast Center |
| McIDAS | Man Computer Interactive Data Acquisition System |
| MDCARS | Meteorological Data Collection and Reporting System |
| MEA | Minimum En route Altitude |
| MESO | Mesoscale Convective Unit |
| METAR | Meteorological Aviation Report |
| MIC | Meteorologist In Charge |
| MMCR | Millimeter-Wave Cloud Radar |
| MM5 | The Penn State/NCAR mesoscale model |
| MOA | Memorandum of Agreement |
| MOS | Model Output Statistics applications |
| MOREnet | Missouri Research and Education Network |
| MPC | Marine Prediction Center |
| MSL | Mean Sea Level |
| MVFR | Marginal Visual Flight Rules |
| MWAVE | Mountain Wave algorithm |
| MWO | Meteorological Watch Office |
| NACA | National Advisory Committee on Aeronautics |
| NADIN | National Airspace Data Interchange Network (FAA) |
| NAOS | North American Atmospheric Observing System |
| NAP | NCEP Advisory Panel |
| NAS | National Airspace System |
| NASA | National Aeronautics and Space Administration |
| NASDAC | National Aviation Safety Data Analysis Center (FAA) |
| NATA | National Air Transportation Association |
| NAWAU | National Aviation Weather Advisory Unit |
| N-AWIPS | National centers-AWIPS |
| NBAA | National Business Aviation Association |
| NCAR | National Center for Atmospheric Research |
| NCAR/RAP | National Center for Atmospheric Research/Research Applications Program |
| NCEP | National Centers for Environmental Prediction |
| NCO | NCEP Central Operations |
| NCDB | NCEP Computer Development Branch |
| NCWF | National Convective Weather Forecast |
| NDB | Non-Directional Beacon (navigational aid) |
| NESDIS | National Environmental Satellite, Data and Information Service |
| NESDIS/SAB | National Environmental Satellite, Data and Information Service/Satellite Analysis Branch |
| NEXRAD | Next Generation Weather Radar |
| NGM | Nested Grid Model |
| NIDS | NEXRAD Information Distribution Service |
| NLDN | National Lightning Detection Network |
| NMC | National Meteorological Center |
| NMOC | National Meteorological Operations Centre (Australia) |

| | |
|---|---|
| NNICE | Neural Network for Icing |
| NOAA | National Oceanic and Atmospheric Administration |
| NOTAM | Notice to Airmen |
| NPRA | National Performance Results Act |
| NPSU | National Public Service Unit |
| NRL | Naval Research Laboratory |
| NSF | National Science Foundation |
| NSSFC | National Severe Storms Forecast Center |
| NSSL | National Severe Storms Laboratory |
| NTOP | NCEP Technical Operating Plan |
| NTSB | National Transportation Safety Board |
| NWS | National Weather Service |
| NWSEO | National Weather Service Employees Organization |
| NWSH | National Weather Service Headquarters |
| NWSTC | National Weather Service Training Center |
| NWSTG | National Weather Service Telecommunications Gateway |
| OASIS | Operational and Supportability Implementation System |
| OAT | Office of Aerospace Technology (NASA) |
| OCS | Oklahoma Climatological Survey |
| OFCM | Office of the Federal Coordinator for Meteorological Services and Supporting Research |
| OJTI | On-the-Job Training Instructor |
| OM | Office of Meteorology |
| OSD | Office of Systems Development |
| OSO | Office of Systems Operations |
| OU | University of Oklahoma |
| PC | Personal Computer |
| PDT | Product Development Team |
| PHI | Petroleum Helicopters Incorporated |
| PIREP | Pilot Report |
| POD | Probability of Detection |
| PPI | Plane Position Indicator |
| PRC | Planning and Research Corporation |
| PTS | Practical Test Standards |
| PUFF | A high-resolution volcanic ash-tracking model |
| PUP | Principal User Processor |
| PWB | Pilot Weather Briefing |
| QCO | Quality Control Office |
| QTP | Quality through Partnership |
| R&D | Research and Development |
| RAFC | Regional Area Forecast Center |
| RAM | Regional Area Meteorologist |
| R/C | Rotorcraft |
| RCA | Root Cause Analysis |
| RCM | Radar Coded Message |
| RDC | Research Data Corporation |
| RF | Radio Frequency |
| RFC | River Forecast Center |
| RFI | Radio Frequency Interference |
| RFP | Request For Proposal |
| RMTN | Regional Meteorological Telecommunications Network |
| ROB | Radar coded Observation |
| RTA | Remote To AFOS |
| RTVS | Real Time Verification System |
| RUC | Rapid Update Cycle (forecast model) |
| SAMEX | Storm and Mesoscale Ensemble Experiment |
| SAWS | Stand Alone Weather System |
| SELS | Severe Local Storms |
| SIGMET | Significant Meteorological Advisory (WS) |
| SIGWX | Significant Weather |
| SLD | Supercooled Large Droplets |
| SMG | Space flight Meteorology Group (NOAA) |
| SOCRATES | Sensor for Optically Characterizing Ring-eddy Atmospheric Turbulence Emanating Sound |

| | |
|---|---|
| SOIT | Satellite Operational Implementation Team |
| SOO | Scientific Operations Officer |
| SPAWAR | Space and Naval Warfare Systems Command |
| SPC | Storm Prediction Center |
| SRH | Southern Region Headquarters |
| SRRS | Systems Record Retention System (AFOS) |
| STARS | Standard Terminal Automation Replacement System |
| SUA | Special Use Airspace |
| SUNYA | State University of New York B Albany |
| S-TAF | Specialized Terminal Aerodrome Forecast |
| TA | Translation Algorithm |
| TAF | Terminal Aerodrome Forecast |
| TAMU | Tropical Aviation Meteorological Unit |
| TAP | Transition Aviation Project |
| TDAM | Turbulence Detection and Mitigation (NASA) |
| TDL | Techniques Development Laboratory |
| TDU | Techniques Development Unit |
| TDWR | Terminal Doppler Weather Radar |
| TEGO | Test Experiment Guidance Operational |
| TELCON | Telephone Conversation |
| TIS | Traffic Information Services |
| TKE | Turbulent Kinetic Energy |
| TMU | Traffic Management Unit |
| TPC | Tropical Prediction Center |
| TRACON | Terminal Radar Approach Control |
| TRMM | Tropical Rainfall Measuring Mission (global change) |
| TSO | Technical Standard Order |
| TSS | True Skill Statistic |
| TWEB | Transcribed Weather En route Broadcast |
| TWIP | Terminal Weather Information for Pilots |
| UCAR | University Corporation for Atmospheric Research |
| UKMETO | United Kingdom Meteorological Office |
| UPS | Uninterruptible Power Supply |
| UPS | United Parcel Service |
| USAF | United States Air Force |
| USGS | United States Geological Survey - Department of Interior |
| USMC | United States Marine Corps |
| USWB | United States Weather Bureau |
| USWRP | United States Weather Research Program (NWS, NSF) |
| VAAC | Volcanic Ash Advisory Centers |
| VAD | Velocity Azimuth Display (NEXRAD) |
| VAS | VISSR Atmospheric Sounder |
| VDUC | VAS Data Utilization Center |
| VFR | Visual Flight Rules |
| VFWG | Vertical Flight Working Group |
| VGF | Virtual Graphics File |
| VHF | Very High Frequency (Radio) |
| VIL | Vertically Integrated Liquid water |
| VISSR | Visible and Infrared Spin Scan Radiometer |
| VMC | Visual Meteorological Conditions |
| VNR | VFR Not Recommended |
| VOR | VHF Omni-directional Range (navigational aid) |
| VV | Vertical Velocity |
| VVSTORM | model-based convection algorithm |
| WAAS | Wide Area Augmentation System (GPS) |
| WAFC | World Area Forecast Center |
| WAFS | World Area Forecast System |
| WARP | Weather and Radar Processor |
| WB | Weather Bureau |
| WCM | Warning Coordination Meteorologist |
| WEFAX | Weather Facsimile |
| WFO | Weather Forecast Office |
| WINCOMM | Weather Information Communication (NASA) |
| WINN | Weather Information Network |

| | |
|---|---|
| WMO | World Meteorological Organization |
| WMO | World Meteorological Organization |
| WMSCR | Weather Message Switching Center Replacement |
| WRF | Weather Research and Prediction |
| WSI | Weather Services International Corporation |
| WSR-88D | Weather Surveillance Radar, 1988 Doppler |
| WxAP | Weather Accident Prevention (NASA) |
| WxLink | Weather Link |
| Y2K | Year 2000 |

# Appendix B

## Definition of Terms

| | |
|---|---|
| Funding, Appropriated | Funding for this task is included in the FY 2000 FAA, NASA, or NWS budget as enacted by Congress. |
| Funding, Budgeted | Funding for this task is included in the FY 2001 FAA, NASA, or NWS budgets submitted to OMB for review. |
| Funding, Planned | Funding for this task is included in FY 2002 or subsequent fiscal year FAA, NASA, or NWS plans currently under development. |
| Funding, Additional | Funding for this task would be in addition to that already appropriated, budgeted, or planned, and would require a reprogramming in FY 2000, and revision in the budget proposal for FY 2001, or changes in the plans for FY 2002 and beyond. |
| Certification Cost | The cost to an applicant for design or manufacturing approval (e.g., a type certificate, supplemental type certificate, etc.), due solely to the FAA certification process. These costs would include additional non-recurring engineering or FAA liaison costs, or recurring product costs that were incurred because of the FAA certification process. They do not include product development, testing, analysis, or documentation costs that a typical aviation company would have incurred in the absence of FAA certification. |
| Data link | Digital telecommunications capability which supports communication between airborne and ground based-computers and their operators. This system may be used to transmit weather information, using text and/or graphics, from the ground to the aircraft. |
| GA Community | For the purpose of this report, to delineate responsibilities for tasks: All of the sector stakeholders in general aviation, |

| | |
|---|---|
| | including industry and non-industry participation, but excluding the FAA (eg. Aircraft owners and operators, pilots, manufacturers, maintenance professionals, and service providers, etc.). |
| Implementation | The means for accomplishing the incorporation of a given intervention |
| Intervention | Suggested solutions, things to do to prevent or lessen the identified problem. |
| Intervention Strategy | A proposed activity or system-wide change intended to prevent, correct or mitigate an identified safety problem associated with a cause of a fatal accident. |
| Priority Program | A defined program with measurable objectives, intermediate milestones and schedule dates, sufficient resources to meet the objectives and schedules, and program manager authority to accomplish the program tasks. |
| Root Cause | A specific systemic reason or factor that contributed to a fatal accident. |
| Weather Accident | As defined by the JSAT: An accident caused by:<br>• The pilot's failure to change the operative flight plan (the route and altitude the pilot plans to fly from the aircraft's present position to its destination) in order to maintain safe separation from a Weather Hazard Area because of: insufficient information on the location and severity of Weather Hazard Areas; or insufficient knowledge, skill and judgment to properly interpret available information<br>• Inadequate aircraft performance or equipment to avoid or tolerate the weather hazard without catastrophic results. |
| Weather Hazard | As defined by the JSAT: A weather phenomena that could have a catastrophic effect on the flight of a specific pilot, aircraft, and mission. This effect could be caused by a structural failure, insufficient aircraft performance to maintain terrain or obstacle clearance, inability of the pilot to navigate clear of terrain or obstacles, or the inability of the pilot to control the aircraft. Weather Hazards are determined in reference to the capabilities of the pilot and the aircraft. They include:<br>1. IMC<br>2. Thunderstorms<br>3. Icing<br>4. Turbulence |
| Weather Hazard Area | As defined by the JSAT: A portion of airspace specified horizontally, vertically, and temporally, that must be avoided to maintain safe separation from weather hazards within it. It is an area within which a pilot cannot reliably avoid weather hazards through normal deviations because of the relatively close spacing, severity level, or growth rate of the weather hazard contained in it. |

# Appendix C

## Charter for Joint Safety Implementation Team (JSIT)

I. **Purpose**. To develop prioritized implementation strategies and action plans and after approval by the Joint Steering Committee (JSC), coordinate the implementation of the strategies and plans.

II. **Background**. Industry and government, through the JSC, have jointly agreed to pursue a data driven approach to reducing the general aviation (GA) fatal accident rate while maintaining or improving GA utility and affordability. Industry and government have further agreed that cooperatively and selectively pursuing implementation of the high leveraged safety intervention strategies will maximize safety benefit. The WEATHER and CFIT JSATs have identified a number of intervention strategies to reduce the fatal accident rate. The next step is for a team to develop prioritized implementation strategies and action plans for those interventions.

III. **Tasks**. The JSIT will use the process developed by the Commercial CFIT JSIT wherever possible to complete the tasks. Adjustment to the process is allowed if necessary because of differences in General Aviation. It is the JSIT member responsibility to coordinate their implementation strategies and get input within their organization.

A. Intervention strategies identified by the CFIT or WEATHER JSATs will be analyzed by the JSIT for the purposes of determining implementation feasibility and identifying prospective strategies for implementation.

B. The implementation plan will contain:

- prioritized implementation strategies
- identification of responsible parties
- resources required for each intervention implementation
- a list of major implementation milestones
- metrics for tracking success of the interventions
- a communications strategy aimed at gaining “stakeholder” buy-in

C. Within six months from its formation the JSIT will present the prospective interventions identified for implementation to the JSC for review and approval. Rationale for how all the CFIT or WEATHER JSAT intervention strategies were addressed will be included in the plan report.

D. As directed by JSC, the JSIT will make periodic progress reports on implementation status JSC.

III. **Membership**. Team members are responsible for communicating issues within their lines of business or organizations and for representing the technical and programmatic positions of their respective entities. Conclusions from the JSIT are brought to the JSC for review and approval.

IV. **Resources**. JSC participating organizations agree to provide appropriate financial, logistical and personnel resources necessary to carry out this charter and approved implementation strategies.

revised – 6/21/99

# Appendix D

## Resource Requirements by JSAT Recommendation

| JSAT Recommen-dation[ab] | FY 2000 | | FY 2001 | | FY 2002 | | FY 2003 | | FY 2004 | | FY 2005 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | FTEs | Cont$ | FTEs | Cont$ | FTEs | Cont$ | FTEs | Cont$ | FTEs | Cont$ | FTEs | Cont$ |
| **JSAT Recommendation 1 (includes JSIT Programs 1–10)** | | | | | | | | | | | | |
| **FAA** | 45.7<br>+7.2 | 40.190<br>+0.050 | 35.0<br>+7.2 | 3.800<br>+6.920 | 33.0 | 28.650 | 25.7 | 26.650 | 25.7 | 24.650 | 25.7 | 24.650 |
| **NWS** | 2.0<br>+0.5 | 0.750<br>+0.050 | 2.0<br>+0.5 | 0.750<br>+0.165 | 2.5 | 0.915 | 2.5 | 0.915 | 2.5 | 0.915 | 1.5 | 0.915 |
| **NASA** | 13.5 | 3.810 | 13.5 | 3.840 | 11.5 | 3.970 | 10.25 | 3.650 | 10.25 | 3.950 | 0.25 | 0.250 |
| **Industry** | 13.0 | 10.000 | 12.0 | 2.000 | 5.0 | 2.000 | 5.0 | 2.000 | 5.0 | 2.000 | 5.0 | 2.000 |
| **Subtotal** | 74.2<br>+7.7 | 54.750<br>+2.100 | 62.5<br>+7.7 | 39.390<br>+7.085 | 52.0 | 35.535 | 43.45 | 33.215 | 43.45 | 31.515 | 32.45 | 27.815 |
| **JSAT Recommendation 2 (includes JSIT Program 11)** | | | | | | | | | | | | |
| **FAA** | 1.15 | 0.000<br>+0.750 | 1.25 | 0.000<br>+1.300 | 1.25 | 0.750 | 1.25 | 1.275 | 1.25 | 0.750 | 1.25 | 0.750 |
| **NWS** | 0.000<br>+0.125 | 0 | 0.000<br>+0.125 | 0 | 0.125 | 0 | 0.125 | 0 | 0.125 | 0 | 0.125 | 0 |
| **NASA** | 0.000<br>+0.125 | 0.500 | 0.000<br>+0.125 | 0.400 | 0.125 | 0.100 | 0.125 | 0.100 | 0.125 | 0.100 | 0.125 | 0 |
| **Industry** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Subtotal** | 1.15<br>+0.25 | 0.500<br>+0.750 | 1.25<br>+0.25 | 0.400<br>+1.300 | 1.5 | 0.850 | 1.5 | 1.375 | 1.5 | 0.850 | 1.5 | 0.750 |
| **JSAT Recommendation 3 (includes JSIT Programs 12-17)** | | | | | | | | | | | | |
| **FAA** | 14.50<br>+18.75 | 5.550<br>+1.600 | 13.5<br>+9.5 | 4.550<br>+1.500 | 21.0 | 5.450 | 18.0 | 5.450 | 13.0 | 4.450 | 13.0 | 4.450 |
| **NWS** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **NASA** | 5.0 | 2.100 | 8.0 | 2.300 | 9.0 | 2.400 | 10.0 | 3.100 | 10.0 | 3.100 | 0 | 0 |
| **Industry** | 1.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Subtotal** | 21.00<br>+18.75 | 7.650<br>+1.600 | 21.5<br>+9.5 | 6.850<br>+1.500 | 30.0 | 7.850 | 28.0 | 8.550 | 23.0 | 7.550 | 13.0 | 4.450 |
| **JSAT Recommendation 4 (includes JSIT Program 18)** | | | | | | | | | | | | |
| **FAA** | 0.5 | 0.000<br>+0.150 | 0.5<br>+1.0 | 0.000<br>+0.300 | 3.5 | 0.500 | 3.5 | 0.500 | 3.5 | 0.500 | 3.5 | 0.500 |
| **NWS** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **NASA** | 15.0 | 5.300 | 15.0 | 6.600 | 15.0 | 5.900 | 15.0 | 6.000 | 15.0 | 6.000 | 7.0 | 3.000 |
| **Industry** | 0 | 2.000 | 0 | 2.000 | 0 | 2.000 | 0 | 7.000 | 0 | 7.000 | 0 | 1.000 |
| **Subtotal** | 15.5 | 7.300<br>+0.150 | 15.5<br>+1.0 | 8.600<br>+0.300 | 18.5 | 8.400 | 18.5 | 13.500 | 18.5 | 13.500 | 10.5 | 4.500 |
| **JSAT Recommendation 5 (includes JSIT Programs 19-20)** | | | | | | | | | | | | |
| **FAA** | 0.00<br>+1.50 | 0.000<br>+0.100 | 0.0<br>+1.0 | 0 | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **NWS** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **NASA** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Industry** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Subtotal** | 0.00<br>+1.50 | 0.000<br>+0.100 | 0.0<br>+1.0 | 0 | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total by FY** | 111.85<br>+32.20 | 70.200<br>+2.830 | 100.75<br>+23.45 | 55.240<br>+10.245 | 102.5 | 52.635 | 91.45 | 56.640 | 86.45 | 53.415 | 57.45 | 37.515 |

# FAA Resource Requirements by JSIT Program

| Program[ab] | FY 2000 | | FY 2001 | | FY 2002 | | FY 2003 | | FY 2004 | | FY 2005 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **FTEs** | **Cont$** | **FTEs** | Cont$ | **FTEs** | **Cont$** | **FTEs** | **Cont$** | **FTEs** | **Cont$** | **FTEs** | **Cont$** |
| **1[c]** | 7.0<br>+6.0 | 3.700<br>+1.500 | 7.0<br>+6.0 | 2.400<br>+6.400 | 13.0 | 9.000 | 13.0 | 8.000 | 13.0 | 6.500 | 13.0 | 6.500 |
| **2** | 1.5 | 0 | 1.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **3** | 1.0<br>+0.5 | 1.000<br>+0.500 | 1.0<br>+0.5 | 1.000<br>+0.500 | 1.5 | 1.500 | 1.5 | 1.500 | 1.5 | 1.500 | 1.5 | 1.500 |
| **4[d]** | 4.3<br>+0.7 | 0 | 4.3<br>+0.7 | 0 | 6.7 | 1.000 | 0.7 | 0 | 0.7 | 0 | 0.7 | 0 |
| **5** | 5.0 | 0 | 5.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **6** | 2.0 | 1.440 | 2.0 | 1.270 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **7** | 5.1 | 0 | 2.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **8** | 1.5 | .000<br>+.100 | 1.5 | .000<br>+.050 | 1.5 | .050 | 1.5 | .050 | 1.5 | .050 | 1.5 | .050 |
| **9** | 1.3 | 0 | 1.3 | 0 | 1.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **10[e]** | 17.0 | 34.000 | 9.0 | 28.100 | 9.0 | 17.100 | 9.0 | 17.100 | 9.0 | 16.600 | 9.0 | 16.600 |
| **11** | 1.15 | .000<br>+.750 | 1.25 | 0.000<br>+1.300 | 1.25 | .750 | 1.25 | 1.275 | 1.25 | .750 | 1.25 | .750 |
| **12** | 0.0<br>+3.5 | .000<br>+.100 | 0.0<br>+1.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **13** | 0.0<br>+4.0 | 1.700 | 0.0<br>+2.5 | 0 | 2.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **14** | 8.0 | 1.000 | 6.0 | 1.600 | 5.5 | 1.000 | 5.0 | 1.000 | 0 | 0 | 0 | 0 |
| **15** | 0.0<br>+5.0 | .200<br>+.800 | 1.0 | .300 | 1.0 | .300 | 1.0 | .300 | 1.0 | .300 | 1.0 | .300 |
| **16** | 6.5<br>+5.5 | 2.650<br>+1.500 | 6.5<br>+5.5 | 2.650<br>+1.500 | 12.0 | 4.150 | 12.0 | 4.150 | 12.0 | 4.150 | 12.0 | 4.150 |
| **17** | 0.00<br>+0.25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **18** | 0.5 | .000<br>+.150 | 0.5<br>+1.0 | .000<br>+.300 | 3.5 | .500 | 3.5 | .500 | 3.5 | .500 | 3.5 | .500 |
| **19** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **20** | 0.0<br>+1.5 | .000<br>+.100 | 0.0<br>+1.0 | 0 | .5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total by FY** | 61.85<br>+30.95 | 45.690<br>+5.630 | 49.85<br>+23.70 | 37.320<br>+10.110 | 59.25 | 35.35 | 48.45 | 33.875 | 43.45 | 30.35 | 43.45 | 30.35 |

Table Notes:

a. "+" indicates an additional amount of resources that must be reprogrammed over what was requested on 10/1/99 in either the FY 2000 or FY 2001 budgets.

b. "Cont$" is in millions of dollars and includes contractor services, equipment, and any other non-salaries employee (non-FTE) expense.

c. Program 1 FTEs and Cont$ include total amount for FAA and NWS, which must be allocated by FAA and NWS Senior Management.

d. Program 4 totals include FTEs and Cont$ allocated for Training and Equipment.

e. Program 10 totals include FTEs and Cont$ allocated for Short-Term ADDS Access and Long-Term OASIS deployment.

# NWS Resource Requirements by JSIT Program

| Program[ab] | FY 2000 | | FY 2001 | | FY 2002 | | FY 2003 | | FY 2004 | | FY 2005 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | FTEs | Cont$ | FTEs | Cont$ | FTEs | Cont$ | FTEs | Cont$ | FTEs | Cont$ | FTEs | Cont$ |
| **1**[c] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **2** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **3** | 1.0 +0.5 | .750 +.050 | 1.0 +0.5 | .750 +.165 | 1.5 | .915 | 1.5 | .915 | 1.5 | .915 | 1.5 | .915 |
| **4** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **5** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **6** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **7** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **8** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **9** | 1.0 | 0 | 1.0 | 0 | 1.0 | 0 | 1.0 | 0 | 1.0 | 0 | 0 | 0 |
| **10** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **11** | .000 +.125 | 0 | .000 +.125 | 0 | .125 | 0 | .125 | 0 | .125 | 0 | .125 | 0 |
| **12** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **13** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **14** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **15** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **16** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **17** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **18** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **19** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **20** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total by FY** | 2.000 +0.625 | 0.750 +0.050 | 2.000 +0.625 | 0.750 +0.165 | 2.625 | 0.915 | 2.625 | 0.915 | 2.625 | 0.915 | 1.625 | 0.915 |

Table Notes:

a. "+" indicates an additional amount of resources that must be reprogrammed over what was requested on 10/1/99 in either the FY 2000 or FY 2001 budgets.

b. "Cont$" is in millions of dollars and includes contractor services, equipment, and any other non-salaries employee (non-FTE) expense.

c. NWS FTEs and Cont$ totals for Program 1 are included in FAA Resource Requirements table.

# NASA Resource Requirements by JSIT Program

| Program[ab] | FY 2000 | | FY 2001 | | FY 2002 | | FY 2003 | | FY 2004 | | FY 2005 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | FTEs | Cont$ | FTEs | Cont$ | FTEs | Cont$ | FTEs | Cont$ | FTEs | Cont$ | FTEs | Cont$ |
| **1** | 7.0 | 1.500 | 7.0 | 1.700 | 5.0 | 1.600 | 4.0 | 1.800 | 4.0 | 2.000 | 0 | 0 |
| **2** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **3** | .25 | .250 | .25 | .250 | .25 | .250 | .25 | .250 | .25 | .250 | .25 | .250 |
| **4** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **5** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **6** | 6.0 | 1.440 | 6.0 | 1.270 | 6.0 | 1.500 | 6.0 | 1.600 | 6.0 | 1.700 | 0 | 0 |
| **7** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **8** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **9** | .25 | .620 | .25 | .620 | .25 | .620 | 0 | 0 | 0 | 0 | 0 | 0 |
| **10** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **11** | .000 +.125 | .500 | .000 +.125 | .400 | .125 | .100 | .125 | .100 | .125 | .100 | .125 | 0 |
| **12** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **13** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **14** | 5.00 | 2.100 | 8.0 | 2.300 | 9.0 | 2.400 | 10.0 | 3.100 | 10.0 | 3.100 | 0 | 0 |
| **15** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **16** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **17** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **18** | 15.0 | 5.300 | 15.0 | 6.600 | 15.0 | 5.900 | 15.0 | 6.000 | 15.0 | 6.000 | 7.0 | 3.000 |
| **19** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **20** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total by FY** | 33.625 +.125 | 11.710 | 36.625 +.125 | 13.140 | 35.625 | 12.370 | 35.375 | 12.850 | 35.375 | 13.150 | 7.375 | 3.250 |

Table Notes:

a. "+" indicates an additional amount of resources that must be reprogrammed over what was requested on 10/1/99 in either the FY 2000 or FY 2001 budgets.

b. "Cont$" is in millions of dollars and includes contractor services, equipment, and any other non-salaries employee (non-FTE) expense.

**Industry Resource Requirements by JSIT Program**

| Program[ab] | FY 2000 | | FY 2001 | | FY 2002 | | FY 2003 | | FY 2004 | | FY 2005 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | FTEs | Cont$ | FTEs | Cont$ | FTEs | Cont$ | FTEs | Cont$ | FTEs | Cont$ | FTEs | Cont$ |
| **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **2** | 0[c] | 0[c] | 0[c] | 0[c] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **3** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **4** | 2.0[c] | 0[c] | 1.0[c] | 0[c] | 1.0 | 0 | 1.0 | 0 | 1.0 | 0 | 1.0 | 0 |
| **5** | 5.0 | 0 | 5.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **6** | 6.0 | 10.000 | 6.0 | 2.000 | 4.0 | 2.000 | 4.0 | 2.000 | 4.0 | 2.000 | 4.0 | 2.000 |
| **7** | 0[c] | 0[c] | 0[c] | 0[c] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **8** | 0[c] | 0[c] | 0[c] | 0[c] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **9** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **10** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **11** | 0[d] | 0[d] | 0[d] | 0[d] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **12** | 0[c] | 0[c] | 0[c] | 0[c] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **13** | 0[c] | 0[c] | 0[c] | 0[c] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **14** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **15** | 0[d] | 0[d] | 0[d] | 0[d] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **16** | 0[d] | 0[d] | 0[d] | 0[d] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **17** | 1.5[c] | 0[c] | 0[c] | 0[c] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **18[e]** | 0 | 2.000 | 0 | 2.000 | 0 | 2.000 | 0 | 7.000 | 0 | 7.000 | 0 | 1.000 |
| **19** | 0[c] | 0[c] | 0[c] | 0[c] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **20** | 0[c] | 0[c] | 0[c] | 0[c] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total by FY** | 14.5 | 12.000 | 12.0 | 4.000 | 5.0 | 4.000 | 5.0 | 9.000 | 5.0 | 9.000 | 5.0 | 3.000 |

Table Notes:

a. "+" indicates an additional amount of resources that must be reprogrammed over what was requested on 10/1/99 in either the FY 2000 or FY 2001 budgets.

b. "Cont$" is in millions of dollars and includes contractor services, equipment, and any other non-salaries employee (non-FTE) expense.

c. Nine programs involve Industry publication actions: Programs 2, 4, 7, 8, 12, 13, 17, 19 and 20. There are seven principal GA pilot/operator publications, by AOPA, EAA, HAI, NBAA, NATA, Flying, and Plane and Pilot. Each of these publications will average four articles that address the JSIT programs. Each article costs $0.015M, for a total of $0.420M.

d. Three programs involve Industry training actions: Programs 11, 15 and 16. The JSIT estimates that two training organizations each will produce one seminar covering all three programs, and will conduct the seminars at 200 locations. The total cost of this effort is $0.830M over two years.

e. Industry Cont$ totals for Program 18 include $10M for NASA cost sharing.

# Appendix E

# JSAT Interventions by Organization and Program Status

The following GA Weather and CFIT JSAT Interventions were included in the scope of the GA Weather JSIT:

- All Interventions contained in the GA Weather JSAT Final Report except items 1-1b; 5-1 a, b and c; 7-1; 7-2; and 7-3.
- Only Interventions TRN 11 bullet 1; TRN 8 bullet 5; TRN 3 bullets 1, 2, 4, and 5; and MISC 1 from the GA CFIT JSAT Final Report

| JSAT Intervention Number | Abbreviated JSAT Intervention Description | Supporting FAA Organizations | Supporting GA Organizations |
|---|---|---|---|
| GA Weather JSAT Interventions | | | |
| 1-1a and c[2] | Improve training materials, with updated practical guidance on weather hazard risk assessment, avoidance, and recovery | AFS-800, AFS-400, AFS-600, ATO-300, ARW-200, ASY-300, NWS | AOPA, EAA, NBAA, HAI |
| 1-2[2] | Improve flight instructor and pilot continuing education programs on weather hazards and decision making | Same as 1-1a and c | Same as 1-1 |
| 1-3[3] | Develop a "model" Flight Operations Manual for assessing weather risks and avoiding or coping with weather hazards | Same as 1-1a and c, and AAM-240 | Same as 1-1 |
| 2-1a and c[2] | Improve certification to accelerate the equipage of GA aircraft with low-cost avionics for data-link display of graphical weather information | AFS-400, AFS-800, ACO AK, ARW-200, AND-520 | SAMA, EAA |
| 2-1b[2] | Improve certification to accelerate the equipage of GA aircraft with low-cost avionics for data-link display of graphical weather information | AIR-130, ACE-100, AK ACO, AFS-400 | SAMA, EAA |
| 2-2[2] | Streamline approval processes to encourage installation of equipment that enables pilots to retain control in IMC and icing | Same as 2-1b, and AFS-400, AK ACO, and ACE-100 | SAMA, AOPA |
| 2-3[2] | Increase R&D for on-board systems, such as forward-looking icing and turbulence detectors, which help pilots identify and cope with weather hazards | NASA, ARW-100, AUA-430, AFS-800, AFS-400 | EAA, SAMA |
| 3-1a, b, c[2] | Produce and make operational graphical weather information products that show how and when a flight can be made safely | NWS AWC, AUA-430, ARW-100, ARW 200, | SAMA, EAA |
| 3-1f[3] | Provide FAA radio Spectrum and funding for automatic weather data collection expanded to include GA aircraft | ARW-100, ASR-100, AND-520 | SAMA, EAA |
| 3-1g[2] | Issue generic operational approvals by FAA Flight Standards for use of new weather product | AFS-400 | SAMA, EAA |
| 3-2a, b, d and e[2] | Improve the PIREP collection and dissemination system to include a common database for controllers, pilots, FSS specialists and dispatchers | ATO-300, ASY-300, NATTS, NATCA, ARW-200 | AOPA ASF, EAA |
| 3-2 c and f[3] | Provide FSS Specialists with an ASD and provide a dedicated frequency for PIREPS in each terminal area | ATO-300, ASY-300, NATTS, NATCA, ARW-200, ASR-100. | AOPA ASF, EAA |
| 3-3 a and b[2] | Expedite implementation of the Flight Information Service (FIS) program to provide a national, weather data-link system | AND-520, AFS-400, ARW-200 | SAMA, EAA |
| 3-4a[2] | Improve the FSS system, including DUATS, FSS equipment and weather briefings. Initial and recurrent FSS Specialist training | ATO-300, ARW-200, ASY-300, NATTS, NWS, ATX- 100 | AOPA ASF, HAI, NBAA, EAA |
| 3-4b[3] | Improve FSS equipment, linking FSS weather displays and pilot home computer, providing advanced graphics for Specialists, and enabling FSS to get airline dispatch data | AT0-300, ARW-100, ARW-300, ARU-300 | AOPA ASF, HAI |
| 3-4c[3] | Determine the adequacy of FSS services | ATO- 300, NAATS, AFS-400, ARW-200, AAM-510 | AOPS ASF, HAI |
| 3-4d[2] | Improve DUATS | ATO-300, NAATS, AFS-400, ARW-200, AAM-510 | AOPA ASF, HAI, NBAA, EAA |
| 4-1a and c[2] | Improve ATC weather information knowledge and dissemination, and develop new procedures for handling of aircraft that are not weather-tolerant. Educate controllers on the need to provide special | NATCA, ATO-100, ATO-300, AFS-400, AFS-800, ASY-300 | EAA, AOPA, HAI |

| | | | |
|---|---|---|---|
| | handling to small aircraft and enable controllers to provide special handing of small aircraft that are not weather-tolerant | | |
| 4-1b[2] | Enable controllers to provide better information on weather hazard areas to pilots. Provide controllers with better tools, enhance ATC displays of weather, and improve training and information transfer between controllers and CWSUs | ARU-100, ATO-400, ATO-300, NWS, ATX, ATO-100, ASY-300, NAATS. | SAMA, EAA |
| 4-2[2] | Implement systems to provide graphical display of traffic information for use when ATC frequency must be abandoned to gather weather information | NATCA, AND-520, AIR-130, AFS-400 | SAMA, EAA |
| 5-1d[2] | Develop enhanced operational procedures for mountain operations. List recommended weather information sources and safety criteria | AFS-400, AFS-800 | SAMA, EAA |
| 5-1e[2] | Place AWOS or remote TV cameras in critical mountain passes | AK ACO, AUA-430, ARW-300 | SAMA, EAA |
| 5-2a[3] | Exploit new CNS systems in mountainous areas to improve ability of pilot to fly safely below freezing levels or cloud bases | AND-520, AFS-400, AK ACO, AIR-130, NASA GRS | HAI, SAMA |
| 5-2b[3] | Provide lower minimum en route altitudes using GPS-defined routes | AFS-400, AIR-130 | HAI, SAMA |
| 6-1[3] | Encourage pilots to make hazardous weather reports by providing immunity from enforcement | AGC, AFS-800, AFS 200, AFS 400, ASY 300 | NBAA, SAMA, AOPA |
| 6-2[3] | Define use of “VFR not recommended” and “known and forecast icing" in ways that are operationally useful to pilots | Same as 6-1, and NAATS, ATO-300, ARW- 200 | Same as 6-1 |
| 7-4[2] | Expedite implementation of precision GPS approaches at smaller airports and heliports | AFS-400, AVN, AND-720, AND-520, AFS-800 | HAI, NBAA |
| JSAT Conclusion K[3] | Improved Data on GA Weather Accidents | ASY-300, AFS-800, AAM-510, AAI | AOPA, HAI |
| **GA CFIT JSAT Interventions** | | | |
| GA CFIT JSAT TRN bullet 1 | The weather dissemination system needs to give accurate WX information | Included in GA Weather JSAT Intervention 3-4 | |
| GA CFIT JSAT TRN 8 bullet 5 | Dispense menu driven mountain weather and passes information routed through the 1-800-wxbrief | Included in GA Weather JSAT Intervention 5-1 | |
| GA CFIT JSAT MISC 1 | Improve the quality and substance of weather briefs | Included in GA Weather JSAT Intervention 3-4 | |
| GA CFIT JSAT TRN bullets 1, 2, 4 and 5 | Expand the pilot personal minimums program. Provide a structured approach to initial and recurrent pilot training specifically pertaining to CFIT accidents. Increase pilot understanding of the terminology used in weather reports. Provide regionally specific training to capture terrain or weather related issues | Included in GA Weather JSAT Intervention 1-3 | |

Table Footnotes:

The following categories were created to describe the status of programs related to the JSAT interventions:

[1] An existing program fully addresses the intervention, and the only action required is to keep it on-performance, on-schedule, and on-cost.

[2] An existing program partially addresses the intervention, and the program must be modified to fully address the intervention, move schedule ahead, adding a deliverable, etc.

[3] No program exists to address the intervention, and one must be developed.

[4] No action should be taken because the cost or time to achieve the intervention is so high compared to the likely benefits, that the intervention is deemed unfeasible for this reason. (This category may be determined only after a category 2 or 3 IP is developed).

# Appendix F

# FSS GA Renaissance Cross Reference

# Pilot Weather Briefing and Service Requirements

## Bold Items Are Incorporated In GA Weather JSIT Report

**I. Policy**

A. JSIT Items

- **Enable service providers (ATC, including FSS specialists and FISDL providers) to have access to airline PIREPs from their dispatch centers.**
- **Develop clarification or substantial modification of VNR guidance, incorporating "how and when" to go safely guidance, to avoid overly conservative application and resulting lack of use, and replace with telling pilots how and when the destination can be reached safely.**
- **Revise enforcement policies to avoid discouraging PIREPS.**
- **Take traffic counts for appropriate staffing.**
- **Provide decision support for pilots to determine how and when to make the flight safely.**
- **Provide information to help pilots, not for legal protection of the FAA.**

B. Summit Items

- **Establish a new and different philosophy of customer focus, with a higher level of personal service, and an integrated partnership of users.**
- **Revise FSS procedures handbook (7110.10) to reflect this philosophy change.**
- Examine supplementing CWSU staff with FSS briefers in ARTCC and TRACON.
- Perform recurrent surveys to identify current performance, future needs, and design new systems based on user information, including focus groups to develop products and services.
- Develop new programs in a lead region before national implementation.
- Encourage VFR flight plan filing by enhancing its value to the user.
- Evaluate how customer service and cost-benefit can be enhanced by either further consolidation or expansion of FSSs.
- De-emphasize the legal motive for briefing elements, do not include information just for CYA reasons, e.g., delete EFAS notice, international flight notice.
- **Provide adequate staff to handle the demand for services and for training.**
- **Examine possible positive attributes of NAVCANADA system.**
- **Market FSS services to users through outreach efforts, including advertising.**

**II. Services**

A. JSIT Items

**1. Improve DUATS:**
- **Conduct a customer satisfaction survey aimed at developing specific improvements.**
- **Provide a plain language NOTAM translator in DUATS.**
- **Eliminate non-relevant data from report.**
- **Revise OASIS requirement document to permit pilot use over modem and additional**
- **weather graphics.**
- **Incorporate a weather risk assessment model.**

2. Improve FSS services generally.
- **Input results of this Conference into Safer Skies.**
- **Conduct a follow up Conference to assess progress in 2002.**

3. Improve access to flight information.
- **Implement FIS data link system (with weather, NOTAMS, SUA status).**

B. Summit Items

- Provide plain language information and simplify products and services.
- Provide more interpretation, including short-term forecasting, with enhanced briefer capability in difficult weather conditions, such as a meteorologist-level briefer.
- Improve the use of local area knowledge; examine tools for acquiring, retaining, and disseminating this information.
- **Provide pilots with alternatives for "mission success", flight routes, altitudes, or times for a safe flight that would avoid weather hazard areas.**
- Replace the NOTAM system; evaluate the new DOD NOTAM system (or others) as a replacement for the current system.
- Evaluate Remote Airport Information Service for the services and operational benefits it would provide, with a focus on safety.
- Provide a site-specific 800# for each AFSS, in addition to the national 800# WXBRIEF, that would not be off-loaded to another facility (this resolves the cell phone issue, and supports the local area knowledge recommendation).
- Improve business practices by automatically providing daily weather packages to major users (e.g., flight schools, FBOs, air taxi operators).
- Provide "pre-emptive" in-flight calls to pilots to alert them to hazards and changes; SUA/ISE recommendation below (providing FSS with position knowledge based on the Aircraft Situation Display -ASD) supports this recommendation by providing VFR flight monitoring for these weather warnings.
- **Examine replacement of DF program with SUA/ISE or other program.**
- Provide single-point service for pilots to avoid need to communicate with other US government offices (e.g., customs, DOD facilities).

- Provide services geared for a new generation of pilot, with a wider range of technical capability, and with varying service needs, and spend the most briefing time on the most important items for that flight.
- Examine re-sectorization of FSS areas based on traffic flow.
- Provide real-time status of SUA occupancy.
- **Provide easier way to get in-flight weather from FSS for IFR pilots.**
- Enable electronic flight plan filing for other than DUATS.
- Examine providing other services, e.g., fuel availability at an airport, etc.
- Provide timely and efficient international weather briefings.
- Evaluate how to improve weather briefing services for rotorcraft.

**III. Training**

A. JSIT Items

**1. Encourage more controller involvement in the PIREP system by creating simple methods for them to enter, retrieve, and disseminate PIREPs through training:**
- **FSS specialists on entry of data from controllers; CWSU staff to manually input PIREPs benefiting GA in to MWSCR.**
- **TRACON controllers who get PIREPs of widespread wx hazards to communicate to others in TRACON, then to pilots.**
- **NWS to request PIREPs where needed to confirm forecast.**

**2. Improve FSS/Flight Watch specialist recurrent training, and supervisor quality control methods:**
- **To ensure that pilots are advised of effective times, locations easy for pilots to identify, severity, movement, of weather hazard areas relative to planned route of flight, and suggest alternative routes, altitudes, and times to avoid weather hazard areas.**
- **Using computer based tutorials, reinforces by Air Traffic Bulletins, to provide more weather knowledge, especially local climatology, and more knowledge of the limitations of typical pilot/airplane combinations.**
- **Providing an additional position of "training manager".**
- **Update and require PWB course, every two years.**
- **Provide EFAS training to all FSS specialists and supervisors.**
- **Provide training in customer service to all specialists and supervisors.**
- **Revise evaluation checklist to include PWB/customer service as a "special emphasis" item.**
- **Increase the number of tape talks to one per quarter, with appropriate additional staff.**

**3. Improve communications with GA pilots by:**
- **Providing ground school training to all non-pilot FSS specialists and supervisors.**
- **Having a FSS representative at all pilot safety seminars.**
- **Develop a video for use by student pilots on FSS services.**

**4. Improve FSS quality control, by tasking NWS to develop and staff a QCO.**

B. Summit Items

- **Re-establish recurrent training program to include customer focus, meteorology (forecasting and nowcasting) weather interpretation, and increased aeronautical knowledge.**

**IV. Equipment**

A. JSIT Items

**1. Encourage more controller involvement in the PIREP system by creating simple methods for them to enter retrieve, and disseminate PIREPs by providing:**

- **A short-term "automation" system, using a direct line to fast file for recording the PIREP, with FSS entry into data base.**
- **A long-term automation program of PIREP entry and access with virtually no increase in workload, such as one-key entry.**

**2. Provide all FSS specialists with:**

- **Aircraft situational displays (SUA/ISE) showing location of aircraft receiving in-flight briefing relative to weather graphics, and incorporate into OASIS.**
- **Communications/displays for accessing NWS ADDS and other graphics, and FISDL products (to have the same information as pilots), and incorporate into OASIS.**

**3. Provide en route, TRACON and tower controllers with equipment and products to display weather hazard graphics.**

**4. Improve area dissemination of PIREPs to pilots by providing one FSS VHF frequency nationwide for a PIREP summary broadcast, transcribed by a FSS specialist.**

B. Summit Items

- Provide a shared (between all FAA facilities) data base containing weather, flight data, flight and briefing history, and NOTAMS.
- Improve data communication system for higher data rates to ensure adequate capacity for new systems, such as OASIS.
- Provide capability to split flight watch positions among RCOs.

**V. Weather Products**

A. JSIT Items

- **Provide operational weather graphics that show current and forecast weather hazard areas from instrument conditions, thunderstorms, icing, and turbulence, and are highly accurate, precise, and timely.**
- **Make these available for pre-flight and in-flight use by FSS/Flight Watch Specialists, controllers, dispatchers, traffic planners, and pilots.**
- **Provide for their transmission by phone, voice radio, computer modem, and data link.**
- **Use the National Weather Service's Aviation Digital Data Service to disseminate the products.**
- **Fully fund the FAA aviation weather research program.**

B. Summit Items

- **Improve accuracy and precision of weather products to increase pilot confidence in the information compared to the weather they encounter.**
- **Enable use of internet by FSS specialists to access weather products.**
- **Provide the same or similar weather products to all ATC users and pilots.**
- **Increase priority (including funding) of aviation weather at NWS.**

## Industry Efforts

A. JSIT Items

- **Improve number and quality of PIREPs, by educating pilots on need and best practice methods of reporting.**
- **Improve pilot understanding of FSS services, by encouraging student pilots visit FSS, logbook signature.**

B. Summit Items

- **Educate pilots on information to provide briefer to improve pre-flight briefing, with information understand pilot/aircraft weather capability, and knowledge from other weather sources.**

## Appendix G

## Implementation Plan Summary 3-1d and f

### I. JSAT Intervention Summary

### A. Description

**Intervention 3-1: Produce and make operational graphical weather information products that show how and when a flight can be made safely**
**d**) Accelerate FAA funding for the flight verification program to confirm the validity of new experimental weather products
**f)** Provide FAA radio spectrum and funding for automatic weather data collection expanded to include GA aircraft
Author(s): Ron Colantonio, NASA/AvSP; Jim Henderson, AWC; Paul Fiduccia, SAMA

### B. Explanation

A GA electronic pilot reporting (E-PIREPs) system will utilize instrumented aircraft in flight as weather observing stations that report in situ conditions to users of that information. These users include weather forecasters, weather briefers, air traffic controllers, and pilots. The information will be relayed to the ground as a digital data stream for collection and dissemination. A GA E-PIREPs system will permit 1) validation of currently available and soon to be available weather products; 2) improved weather forecasting (aviation and non-aviation) accuracy by using the E-PIREPs data as improved forecast model inputs and 3) increased pilot situational awareness.

Currently, Aircraft Communications Addressing And Reporting System (ACARS) equipped transport airplanes are sending temperature and wind data to the ground for collection and dissemination to the National Weather Service (NWS) via the Meteorological Data Collection And Reporting System (MDCARS). Data are collected during climb, cruise and descent phases of flight. Due to the nature of jet transport operations, the majority of data are reported for high altitude cruise. This program is being expanded to regional carriers, with Sky West, Comair, Air Wisconsin, Atlantic Coast and will soon be providing EPIRPES of icing (or no icing).

Most of the moisture and weather are at altitudes of 18,000 feet and below, well below jet-transport cruise altitudes. Therefore, there is a desire to gain more meteorological observations of conditions below 18,000 feet, especially water vapor. This intervention plan proposes that GA airplanes be equipped to report these data.

## II. JSIT Implementation Summary

### A. Action(s)

#### 1. FAA

a. Expand the current transport E-PIREP program to include the GA aircraft, which contribute most to forecast model schedule, have high-utilization, and fly under 18,000 feet MSL operations (i.e., Part 135 cargo (check haulers), Part 135 scheduled carriers, Part 121 regional carriers, Part 141 flight school aircraft used for cross country flights).
b. Include this activity under the current MDCRS program management.
c. Define GA E-PIREP system/architecture including number and location of participating aircraft, avionics requirements, and means of communicating data to NWS and reports from the EPIREPs to FSS, and equipage and user requirements.
d. Reserve additional E-PIREPs frequency spectrum.
e. Define incentives for the aircraft owner to consider E-PIREP capability in a viaible business case.
f. Develop and fund a system to equip aircraft with necessary avionics, including STCs for the most common aircraft types involved, and the purchase, installation, and maintenance of airborne equipment.
g. Develop and deploy necessary ground infrastructure, possibly using current data link systems and ground communications system (e.g. the FISDL service providers and ARINC).

#### 2. Industry

a. Assist in developing user incentives.
b. Manufacturers develop avionics.

#### 3. NWS

a. Expand the current transport E-PIREP program to include GA aircraft by being prepared to accept more data into models.
b. Assist in defining GA E-PIREP weather model input requirements, e.g., types of sensor accuracy.
c. Assist in defining GA E-PIREPs architecture for proper data dissemination into weather models.
d. Determine total US economic benefit from acquisition of the GA data through the improvement in model accuracy.

## 4. NASA

a. Continue funding GA E-PIREP Industry cooperative agreements and sensor development for the next five years.

## B. Resources

| FAA | FY 2000 | FY 2001 | FY 2002 | FY 2003 | FY 2004 | FY 2005 |
|---|---|---|---|---|---|---|
| **Change Type** | 100%C/ 50%M | 100%C/ 50%M | 100%C/ 50%M | 100%C/ 50%M | 100%C/ 50%M | 100%C/ 100%M |
| **FTEs** | 1/.5 | 1/.5 | 1/.5 | 1/.5 | 1/.5 | .5/.5 |
| **Contract $** | 1M/500K | 1M/500K | 1M/500K | 1M/500K | 1M/500K | 500K/500K |

**Offices: ARW-100, AUA-400, AND-300; includes transport humidity sensor program ($2.9M FY0-04)**

| NASA | FY 2000 | FY 2001 | FY 2002 | FY 2003 | FY 2004 | FY 2005 |
|---|---|---|---|---|---|---|
| **Change Type** | 100%C | 100%C | 100%C | 100% | 100%C | N/A |
| **FTEs** | .25/0 | .25/0 | .25/0 | .25/0 | .25/0 | N/A |
| **Contract $** | $250/0 | $250/0 | $250/0 | $250/0 | $250/0 | N/A |

**Organizations: NASA AvSP/Weather Accident Prevention Project**

| NWS | FY 2000 | FY 2001 | FY 2002 | FY 2003 | FY 2004 | FY 2005 |
|---|---|---|---|---|---|---|
| **Change Type** | 100%C/ 10%M | 100%C /25%M | 100%C /25%M | 100%C /25%M | 100%C /25%M | 100%C /100%M |
| **FTEs** | 1/.5 | 1/.5 | 1/.5 | 1/.5 | 1/.5 | .5/.5 |
| **Contract $** | $750/50K | $750/165K | 750/165K | 750/165K | 750/165K | 165/165K |

**Note: Includes shared costs with FAA for current transport ARINC/MDCRS for data collection; includes transport humidity sensor program ($2.1M FY0-04). Additional funding for GA data handling costs.**

| Industry | FY 2000 | FY 2001 | FY 2002 | FY 2003 | FY 2004 | FY 2005 |
|---|---|---|---|---|---|---|
| **Change Type** | 100%C | 100%C/15 %M | 100%C/ 15%M | 100%C/ 15%M | 100%C/ 15%M | 100%C/ 15%M |
| **FTEs** | 2/0 | 2/.5 | 2/.5 | 2/.5 | 2/.5 | 1/.5 |
| **Contract $** | $2M/0K | 2M/330K | 2M/330K | 2M/330K | 2M/330K | 500K/330K |

**Note: Includes estimated cost to airlines per message ($.02 to $.10), industry cost sharing on NASA Cooperative Agreements, and the transport humidity sensor program ($8.3M FY0-04).**

See "IP Summary Key" for Explanation of Tables

# Appendix H

## Intervention Program Plan 3-1d and f

**Intervention 3-1: Produce and make operational graphical weather information products that show how and when a flight can be made safely**

**d.** Accelerate FAA funding for the flight verification program to confirm the validity of new experimental weather products.

**f.** Provide FAA radio spectrum and funding for automatic weather data collection expanded to include GA aircraft.

Author(s): Ron Colantonio, NASA/AVSP; Richard Young, ARW-100; Jim Henderson, AWC; Paul Fiduccia, SAMA

### I. Current NWS, FAA, NASA, Research and Industry Programs Addressing Intervention

### A. Joint FAA/Industry Program Data

| | |
|---|---|
| Program Name | E-PIREPS |
| Lead Organization | FAA, NASA |
| Performing Organization(s) | FAA:ARW-100/AUA-400/AND-300, NASA AvSP, NWS, NCAR |
| Program Manager, Organization | FAA ARW-100 Manager; NASA AvSP Weather Accident Prevention Manager |
| Mission Needs Statement: Name; Number | Implement a flight verification program/E-PIREPS for the General Aviation community. |
| Sponsoring Organizations | NASA, FAA, General Aviation Coalition, Private Industry, NWS |
| Program Products | E-PIREPS used to validate and verify new aviation hazard graphical products. |
| Degree to which Program achieves Weather JSIT Intervention | Addresses the JSIT intervention of establishing a flight verification program for GA aircraft to validate new experimental weather products. |
| Relations to Other Interventions | Relates to FAA FIS Policy, NASA AWIN effort |

### B. Program Description: Statement of Work by NASA, FAA, NWS, and Industry

In January, 1999, the National Aviation Weather Program Council issued the National Aviation Weather Initiatives documents. This plan, using inputs from throughout the aviation industry, presented a small number of achievable high impact initiatives including one that stated:

> "Expand and institutionalize the generation, dissemination, and use of automated **PIREPs** to the full spectrum of the aviation community, including general aviation."

Electronic pilot reporting (E-PIREP) will utilize instrumented aircraft in flight as weather observing stations that report in situ conditions to users of that information. These users include weather forecasters, weather briefers, air traffic controllers, and pilots. The information will be relayed to the ground as a digital data stream for collection and dissemination. Electronic Pilot Reporting needs to be developed using a systems approach to ensure a commercially viable implementation. Three elements have to be considered for an E-PIREP system: (1) coverage, (2) capability, and (3) cost.

Currently, Aircraft Communications Addressing And Reporting System (ACARS) equipped transport airplanes are sending temperature and wind data to the ground for collection and dissemination to the National Weather Service (NWS) via the Meteorological Data Collection And

Reporting System (MDCARS). This program is being expanded to regional carriers with Sky West, Comair, Air Wisconsin and Atlantic Coast to provide E-PIREPS for "icing" or "no icing". Data are collected during climb, cruise and descent phases of flight. A humidity sensor FAA/NOAA MDCARS project is also currently funded for ACARS equipped transport, however, most of the moisture and weather are at altitudes of 18,000 feet and below, well below jet transport cruise altitudes. Due to the nature of jet transport operations, the majority of data are reported for high altitude cruise. Therefore, there is a desire to gain more meteorological observations of conditions below 18,000 feet. It has been proposed that general aviation (GA) airplanes be equipped to report these data.

The benefits of a GA E-PIREPS clearly extend beyond the aviation community. The added data obtained for a GA E-PIREPS system will improve and validate non-aviation weather forecasting skills that effect other modes of transportation, agricultural communities, DoD operations, enhanced public awareness of weather, etc. Such spin-offs for a GA E-PIREP system may provide future R&D and implementation leveraging opportunities. Currently the FAA/NOAA humidity sensor project for transports will cost FAA, NOAA and industry approximately $14M of investment. The life cycle cost benefit for such an investment is estimated to be $217M just based on replacing the soundings made by 70 weather stations across the United States. This does not include the aviation and non-aviation impacts from improved inflight icing and ceiling and visibility forecasts.

NASA's Aviation Safety Program (AvSP) has taken a role in this initiative under its AWIN (Aviation Weather Information) project. NASA has a cooperative research agreement with NavRadio to develop a "General Aviation Oriented Electronic Pilot Report Generation and Datalink System" along with team members Aspen Mountain Airlines, Atmospheric Systems, Avidyne, Avrotec, D-TEK, EAA, FAA CAMI, Inertia Technology, NCAR, RAA, Seagull Technology, Unisys Weather Information Services, State of Minnesota/DOT Office of Aeronautics, and State of Wisconsin/DOT Division of Aeronautics. This work will create a near-term, practical E-PIREP system based on next-generation sensor, packaging, and datalink technology. The end result of this research will be 30 production airborne equipment packages and two operational ground stations for in-flight evaluation of a low-cost sensor package bundled with VHF datalink capabilities. The sensor system for the E-PIREP GA system includes an airspeed inlet, optical icing detector, integral GPS antenna and air data sensor for the measuring of air temperature, relative humidity, heading, GPS positioning, airspeed, vertical accelerations, icing, and pressure.

Phase II of the NASA cooperative research agreement on GA E-PIREPS will be up to a 3 year effort and will continue to develop useable, operational E-PIREP weather products and implement the data collection to larger scales. It will potentially involve participation of regional airline users as well as integration evaluation of E-PIREP system into the FIS.

NASA will also help develop airborne sensors to cover requirements for several aviation weather hazards. Requirements for icing and turbulence will be considered, and other aviation weather hazards and atmospheric measurables addressed will include ceiling & visibility, convective weather, winds, wind shear, wake vortices, moisture/humidity, temperature, precipitation type (rain/freezing rain/sleet/snow/hail), and volcanic ash. Some of these sensors could potentially be integrated into an E-PIREP system.

**C.** **Program Outcome:** Measurable improvement of forecast modeling by including airborne equipment to collect more and better airborne electronic weather data from GA aircraft and regional airline aircraft operating at low altitudes. There is also the opportunity to data link back into the cockpit processed, graphical near-real time weather depictions based in large part on the E-PIREP data.

**D.** **Program Outputs:**

1. Affordable, certifiable sensor package suite/avionics bundled with a VHF datalink for GA A/C

**C.** Prototype demonstration of a E-PIREP system for GA A/C

**D.** **Government and Industry Program Milestones and Dates (Who; What; When):** Specifically targeted to GA and not Transport E-PIREP Systems

**Government Items**

| FY 2000 | FY 2001 | FY 2002 |
|---|---|---|
| NASA 1Q: Complete NavRadio Phase I Cooperative Research Agreement on "General Aviation Oriented Electronic Pilot Reporting (E-PIREP) Generation and Data-Link System"<br><br>NASA 2Q: Identify and Initiate Phase II 3-year Cooperative Research Agreement on E-PIREPS<br><br>NASA 2Q: Report on the identification and specification of weather information and sensor measurables requirements<br><br>NASA 3Q: Initial atmospheric models and sensor simulation for selected technologies and preliminary weather hazard algorithms delivered.<br><br>NASA 4Q: Initiate flight/ground test series to evaluate enhanced weather products/concepts and sensors. | NASA 2Q: Report complete on initial flight/ground test series to evaluate enhanced weather products/concepts and sensors<br><br>NASA 3Q: Weather product definition and sensor selection for national prototype demonstrations<br><br>NASA 4Q: Delivery of simulation software and documentation for atmospheric models and sensors for selected weather hazards algorithms and sensors. | NASA 3Q: Initiate flight/ground demonstrations of national AWIN/Enhance weather product capability |

**F. Government and Industry Resources**

| Fiscal Year | Staff FTEs by Office and Function | Contract $ by Function | Industry Resources |
|---|---|---|---|
| FY 2000 | NASA: .25 | NASA CRA: $.220M; NASA Sensor Development Reflected in 3-1a | 50% cost-sharing on NASA CRAs |
| FY 2001 | NASA: .25 | NASA CRA: $.220M; NASA Sensor Development Reflected in 3-1a | 50% cost-sharing on NASA CRAs |
| FY 2002 | NASA: .25 | NASA CRA: $.220M: NASA Sensor Development Reflected in 3-1a | 50% cost-sharing on NASA CRAs |

## II. Modification of Current Program Plan

**A. Description of Modification:**

Before equipping GA airplanes with E-PIREPS capability, its cost and benefits need to be studied. Weather observations are needed on a regular basis if users are to be able to depend upon the availability of the resulting enhanced reporting and forecasting capabilities. Thus, the question of which aircraft to equip from among the 192,000 active general aviation aircraft needs to be answered. The answer to this question depends upon an understanding of the airspace that needs to be sampled and the frequency with which it needs to be sampled, i.e. the coverage that the equipped airplanes would provide. As a group, the E-PIREP-equipped aircraft should provide observations spanning the entire United States at altitudes of 18,000 feet and below; have availability seven days a week both day and night in both VMC and IMC; and throughout all four seasons. An airplane that is operated for flight training in day VMC would be of limited use, as would be an airplane that is operated sporadically or that is not operated in northern states during the winter. IMC-capable aircraft that are operated over defined routes on a regular basis appear to be the best candidates for E-PIREPS equipage. This seems to point one towards the regional commuter airlines and package carriers.

Once the aircraft that provide the needed coverage have been identified, an acceptable cost of this capability needs to be established. Cost of data collection, messaging, processing and dissemination need to be established. The cost of installation, approval, upkeep, periodic calibration, and replacement need to be considered. The incentives for aircraft owners to equip their aircraft for E-PIREPS need to be weighed against the cost involved. Finally, the need for incentives to implement and operate a system of electronic pilot reporting should be addressed. It is not unreasonable to envision the operator of an E-PIREP-equipped aircraft selling the meteorological observations to the users. In defining the requirements for a GA E-PIREP system the following questions need to be answered:

1. What information is desired from the aircraft?
2. What airplanes could provide the spatial and temporal distribution of observations needed?
3. What sensors are available to make these measurements?
4. How will sensors be mounted on aircraft?
5. How will data be transmitted to the ground?
6. How will data be collected on the ground?
7. To whom will data be sent and in what format and how often?
8. What use will be made of these observations?
9. How often will sensors need to be serviced/calibrated?
10. What will be the cost of the sensors and data transmissions?
11. What incentives will be needed for operators to participate?
12. What are the projected improvements in forecasting?
13. What information is desired from the aircraft?

**B. Revised Deliverables:**

1. GA E-PIREPS System Architecture and User Requirements
2. GA E-PIREPS frequency allocation or equivalent defined
3. Aircraft owner/industry incentives defined/developed
4. GA E-PIREP infrastructure operational

**C. Additional Government and Industry Milestones and Dates (Changes from current plan):**

| FY 2000 | FY 2001 | FY 2002 | FY 2003 | FY 2004 | FY 2005 |
|---|---|---|---|---|---|
| ARW-100/NWS: Develop E-PIREP architect and user requirements<br><br>ARW-100: E-PIREP Cost Benefit (aviation and | AND-300: Evaluate E-PIREP data link requirement;<br><br>AND-300: Select E-PIREP data link(s)<br><br>Industry: | AUA-400/ARW-100: Initiate GA E-PIREP infrastructure<br><br>AUA-400/ARW-100/NWS: Integrate E-PIREP data into FIS and | AUA-400/ARW-100/NWS: Develop and maintain GA E-PIREP Infrastructure | AUA-400/ARW-100/NWS: Develop and maintain GA E-PIREP Infrastructure | AUA-400/ARW-100/NWS: Develop and maintain GA E-PIREP Infrastructure |

| | | | | | |
|---|---|---|---|---|---|
| non-aviation) Report<br><br>ARW-100: E-PIREP Aircraft Owner Incentive Report | Prototype low-cost E-PIREP avionics | improved NWC/AWC weather products. | | | |

**D. Additional Government and Industry Resources (Beyond existing program resources)**

| Fiscal Year | Staff FTEs by Office and Function | Contract $ by Function | Industry Resources |
|---|---|---|---|
| FY00 | ARW-100: .5<br><br>NWS: .5 | ARW-100: $.250M E-PIREPs Architect/User Requirements Study; $.150M E-PIREP Cost Benefit Analysis; $100K E-PIREP Incentive Study<br><br>NWS: $.050M Weather Model Requirements Study | |
| FY01 | AND-300: .10<br><br>ARW-100: .3<br>AUA-400: .1<br><br>NWS: .5<br><br>Industry: .5/year | AND-300: $.150M E-PIREP data-link studies<br><br>ARW-100: $.350M Additional infrastructure/ sensors suite costs/ data collection<br><br>NWS: $.165M Additional data collection cost shared with the FAA | Industry: $.330M (estimated) weather data message cost/avionics |
| FY02-05 | ARW-100: .3/year<br>AUA-400: .1/year<br><br>NWS: .5/year<br><br>Industry: .5/year | ARW-100: $.500M/year: infrastructure/ sensors suite/data collection<br><br>NWS: $.165M/year Additional data collection cost shared with the FAA | Industry: $.330M/year (estimated) weather data message cost/avionics |

**E.** **FAA Budget Reprogramming:** Additional funding required for concept and user incentives definitions, additional infrastructure, sensor suite and installations costs, and data collection of approximately $500K/year through FY-2004. This is based on the current transport ACARS/MDCRS government cost of processing downlinked data with supporting infrastructure.

**III.** **New Program Plan:** n/a

**IV.** **Chain of FAA and Industry managers in agreement with above**

**A.** **FAA:**
ARW/AUA/AND approval

**B.** **NASA:**
Level II Project Manager, Weather Accident Prevention approval

**C.** **NWC:**
Director AWC approval
Director NCEP approval
Director Office of Meteorology approval
Deputy Director of NWS briefed
Director NWS - TBD

**V.** **Other issues:** As noted in Section II A.

**VI.** **Statement of effectiveness and feasibility of intervention:**

Primary Benefits

1. Regulatory mandates for equipage are not necessary to derive sufficient benefits to justify the investment, however, incentives must be provided for sufficient aircraft operators to participate.
2. Improved quality and timeliness of hazardous weather condition advisories for aircraft
3. Improved aviation weather modeling by NCAR and NWS
4. Improved **non-aviation** weather modeling
5. Improved regional airline safety information for both dispatch and in-flight users
6. Enhanced pre-flight weather briefing and hazardous weather annunciation

Secondary Benefits

1. National Aviation System capacity/efficiency improvements
   a. Increased information to pilots enroute for early route diversion. This helps ATC handle pile-ups or system “clogs” where poor conditions mandate holding patterns or IFR approaches.
   b. Terminal flight in VFR- helps avoid system congestion where IFR approach not necessarily needed.
   c. Avoid “follow-the-leader” through suspected clear spots or passages through line of storms- helps with congestion and ATC workload when “leader” choose poor route or weather rapidly changes.
   d. Benefits ALL class aircraft in the NAS by providing comprehensive next-generation modeling, forecasting, and current weather scenario depiction.
1. Voice/Datalink Communication Spectrum Improvements
   a. Because of E-PIREP datalink system usage, less reliance on and use of analog FDD, FlightWatch, and ATC frequencies- Pilots will help efficiencies within the system just by using the datalink and freeing up analog spectrum (PIREPS and generic weather reporting)
   b. Increased efficiency by datalink usage vs. analog voice usage fueled by operators’ choice
1. Increased efficiencies for pilots
   a. Better flight-route decision making tools may cause fewer weather delays and help avoid congested IFR holding and approach bottle-necks
   b. Increased weather cognizance can increase pilot ability to make safe decisions

**VI. Status of Current Planned FAA/Industry Project Implementation Compared to Recommended Intervention**

**A.** **Program Performance:** Current FAA program does not address this intervention, although it provides an infrastructure.

**B.** **Program Schedule:** Current program (ARINC/MDCRS) is 20% of needed program, mainly lacking concept definition, downlink infrastructure (i.e. new VHF frequencies) and equipage incentives to expand the program to regional and general aviation participation.

**C.** **Program Cost:** Current program is 10% of needed program, mainly lacking funding for initial investment in infrastructure depending on solution, and incentives to equip.

**VIII. Relationship to Current Aviation Community Initiatives.**

Related to National Aviation Weather Initiative

**IX. Performance Goals & Indicators for Outcomes/Outputs**

Accident Reduction:
Goal: Reduce fatal GA weather accident
Indicator: Number of fatal GA weather accidents of this type drops.

**X. Plan and Execution Requirements**

**A.** FAA, NWS, NASA and Industry must commit adequate levels of staffing and funding support to accomplish its actions on-performance and on-schedule.
**B.** Regional Airlines and the GA community must commit to adequate levels of participation, and perhaps partial financial support.

**XI. Risk Description**

**A.** Lack of incentives for the aircraft owner to consider E-PIREP capability in a visible business case.
**B.** Delay of FAA committing a dedicated frequency for GA E-PIREPS which could delay bundling E-PIREP package with the quickly emerging FIS service.
**C.** Delay of FAA issuance of certification and operational guidelines

**XII. Risk Mitigation Plan**

NASA AvSP research project plans must continue to be closely coordinated with related FAA, NWS and Industry efforts to ensure success in development of the GA E-PIREPS

**XIII. Summary of Recommendation**

FAA

- Expand the current transport E-PIREP program to include GA aircraft which contribute most to the forecast model schedule, have high-utilization and fly under 18,000 MSL operations, i.e., Part 135 cargo (check haulers), Part 135 scheduled carriers, Part 121 regional carriers, Part 141 flight school aircraft used cross country.
- Include this activity under the current MDCRS program management.

- Define GA E-PIREP system/architecture including number and location of participating aircraft, avionics requirements, and means of communicating data to NWS and reports from the EPIREPS to FSS, and equipage and user requirements.
- Reserve additional E-PIREPS frequency spectrum.
- Define incentives for the aircraft owner to consider E-PIREP capability in a viable business case.
- Develop and fund a system to equip aircraft with necessary avionics, including STCs for the most common aircraft types involved, and the purchase, installation, and maintenance of airborne equipment.
- Develop and deploy necessary ground infrastructure, possibly using current data link systems and ground communications system (e.g. the FISDL service providers and ARINC).

Industry

- Assist in developing user incentives.
- Manufacturers develop avionics.

NWS

- Expand the current transport E-PIREP program to include GA aircraft by being prepared to accept more data into models.
- Assist in defining GA E-PIREP weather model input requirements, e.g., types of sensor accuracy.
- Assist in defining GA E-PIREPS architecture for proper data dissemination into weather models.
- Determine total US economic benefit from acquisition of the GA data through the improvement in model accuracy.

NASA

- Continue funding GA E-PIREPS industry cooperative efforts and sensor development as currently planned in 5-year program

## A. FY 2000

**FAA**

**1.** Additional Deliverable or Acceleration: E-PIREPS Requirements Defined
**2.** Additional FTEs Required: .5
**3.** Additional Contract $ Required: $.500M

**NWS**

**1.** Additional Deliverable or Acceleration: E-PIREPS Weather Model Requirements Defined
**2.** Additional FTEs Required: .5
**3.** Additional Contract $ Required: $.050M

## B. FY 2001-2005

**FAA**

1. Additional Deliverable or Acceleration: E-PIREPS Infrastructure/Sensor Suite/Installation/Data Collection
2. Additional FTEs Required: .5/year
3. Additional Contract $ Required: $.500M/year

**NWS**

1. Additional Deliverable or Acceleration: Shared data collection cost
2. Additional FTEs Required: .5
3. Additional Contract $ Required: $.165M

**Industry**

1. Additional Deliverable or Acceleration: Data-messaging cost
2. Additional FTEs Required: .5
3. Additional Contract $ Required: $.330M (estimated)

# Appendix I

## Federal Aviation Administration

## Safer Skies:
## A Focused Safety Agenda

## General Aviation

## Weather Joint Safety Analysis Team

## Final Report

April 1999

***Will be available on CDROM pending JSC report revisions***

## Appendix J. JSIT Team Members and Statement of Team Consensus

**Statement**: The undersigned Members of the General Aviation Weather Joint Safety Implementation Team (GA Weather JSIT), as individuals and as representatives of their organizations, have reached consensus that the implementations contained in this Report would be highly effective and feasible, have a substantial benefit/cost ratio, and appropriately address the interventions recommended in the GA Weather JSAT report.

### Team Members

| **Joint Steering Committee Liaison Member** | |
|---|---|
| **Henry Armstrong**<br>Manager, Rotorcraft Directorate<br>FAA ASW-100<br>Fort Worth, TX | |
| **Team Co-Chairs** | |
| **Paul Fiduccia**<br>President<br>Small Aircraft Manufacturers Association<br>Alexandria, VA | **Fred Gibbs**<br>Manager<br>Weather Standards<br>FAA ARW-200<br>Washington, DC<br><br>**Dr. Frances Sherertz**<br>Deputy Director<br>Aviation Weather<br>FAA ARW-2<br>Washington, DC |

| Team Members | |
|---|---|
| **Monica Bradford**<br>Air Traffic Control Specialist<br>Flight Service Division<br>FAA ATP-300<br>Washington DC | **Kevin Bridges**<br>General Engineer<br>Avionics Systems Branch<br>FAA AIR-130<br>Washington DC |
| **Douglas Carr**<br>Manager, Domestic Operations<br>National Business Aviation Association<br>Washington, DC | **Stephen Chenault**<br>Aviation Safety Inspector<br>Aviation Weather<br>FAA AFS-400<br>Washington DC |
| **James Chudy**<br>Aerospace Engineer<br>Aircraft Certification Office<br>Anchorage, AK | **Ron Colantonio**<br>Manager, Weather Accident Prevention Project<br>Aviation Safety Program<br>NASA<br>Cleveland OH |
| **Susan Gardner**<br>Aviation Safety Inspector (GA/AC/Ops)<br>General Aviation and Commercial Division, Certification Branch<br>FAA AFS-840<br>Washington, DC | **Ruth Grasel**<br>Aviation Safety Inspector (GA/Ops)<br>General Aviation and Commercial Division, Flight Operations Branch<br>FAA AFS-820<br>Washington, DC |
| **George Greene**<br>Aviation Research<br>FAA AAR<br>Langley, VA | **Dorothy Haldeman**<br>Manager<br>Aviation Weather<br>National Weather Service<br>NOAA<br>Suitland, MD |
| **Hooper Harris**<br>Aviation Safety Inspector (GA/Ops)<br>Flight Technologies and Procedures Division, Flight Operations Branch,<br>FAA AFS-410<br>Washington, DC | **James Henderson**<br>Deputy Director<br>Aviation Weather Center<br>National Weather Service<br>NOAA<br>Kansas City, MO |

| | |
|---|---|
| **Lynda Hobbs**<br>Air Traffic Control Specialist<br>Flight Service Division<br>FAA ATP-300<br>Washington DC | **Pete Hwoschinsky**<br>General Aviation/Vertical Flight<br>Technical Manager<br>FAA AND-520<br>Washington, DC |
| **Daphne Jefferson**<br>Branch Manager<br>Meteorological Support Branch<br>Flight Service Division<br>FAA ATP-310<br>Washington, DC | **Kurt Joseph**<br>Research Psychologist<br>Civil Aeromedical Institute<br>FAA AAM-500<br>Oklahoma City, OK |
| **Robert J. Kopecky**<br>Program Manager,<br>Airman Testing Standards Branch<br>FAA AFS-630<br>Oklahoma City, OK | **Bruce Landsberg**<br>Executive Director,<br>AOPA Air Safety Foundation<br>Frederick, MD |
| **Mike Lenz**<br>Aviation Safety Program Analyst<br>Office of System Safety<br>FAA ASY-300<br>Washington, DC | **Joe Mooney**<br>Program Analyst<br>Office of Accident Investigation<br>FAA AAI-220<br>Washington, DC |
| **Don Nellis***<br>Office of Spectrum Management<br>FAA ASR-100<br>Washington, DC | **Rick Peri**<br>National Air Transport Association<br>Alexandria, VA |
| **Dan Petlowany**<br>Air Traffic Control Specialist<br>Air Traffic Requirements Service<br>NAATS Liaison<br>Washington, DC | **Walter Pike**<br>President,<br>National Association of Air Traffic Specialists<br>FAA Air Traffic Control Specialist<br>Wheaton, MD |
| **Glenn Rizner**<br>Vice President, Operations<br>Helicopter Association International<br>Alexandria, VA | **David A. Sankey**<br>Product Lead<br>Weather Sensors and Aviation Weather Research Product Team<br>AUA-430<br>Washington, DC |

| | |
|---|---|
| **James Sheets**<br>Aviation Weather Research<br>GSC AUA/TAC<br>Washington, DC | **Nan Shellabarger***<br>Office of Policy and Plans<br>FAA APO<br>Washington, DC |
| **Cal Smith**<br>Air Traffic Control Specialist<br>Air Traffic System Requirements Service, FAA ARW Representative,<br>National Air Traffic Controllers Association<br>Washington, DC | **John Steuernagle**<br>Vice President<br>Operations<br>AOPA Air Safety Foundation<br>Frederick, MD |
| **Steve Teager**<br>Aerospace Engineer<br>FAA AND-520<br>Washington, DC | **James Tegtmeier***<br>Office of Chief Counsel<br>FAA AGC-300<br>Washington, DC |
| **Richard A. Weiss**<br>Washington Representative<br>Experimental Aircraft Association<br>Oshkosh, WI | **Richard Young**<br>Air Traffic Control Specialist<br>Aviation Weather Policy<br>FAA ARW-100<br>Washington, DC |

Note: Persons denoted with an asterisk did not participate in the Implementation Plan evaluation sessions, but did provide important information to the JSIT.