



Aviation Safety Program

Weather Accident Prevention (WxAP) Project Overview and Status

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NASA Glenn Research Center (GRC)
Cleveland, OH



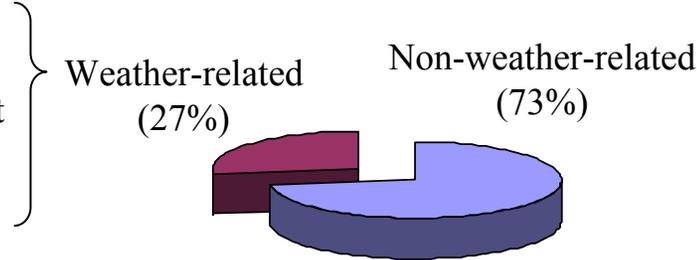
- Weather Accident Prevention Project Background/History
- Project Modifications
- Project Accomplishments
- Project's Next Steps



Weather Safety Benefits Needed

41% during cruise

27% due to visual flight operation in instrument flight conditions

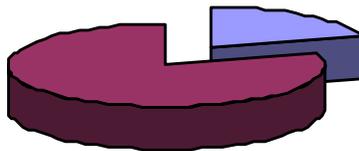


GA Aviation Accidents 1982-1998
(22053 total accidents)

Source: AOPA Air Safety Foundation

Non-Turbulence-related Injuries (67%)

Turbulence Injuries (33%)
Ranked #1 for Injuries



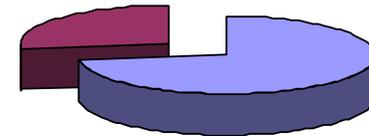
Commercial Transport Serious Injuries 1990-1996

Fatal/Non-fatal Accidents

Source: NTSB Data

Weather-related (33%)

Non-weather-related (67%)

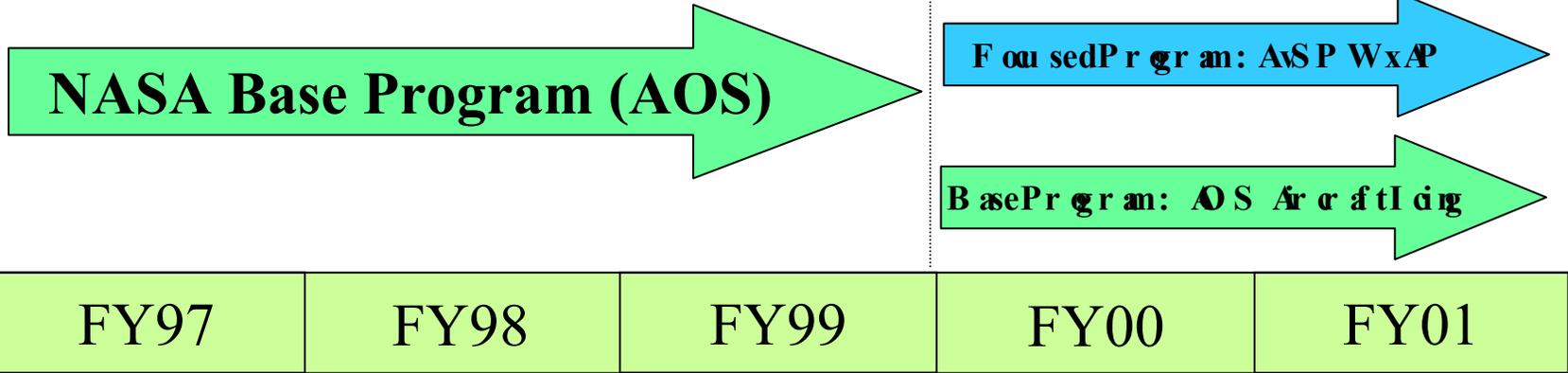


Commercial Carrier Accidents 1988-1995

Source:NTSB



Project Evolution



Aviation Safety Investment Strategy Team

White House Commission on Safety and Security Sets Goal of 80% reduction in fatal accidents within 10 years

National Aviation Weather Program Strategic Plan- Office of the Federal Coordinator for Meteorology

National Aviation Weather Initiatives

FAA-NASA Memorandum Of Understanding Signed On Aviation Safety

Commercial Aviation Safety Team and GA Joint Steering Committee activities initiated

*FAA-NASA Weather Safety Memorandum Of Agreement
*Signed June, 2000**

NASA-Other Agency Weather Safety Memorandum Of Agreements (in progress)

NASA AvSP Organizational Structure



Aviation Safety Program

Weather Accident Prevention

Aviation Safety Program Office

Michael Lewis, Director

George Finelli, Deputy Director

Connie Smith, Secretary

Brian Smith, Dep Prog Mgr (ARC)

Jaiwon Shin, Dep Prog Mgr (GRC)

Frank Jones, Asst Tech Mgmt

Glenn Bond, Senior Prog Analyst

AvSPEC

1.1
Technical Integration
Vincent Schultz (LaRC)

1.2
Program Integration
Michael Basehore (FAA)
Carrie Walker (Hq)

Programs

Projects

2.1
Aviation System
Monitoring &
Modeling

Irv Statler
(ARC)

2.2
System-Wide
Accident
Prevention

Tina Beard
(ARC)

2.3
Single Aircraft
Accident
Prevention

John White
(LaRC)

2.4
Weather
Accident
Prevention
(WxAP)
Shari-Beth Nadell
(acting) (GRC)

2.5
Accident
Mitigation

Douglas Rohn
(GRC)

2.6
Synthetic
Vision

Daniel Baize
(LaRC)

Elements

Aviation Weather
Information (AWIN)
2.4.1
Paul Stough
(LaRC)

Weather Information
Communication
(WINCOMM)
2.4.2
Gus Martzaklis
(GRC)

Turbulence
Detection and
Mitigation (TDAM)
2.4.3
Rod Bogue
(DFRC)



WxAP Project Goals/Objectives/Products

Aviation Safety Program

Weather Accident Prevention

Goal

Develop enabling technologies to reduce weather-related accident causal factors by 50% and turbulence-related injuries by 50% by year 2007.

Objectives

Provide the Flight Deck with Higher Fidelity, More Timely Intuitive Graphical Information

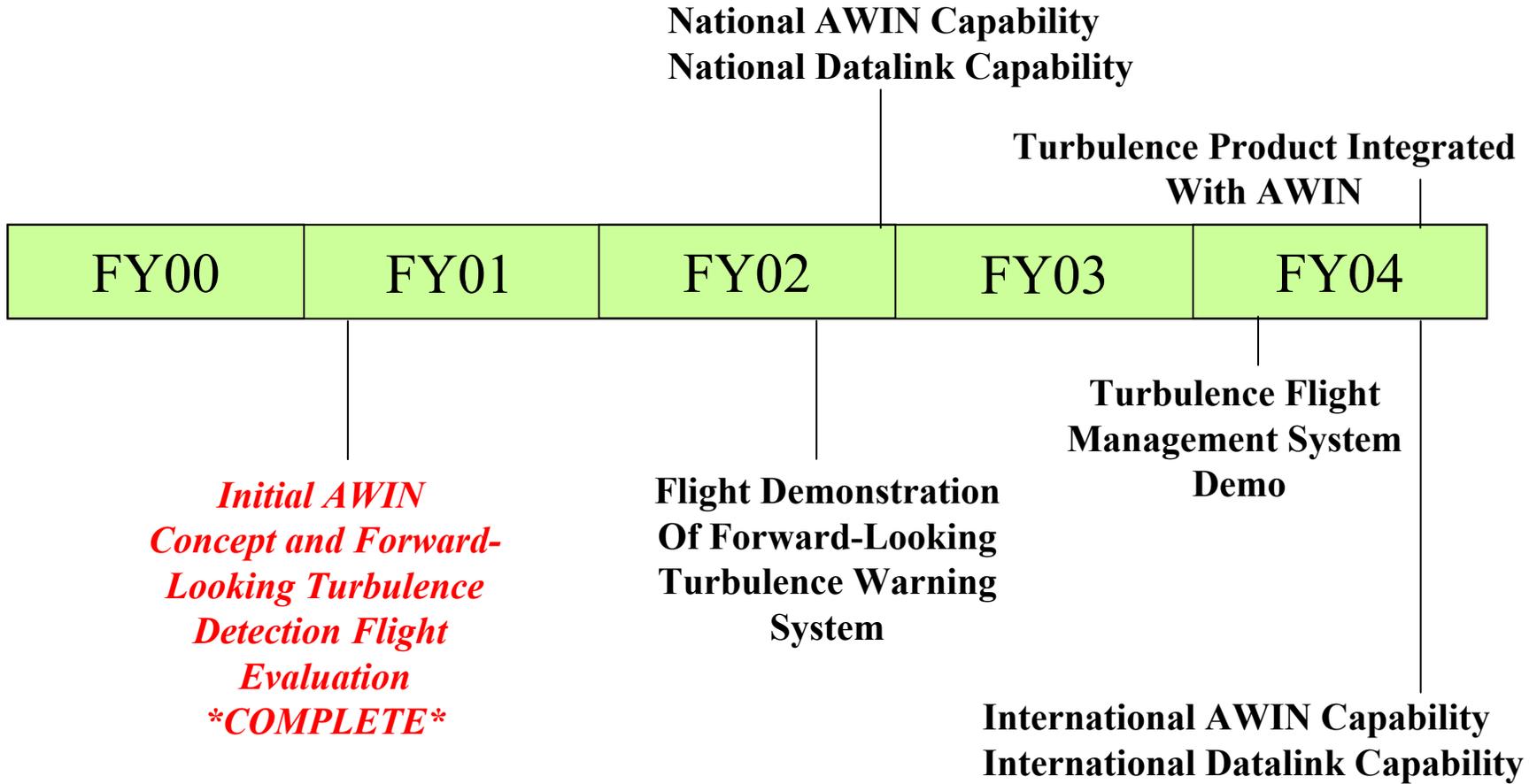
Detect & Mitigate Weather Hazards

Products

1. Cockpit weather display technologies and design guidelines and pilot decision support tools
2. Weather Information data link technologies, architecture, and design guidelines
3. Improved low-altitude Automet technologies and design guidelines
4. Turbulence hazard characterization
5. Forward-looking turbulence sensor technologies and system design guidelines
6. Turbulence mitigation procedure guidelines



Project Schedule and Milestones





Product Development Strategy

Aviation Safety Program

Weather Accident Prevention

- Strong Industry cost sharing through Cooperative Research Agreements (CRA)
- Airline/operator participation in CRAs
- Cost/Market assessment studies funded
- FAA/NASA/NWS Working Groups being established
- Participation in Industry/Government working groups dealing with technology and standards development: RTCA, ICAO Joint Safety Assessment/Implementation Teams, etc.
- Strong National Turbulence Research Coalition assisting in defining NASA direction



Project Modifications

- Reasons for modifications
 - » *Resource limitations (funding, staff)*
 - » *Customer feedback and recommendations*

- Content of changes
 - » *Research area focus modifications*
 - » *WBS modifications*

- Research area focus modifications
 - » *Nowcasting/Forecasting technology development eliminated*
 - Feedback from joint Turbulence PDT and FAA meeting
 - FAA responsible for developing nowcasting/forecasting products
 - NASA responsible for investigating turbulence characteristics and defining hazard metrics

 - » *Turbulence Mitigation technology development refocused*
 - Flight System Controls development descope to investigation of autopilot usage in turbulence encounters
 - Integration of turbulence warning information on the flight deck added



Project Modifications (concl.)

- Research area focus modifications (concl.)
 - » *Specific technology development focus on commuter aircraft and rotorcraft eliminated*
 - Addresses the spectrum of users and key accident areas
 - » *Graphical weather presentation and usage research and technology development limited to cockpit systems*
 - FAA responsible for developing ATC and AOS products and technologies
 - » *Research focus on AutoMET sensor and datalink technology development increased*
 - GA Wx JSIT Recommendation
 - National Aviation Wx Program Council feedback
 - FAA Wx requirements office input
 - WxAP Project Review feedback
 - » *Research focus on Satellite Datalink Communications technology development increased*



Modified WxAP Products

Weather Accident Prevention (WxAP)
Shari-Beth Nadell, GRC

Aviation Weather Information
Paul Stough, LaRC

Weather Information Communications
Gus Martzaklis, GRC

Turbulence Detection & Mitigation
Rod Bogue, DFRC

AWIN System
*Cockpit Weather Display Technologies,
 Pilot Decision Support Tools,
 Ground-to-Air Datalink Technologies*

AutoMET System
*Airborne Weather Reporting Sensor Technologies,
 Air-to-Ground, Air-to-Air Datalink Technologies*

Wx Products (external source)

Turbulence Sensor Technologies

Turbulence Mitigation Procedures

Turbulence Characterization

Products



Project Accomplishments

- Completed Project Milestone #1: Initial AWIN and Forward-Looking Turbulence Detection Flight Evaluation
- Total of six flights between September and December 2000 (including two ferry flights to DFW)
- Four WxAP experiments were conducted:
 - › In-Situ Turbulence Algorithm
 - › Turbulence Radar
 - › AWIN-Weather Information Network (WINN) System
 - › Enhanced Weather Radar



WINN Display Mounted in the B757 Cockpit



EWxR multifunction display with ship's weather radar data to 50 nmi and NEXRAD data beyond.

Turbulence Radar Installation on B757



Project Accomplishments (cont.)

- Successful completion of the first test subject data collection flight of the AWIN Convective Weather Sources (COWS) experiment on August 9, 2000
 - › Experiment investigates how situation awareness and flight deck decision making is affected by access to different sources of weather information
 - › Conditions investigated included: conventional audio information only, out-the-window visual cues plus conventional audio information, and a composite radar image (a tethered AWIN display) plus the conventional audio information



NASA BE-200 King Air

Honeywell AWIN Display in King Air Cockpit





Project Accomplishments (cont.)

- TAMDAR Sensor tested in NASA GRC Icing Research Tunnel, March 21-23
 - › Preliminary results indicate the overall infrared sensing principle is sound and detected both glaze and rime ice
 - › Probe de-icing method needs to be reworked with respect to heater size and placement and the software algorithm that tried to melt the ice or declare the sensor “contaminated”
 - › Next-generation unit will have the temperature sensor better isolated thermally from the heater
 - › TAMDAR sensor development task initiated with GTRI and ODS; kickoff meeting April 25



ODS
TAMDAR
sensor



TAMDAR sensor (left), ODS Model 1000
Icing Sensor (right) in IRT

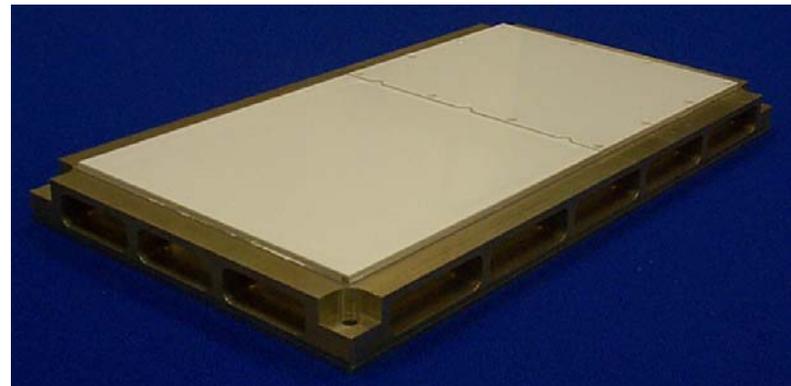
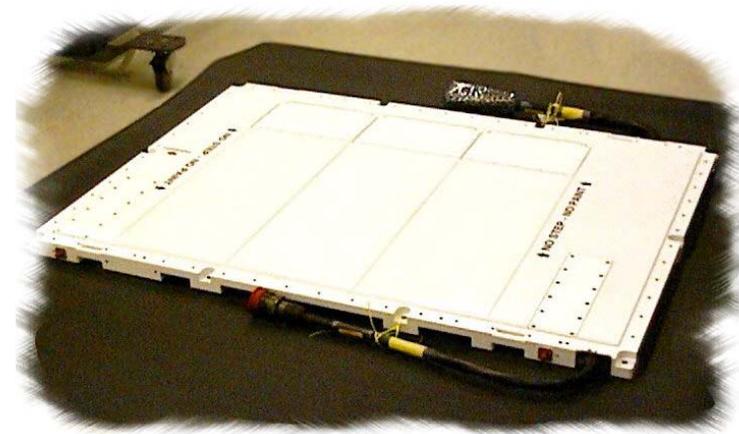


Project Accomplishments (cont.)

- Continued to develop Broadband SATCOM Datalink
 - › Enabling technologies: phased array antennas, broadband mobile terminal
 - › Joint NASA/Boeing development
 - › Up to 1000x capacity increase
 - › Ground-mobile experiments
 - › Proof flight test Dec, 2000 (DC-8)
 - › Upcoming B-757 experiments
 - › Enabling to new *Connexion by Boeing* datalink service



NASA DC-8 Flight Test



*Ku-band Receive and Transmit
Phased Array Antennas*



Project Accomplishments (concl.)

- Test development planning for Turbulence Secure Cabin Exercise
 - › First implementation will use FAA CAMI B747 Cabin Evacuation simulator training facility
 - › Secure Cabin Exercise team includes NASA, FAA, airlines, cabin attendants associations, etc.
 - › Three cabin scenarios will be used to develop requirements for “securing” a cabin prior to a turbulence encounter
 - › Will provide important input to the development of Airborne Turbulence Warning System requirements and procedural guidelines



FAA CAMI B747 Cabin Evacuation Simulator





Project's Next Steps

- Develop systems architecture and concept of operations for WxAP technology products.
- Revisit and redefine project milestones based on accomplishments over first two years of the program.
- Update NASA plans per stakeholder comments (i.e. THIS REVIEW), requirement studies, joint team recommendation etc.
- Continue to integrate and leverage activities with FAA, NWS and DoD.
- Continue to seek greater participation with aviation user community.