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Low Cost General Aviation Flight Research Vehicle Project Plan

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1.0 Introduction

This plan describes the Low Cost General Aviation Flight Research project. The project utilizes a Cooperative Agreement, (Number 97-G-022) between the FAA and the Experimental Aircraft Association (EAA) in which the EAA has provided an experimental aircraft for use by the FAA's William J. Hughes (WJH) Technical Center near Atlantic City, New Jersey. The aircraft serves as a test bed platform in which evaluations of new and emerging cockpit avionics and other technologies can be conducted. The program is entering its third year of activity. The purpose of this document is to communicate the plan for this project for this third year.

2.0 Project Scope

The scope of this project will be adjusted accordingly as new technologies and products are discovered, volunteered and time is available for installation and evaluation. Research and testing have special emphasis on those products geared towards low cost and maximum utility for the general aviation user. The project will address the need for prototype and pre-production testing of innovative and low cost avionics, antennae and services on board a platform representative of a state-of-the-art, light single engine general aviation aircraft. This project is an integral component to the overall FAA CNS Flight Systems Integrated Product Team (AND-500) master plan to expedite the introduction of cost effective and safe airborne equipment for General Aviation.

The low cost general aviation test bed will provide both a flight evaluation platform to government and industry researchers and manufacturers to study prototype avionics and other systems. These evaluations will help the FAA to focus efforts in the near term to help implement the most promising applications of airborne CNS technology. A primary goal is to aid the GA community in achieving a safer flying environment. The aircraft will be deployed to serve as a general aviation participant in support of relevant FAA or joint EAA/FAA flight evaluations or public displays. At all times, these tests will be conducted and overseen in a controlled and professional test environment. Each flight evaluation, test or ferry flight will be planned and executed in accordance with prescribed FAA and EAA policy. This testing will enable manufacturers and FAA program offices to evaluate new, low cost solutions suitable to general aviation and FAA needs. This testing will promote the

inclusion of general aviation in the National Airspace System, improve system safety and capacity and reduce general aviation fatalities.

Whenever possible or desirable, the aircraft will be utilized as a test bed for those technologies associated with ongoing CNS applied technology programs. These include the Safe Flight 21 Program, the Flight Information and Traffic Information System programs, the Gulf of Mexico CNS Program, and the General Aviation and Vertical Flight Program. Additionally, the aircraft will support technologies developed by the FAA-NASA-Industry AGATE consortium and Small Aircraft Transportation System (SATS) Programs.

Additional tests in support of various FAA and EAA programs, including communications by data link, satellite navigation systems, the Administrator's Safer Skies initiative, and airport marking and lighting, as appropriate to the small and light airplane general aviation user, will be will be considered as time and resources permit. Industry and user group requests for testing and evaluation are welcomed. Suitable products and services will be considered for installation and test on a case by case basis. These requests will be coordinated through ACT-340 and the EAA project manager.

Throughout the project, the certification and human factor(s) methods appropriate to each product or service will be included in individual flight evaluation planning. Where possible, data and results will be generated to aid in the eventual approval of candidate technologies via the STC and TSO process. In addition to any data on system performance, subjective pilot reaction will be collected and included in the data gathered during ground and flight evaluations. A goal of the subject pilot evaluations is to ascertain the appropriate level of information to be provided to a single engine, small single piloted aircraft. When applicable, existing certification techniques and procedures will be included in the evaluation project, using the basis of FAR Part 23 as a guide. To this end, human factors and certification specialists in the FAA, NASA, user groups and industry have been and will be invited to participate in the initial and ongoing planning and flight testing involved in this project.

3.0 Goals and Objectives

The primary goal of this project is to contribute to the overall FAA goal to reduce the number of fatal aviation accidents. The strategies the project will pursue to accomplish this goal include (1). Identification of methods to reduce fatal accident rates due to aircraft systems failures, (2) identification of methods to reduce fatal accident rates due to operational hazards, and (3) identification of methods to improve human performance in aviation operations.

The specific activities described within this plan are aimed at:

Improving pilot capabilities: aviating, communicating, and navigating

Determining Technology Impact on pilot capabilities, such as:

- Time to train and operate
- Time in-flight
- Ease of use
- Aeronautical decision making
- Situational awareness

A second goal of this project is to contribute to the FAA goal of NAS system efficiency/modernization. In support of this mission goal (as related to system efficiency) the project will provide a flight test bed to support the FAA's acquisition organization: (1) to contribute to the deployment of systems to support NAS modernization, (2) to help expedite delivery of capabilities described in the NAS Architecture, (3) to collect data to aid in the determination of the value and interdependencies of planned capabilities (4) to identify and set priorities, with the help of the user community.

The specific activities described within this plan are aimed at improving:

- Pilot/Controller efficiency and safety
- Cockpit procedures & practices

4.0 Approach

Using a small, general aviation aircraft that is typical of many "homebuilt" kit airplanes in operation today, various avionics systems will be evaluated using flight tests. Subject pilots will be used for data collection and evaluation. An approved safety pilot will be used to ensure the complete safety of the subject pilot data collection flights.

Avionics systems will be evaluated one at a time, even though multiple systems are installed in the flight test bed. Avionics flight systems that are not being evaluated will be inactive during flight. At some time in the test program, all avionics systems will be turned on in order to evaluate the entire cockpit suite

The flight test bed utilized by this project is a kit aircraft provided by the EAA. The EAA's Young Eagles built the aircraft in 1996 at the EAA Weeks facility by EAA volunteers with help from Stoddard Hamilton, the kit's manufacturer. The 160-horse power GlaStar has a composite body and aluminum wings, fixed tricycle gear and a cabin for pilot and co-pilot. The rear luggage compartment has been converted to accommodate the installation of avionics related equipment. The instrument panel of the GlaStar is configured to provide standard avionics flight instrumentation for the safety pilot in the right seat. The left seat pilot position is set up to accommodate subject pilots who will be used in the avionics evaluations.

The suite of candidate avionics systems was determined during the prior years of this program. This year will be devoted to maximize flight data collection relative to the avionics systems currently installed in the GlaStar. The candidate avionics systems to be evaluated may change, as opportunities become available.

The flight test bed aircraft will be provided for public display at popular aircraft and pilots conventions and air shows coordinated with the flight data collection schedule.

5.0 General Aviation Avionics Flight Test Bed Team

The primary participants of the General Aviation Avionics Flight Test Bed Team are the Flight Systems Product Team, AND-520; the Voice Switching Branch, ACT-340; the Aircraft/Avionics Branch, ACT-370; and the EAA. The FAA sponsor for this project is the Flight Systems Product Team, AND-520. AND-520 manages the overall project activity and sets the goals and objective. The project utilizes a Cooperative Agreement between the FAA and the Experimental Aircraft Association (EAA).

The agreement is administered by the William J. Hughes Technical Center. At the Technical Center, ACT-340 is responsible for technical activity of the project, including design and execution of product evaluation. ACT-340 is also the technical officer of the Cooperative

Agreement with EAA. ACT-370 is responsible for configuration management and flight operations of the aircraft. ACT-370 is where the R&D Flight Test Program is conducted.

The EAA and the FAA work in full partnership in all aspects of project strategy and execution. The aircraft flight test bed is owned by EAA, and as such, is intimately involved in all decisions affecting the aircraft. Maintenance and modifications, including avionics systems for consideration, are accomplished with complete EAA concurrence.

The Cooperative Agreement between the FAA and the EAA under which the GlaStar is utilized provides for custody of the GlaStar to be transferred between FAA and EAA at mutual discretion. While the aircraft is in FAA custody, ACT-370 is responsible for maintenance and flight operations. While the aircraft is in EAA custody, maintenance and flight operations are transferred back to EAA. Specific conditions for transfer of custody are specified in the Cooperative Agreement. The aircraft will be maintained and operated under all pertinent FAA rules, regulations and orders.

6.0 Avionics Flight Test Evaluations

The General Aviation Avionics Flight Test Bed Team will work with individual avionics product developers (of the items installed in the test bed) as evaluation methodologies are developed and conducted.

A test plan will be developed for each avionics system to be evaluated. Specific data collection protocols will be developed which are tailored to the avionics system under evaluation. The test procedures protocols will be designed such that when executed, will generate data that provides a basis to aggregate data. The aggregate data will be used to conduct trend analysis in which data consistency and inconsistency will be identified.

Subject pilot qualifications will be considered when developing test plans and procedures. Throughout the project, human factor(s) evaluation methods appropriate to each product or service will be included in individual flight evaluation planning. Data and results will be provided to the product developers, as feedback to them in their quest for the eventual

approval of candidate technologies via the STC and TSO process. Test subject pilot impressions and opinions will be sought and included in the data gathered during ground and flight evaluations. A goal of the subject pilot evaluations is to ascertain the appropriate level of information to be provided to the pilot of a small, single engine aircraft. When applicable, existing certification techniques and procedures will be included in the evaluation project. To this end, human factor(s) specialists will be consulted in the planning of flight test evaluations.

Evaluation results and feedback from the data collection flights will be provided to the avionics system developers so that product refinement can occur. Evaluation results will be published whenever practical. Proprietary information will be protected and not divulged to the public.

7.0 Flight Test Bed Activities In Support of NAS Modernization

The test bed will provide a flight evaluation platform to government and industry researchers and manufacturers to study prototype avionics and other systems. These evaluations will help the FAA to focus efforts in the near term to help implement the most promising applications of airborne CNS technology. By working closely with the FAA's office of Research and Acquisitions, this testing will promote the inclusion of general aviation in the National Airspace System, improve system safety and capacity and reduce general aviation fatalities. As requested, the GlaStar will be utilized as a test bed for those technologies associated with ongoing CNS applied technology programs. These include the Safe Flight 21 Program, the Flight Information and Traffic Information System programs, the Gulf of Mexico CNS Program, ADS-B, and the General Aviation and Vertical Flight Program. Additionally, the aircraft may be used to support technologies developed by the FAA-NASA-Industry AGATE consortium and Small Aircraft Transportation System (SATS) Programs.

Additional tests in support of various FAA and EAA programs, including communications by data link, satellite navigation systems, the Administrator's Safer Skies initiative, and airport marking and lighting, as appropriate to the small and light airplane general aviation user, will be will be considered as time and resources permit.

8.0 Primary Research & Evaluation Areas

The following is a list of the primary research and evaluation areas to be investigated under this program. Detailed plans will be generated for each individual test. See APPENDIX B, Test Schedule FY 2000. This schedule will be used as a guide (i.e., living document).

8.1 Sierra Flight Systems Primary Flight Display (SFS/PFD)

The purpose of evaluation of the SFS/PFD is to aid in the identification of methods to reduce fatal accident rates due to aircraft systems failures. The SFS/PFD is a digital based software intensive system that provides many of the same functions as standard vacuum driven or electrical systems. Pilot reaction to induced SFS/PFD failure will be observed.

A second purpose of evaluation of the SFS/PFD is to aid in the identification of methods to reduce fatal accident rates due to operational hazards. The SFS/PFD has been designed to give the GA aircraft pilot improved situational awareness and as such will be evaluated to that purpose.

A third purpose of evaluation of the SFS/PFD is to aid in the identification of methods to improve human performance in aviation operations. New technology should enable the pilot to be free to concentrate on aircraft control, systems management, and critical decision making. Data will be collected relative to improving pilot capabilities: aviating, communicating, and navigating.

An over all goal of evaluation of the SFS/PFD is to determine technology impact on pilot capabilities, such as: time to train and operate, time in-flight, ease of use, and pilot in-flight decision making capabilities.

Research will be undertaken to investigate the applicability, pilot human factors and workload associated with new primary flight displays for GA aircraft. Primary flight guidance and navigation displays, such as the highway-in-the-sky concept advocated by the NASA AGATE and SATS programs, will be evaluated.

Primary Flight Display Evaluation Specifics

Goal: identification of methods to reduce fatal accident rates due to aircraft systems failures, aid in the identification of methods to reduce fatal accident rates due to operational hazards, determine technology impact on pilot capabilities

ARA Goals supported: 1. Aviation Safety, 2. Human Factors, 6. NAS Modernization

Estimated Flight Hours: 100

Estimated Mod/Integration Hours: 100

Special Equipment Required: Sierra Flight Systems PFD AHRS

Outside Participation: Sierra Flight Systems, EAA Subject Pilots, NASA Langley, AGATE, SATS, and FAA Human Factors

Location: WJH Technical Center

Date: See APPENDIX B.

Deliverables: Summary of Pilot post-flight surveys. Information to include human factors, safety and efficiency.

Evaluation Overview: Flight evaluations will be conducted with pilots of various personal pilot experience, from relatively low (up to several hundred hours) flight time GA pilots up to and including high (over several thousand hours) flight time GA pilots. Subject pilots (and the data that results from their flights) will be categorized by their capabilities and flight time experience, including ratings such as IFR, commercial, CFI, ATP, etc. Pilots will first fly the aircraft without the use of the SFS/PFD in general visual flight rules flight in order to become familiar and proficient with the aircraft. An approved safety pilot will be used to ensure the complete safety of the subject pilot data collection flights. Subject pilots will be asked to perform the Practical Test Standards that are used to qualify pilots for the Private Pilot test. Additional evaluation data will be collected that more specifically addresses the capabilities of the SFS/PFD, such as cross country flying, terrain avoidance, situational awareness, and simulated IFR operations. Flights will be conducted in varying lighting conditions (remaining day VFR) and over varying terrain, to include test of the terrain avoidance feature of the PFD. SATS airports may be incorporated into the evaluations to include a highway-in-the-sky guided flight through high-density airspace and over semi-mountainous terrain.

8.2 Low Cost Head Up Display (HUD)

An ongoing joint research project with Parks College, St. Louis University, designed to develop an inexpensive Head Up display for use in light aircraft will continue. This project currently involves the modification of a General Motors automotive HUD to display aircraft flight parameters. Associated research to investigate a low cost air data computer to drive this device is a follow on activity to be undertaken as time permits.

The purpose of evaluation of the HUD is to aid in the identification of methods to reduce fatal accident rates due to aircraft systems failures. The HUD is a digital based automotive system that can ultimately provide the pilot with additional flight data viewed through the windshield. Once pilots become accustomed to use of the HUD, pilot reaction to induced HUD failure will be observed.

A second purpose of evaluation of the HUD is to aid in the identification of methods to reduce fatal accident rates due to operational hazards. Of considerable importance is the ability of a GA pilot to concentrate on flying the aircraft properly when preparing for and during the landing process. The use of a HUD during the landing process is anticipated to give the GA aircraft pilot improved VFR situational awareness in the airport environment, and as such will be evaluated to that purpose.

A third purpose of evaluation of the HUD is to aid in the identification of methods to improve human performance in aviation operations. New technology should enable the pilot to be free to concentrate on aircraft control, systems management, and critical decision making. Data will be collected relative to improving pilot capabilities: aviating, communicating, and navigating.

An over all goal of evaluation of the HUD is to determine technology impact on pilot capabilities, such as: time to train and operate, time in-flight, ease of use, and pilot in-flight decision making capabilities.

Low Cost Head Up Display Specifics

Goal: Identification of methods to reduce fatal accident rates due to aircraft systems failures, aid in the identification of methods to reduce fatal accident rates due to operational hazards, determine technology impact on pilot capabilities

ARA Goals Supported: 1. Aviation Safety, 2. Human Factors, 6. NAS Modernization

Estimated Flight Hours: 160

Estimated Mod/Integration Hours: 40

Special Equipment Required: GM Delco Heads-Up-Display

Outside Participation: Parks College of Engineering and Aviation, St. Louis University

Location: WJH Technical Center

Date: See APPENDIX B.

Deliverables: Operational prototype Head Up display, Summary of Pilot post-flight surveys. Information to include human factors, safety.

Evaluation Overview: Flight evaluations will be conducted with pilots of various personal pilot experience, from relatively low (up to several hundred hours) flight time GA pilots up to and including high (over several thousand hours) flight time GA pilots. Subject pilots (and the data that results from their flights) will be categorized by their capabilities and flight time experience, including ratings such as IFR, commercial, CFI, ATP, etc. Pilots will first fly the aircraft without the use of the HUD in general visual flight rules flight in order to become familiar and proficient with the aircraft An approved safety pilot will be used to ensure the complete safety of the subject pilot data collection flights. Subject pilots will be asked to perform the Practical Test Standards that are used to qualify pilots for the Private Pilot test. Additional evaluation data will be collected that more specifically addresses the capabilities of the HUD, such as improved proficiency in landing, improved VFR situational awareness during landing, and cross-country flying. Flights will be conducted in varying lighting conditions (remaining day VFR) and at various airport environments.

8.3 Flight Information Service (FIS) Evaluation

Using the FAA's FIS service provider (ARNAV Systems, Inc.), the aircraft will be used to evaluate prototype FIS baseline and value added products. FIS signal coverage and Electronic Pilot Reporting (EPIREP) functions will be investigated.

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The purpose of evaluation of the FIS is to aid in the identification of methods to improve human performance in aviation operations. New technology should enable the pilot to be free to concentrate on aircraft control, systems management, and critical decision making. Data will be collected relative to improving pilot capabilities: aviating, communicating, and navigating. FIS should allow the pilot better decision making capability, as he is presented with real-time information that is normally only available during flight planning.

A second purpose of evaluation of the FIS is to aid in the identification of methods to reduce fatal accident rates due to operational hazards. FIS can give the GA aircraft pilot improved navigational aid operation status and weather situational awareness and as such will be evaluated to that purpose. Real-time weather information is useful to the GA pilot as he progresses on his flight plan for cross-country flight, allowing him to confirm the ability to execute his flight plan without encountering unexpected weather. When unexpected weather systems enroute or at the destination are brought to the pilots attention via FIS, the GA pilot can then alter his flight plan accordingly.

An over all goal of evaluation of the FIS is to determine technology impact on pilot capabilities, such as: time to train and operate, time in-flight, ease of use, and pilot in-flight decision making capabilities.

Research will be undertaken to investigate the applicability, pilot human factors and workload associated with FIS and multifunction displays for GA aircraft.

Flight Information Service (FIS) Evaluation Specifics

Goal: Evaluation of prototype FIS services, coverage and products; identification of methods to improve human performance in aviation operations, identification of methods to reduce fatal accident rates due to operational hazards, determine technology impact on pilot capabilities

ARA Goals Supported: 1. Aviation Safety, 2. Human Factors, 6. NAS Modernization, 8. Weather Delays.

Estimated Flight Hours: 200

Estimated Mod/Integration Hours: 40

Special Equipment Required Avionics from ARNAV Systems, Inc., Multi Function Displays.
Outside Participation: FIS Service Provider ARNAV Systems, Inc.
Location: WJH Technical Center
Date: See APPENDIX B.
Deliverables: System status reports to the FIS program director. Input on system performance to the FIS service providers and program office. Data relative to pilot capabilities and usability. Summary of pilot post-flight surveys. Information to include human factors, safety and efficiency.
Evaluation Overview: Flight evaluations will be conducted with pilots of various personal pilot experience, from relatively low (up to several hundred hours) flight time GA pilots up to and including high (over several thousand hours) flight time GA pilots. Subject pilots (and the data that results from their flights) will be categorized by their capabilities and flight time experience, including ratings such as IFR, commercial, CFI, ATP, etc. Pilots will first fly the aircraft without the use of the FIS in general visual flight rules flight in order to become familiar and proficient with the aircraft. An approved safety pilot will be used to ensure the complete safety of the subject pilot data collection flights. Subject pilots will be asked to perform the Practical Test Standards that are used to qualify pilots for the Private Pilot test. Additional evaluation data will be collected that more specifically addresses the capabilities of the FIS, particularly cross country flying, situational awareness, and simulated IFR operations. Flights will be conducted in varying lighting conditions (remaining day VFR). SATS airports may be incorporated into the flight evaluations.

Special accommodation will be made to demonstrate the system to FAA management and to members of the General Aviation community including EAA, AOPA, National Business Aviation Association, and the press.

8.4 Traffic Information Service (TIS) Evaluation

The purpose of evaluation of the TIS, which is a subset of the FIS program, is to aid in the identification of methods to improve human performance in aviation operations. A second purpose of evaluation of the TIS is to aid in the identification of methods to reduce fatal accident rates due to operational hazards, especially by GA pilots. Another goal of evaluation

Low Cost Head Up Display Specifics

Goal: Identification of methods to reduce fatal accident rates due to aircraft systems failures, aid in the identification of methods to reduce fatal accident rates due to operational hazards, determine technology impact on pilot capabilities

ARA Goals Supported: 1. Aviation Safety, 2. Human Factors, 6. NAS Modernization

Estimated Flight Hours: 160

Estimated Mod/Integration Hours: 40

Special Equipment Required: GM Delco Heads-Up-Display

Outside Participation: Parks College of Engineering and Aviation, St. Louis University

Location: WJH Technical Center

Date: See APPENDIX B.

Deliverables: Operational prototype Head Up display, Summary of Pilot post-flight surveys. Information to include human factors, safety.

Evaluation Overview: Flight evaluations will be conducted with pilots of various personal pilot experience, from relatively low (up to several hundred hours) flight time GA pilots up to and including high (over several thousand hours) flight time GA pilots. Subject pilots (and the data that results from their flights) will be categorized by their capabilities and flight time experience, including ratings such as IFR, commercial, CFI, ATP, etc. Pilots will first fly the aircraft without the use of the HUD in general visual flight rules flight in order to become familiar and proficient with the aircraft An approved safety pilot will be used to ensure the complete safety of the subject pilot data collection flights. Subject pilots will be asked to perform the Practical Test Standards that are used to qualify pilots for the Private Pilot test. Additional evaluation data will be collected that more specifically addresses the capabilities of the HUD, such as improved proficiency in landing, improved VFR situational awareness during landing, and cross-country flying. Flights will be conducted in varying lighting conditions (remaining day VFR) and at various airport environments.

8.3 Flight Information Service (FIS) Evaluation

Using the FAA's FIS service provider (ARNAV Systems, Inc.), the aircraft will be used to evaluate prototype FIS baseline and value added products. FIS signal coverage and Electronic Pilot Reporting (EPIREP) functions will be investigated.

The purpose of evaluation of the FIS is to aid in the identification of methods to improve human performance in aviation operations. New technology should enable the pilot to be free to concentrate on aircraft control, systems management, and critical decision making. Data will be collected relative to improving pilot capabilities: aviating, communicating, and navigating. FIS should allow the pilot better decision making capability, as he is presented with real-time information that is normally only available during flight planning.

A second purpose of evaluation of the FIS is to aid in the identification of methods to reduce fatal accident rates due to operational hazards. FIS can give the GA aircraft pilot improved navigational aid operation status and weather situational awareness and as such will be evaluated to that purpose. Real-time weather information is useful to the GA pilot as he progresses on his flight plan for cross-country flight, allowing him to confirm the ability to execute his flight plan without encountering unexpected weather. When unexpected weather systems enroute or at the destination are brought to the pilots attention via FIS, the GA pilot can then alter his flight plan accordingly.

An over all goal of evaluation of the FIS is to determine technology impact on pilot capabilities, such as: time to train and operate, time in-flight, ease of use, and pilot in-flight decision making capabilities.

Research will be undertaken to investigate the applicability, pilot human factors and workload associated with FIS and multifunction displays for GA aircraft.

Flight Information Service (FIS) Evaluation Specifics

Goal: Evaluation of prototype FIS services, coverage and products; identification of methods to improve human performance in aviation operations, identification of methods to reduce fatal accident rates due to operational hazards, determine technology impact on pilot capabilities

ARA Goals Supported: 1. Aviation Safety, 2. Human Factors, 6. NAS Modernization, 8. Weather Delays.

Estimated Flight Hours: 200

Estimated Mod/Integration Hours: 40

Special Equipment Required Avionics from ARNAV Systems, Inc., Multi Function Displays.
Outside Participation: FIS Service Provider ARNAV Systems, Inc.
Location: WJH Technical Center
Date: See APPENDIX B.
Deliverables: System status reports to the FIS program director. Input on system performance to the FIS service providers and program office. Data relative to pilot capabilities and usability. Summary of pilot post-flight surveys. Information to include human factors, safety and efficiency.
Evaluation Overview: Flight evaluations will be conducted with pilots of various personal pilot experience, from relatively low (up to several hundred hours) flight time GA pilots up to and including high (over several thousand hours) flight time GA pilots. Subject pilots (and the data that results from their flights) will be categorized by their capabilities and flight time experience, including ratings such as IFR, commercial, CFI, ATP, etc. Pilots will first fly the aircraft without the use of the FIS in general visual flight rules flight in order to become familiar and proficient with the aircraft. An approved safety pilot will be used to ensure the complete safety of the subject pilot data collection flights. Subject pilots will be asked to perform the Practical Test Standards that are used to qualify pilots for the Private Pilot test. Additional evaluation data will be collected that more specifically addresses the capabilities of the FIS, particularly cross country flying, situational awareness, and simulated IFR operations. Flights will be conducted in varying lighting conditions (remaining day VFR). SATS airports may be incorporated into the flight evaluations.

Special accommodation will be made to demonstrate the system to FAA management and to members of the General Aviation community including EAA, AOPA, National Business Aviation Association, and the press.

8.4 Traffic Information Service (TIS) Evaluation

The purpose of evaluation of the TIS, which is a subset of the FIS program, is to aid in the identification of methods to improve human performance in aviation operations. A second purpose of evaluation of the TIS is to aid in the identification of methods to reduce fatal accident rates due to operational hazards, especially by GA pilots. Another goal of evaluation

of the TIS is to determine technology impact on pilot capabilities, such as: time to train and operate, time in-flight, ease of use, and pilot in-flight decision making capabilities.

Research will be undertaken to investigate the applicability, pilot human factors and workload associated with TIS and multifunction displays for GA aircraft.

Traffic information that is normally available only to air traffic controllers can now be provided to the GA pilot during flight. New technology should enable the pilot to be free to concentrate on aircraft control, systems management, and critical decision making. Data will be collected relative to improving pilot capabilities: aviating, communicating, and navigating. TIS should allow the pilot better decision-making capability, as he is presented with real-time information about air traffic in the vicinity of his aircraft.

As pilots are provided with the ability to ascertain air traffic around them, data will be gathered to determine if this information is useful, or if it causes further distraction to the GA pilot away from basic aviation of the aircraft.

Evaluation of TIS products is pending coordination and direction from the TIS program office.

Traffic Information Service (TIS) Evaluation Specifics

Goal: Evaluation of prototype TIS services, coverage and products. Identification of methods to improve human performance in aviation operations, to aid in the identification of methods to reduce fatal accident rates due to operational hazards, determine technology impact on pilot capabilities.

ARA Goals Supported: 1. Aviation Safety, 2. Human Factors, 6. NAS Modernization

Estimated Flight Hours: 100

Estimated Mod/Integration Hours: 40

Special Equipment Required Mode S Transponder, TIS Processor, and Multi Function Display.

Outside Participation: TIS Vendors.

Location: WJH Technical Center

Date: See APPENDIX B.

Deliverables: System status reports to the TIS program manager. Summary of Pilot post-flight surveys. Information to include human factors, safety and efficiency.

Evaluation Overview: Flight evaluations will be conducted with pilots of various personal pilot experience, from relatively low (up to several hundred hours) flight time GA pilots up to and including high (over several thousand hours) flight time GA pilots. Subject pilots (and the data that results from their flights) will be categorized by their capabilities and flight time experience, including ratings such as IFR, commercial, CFI, ATP, etc. Pilots will first fly the aircraft without the use of the TIS in general visual flight rules flight in order to become familiar and proficient with the aircraft. An approved safety pilot will be used to ensure the complete safety of the subject pilot data collection flights. Subject pilots will be asked to perform the Practical Test Standards that are used to qualify pilots for the Private Pilot test. Additional evaluation data will be collected that more specifically addresses the capabilities of the TIS, particularly cross country flying in higher traffic air space, situational awareness, and simulated IFR operations. Flights will be conducted in varying lighting conditions (remaining day VFR). SATS airports may be incorporated into the flight evaluations.

Special accommodation will be made to demonstrate the system to FAA management and to members of the General Aviation community including EAA, AOPA, National Business Aviation Association, and the press.

8.5 AGATE, SATS and AWIN Program Support

The NASA AGATE, SATS and AWIN test programs may utilize the aircraft as an evaluation bed. An evaluation of a prototype "highway-in-the-sky" flight guidance display integral to the SATS program is described in paragraph 7.1.

AGATE, SATS and AWIN Program Support Specifics

Goal: Evaluation of prototype AGATE, SATS and AWIN avionics and services.

ARA Goals Supported: 1. Aviation Safety, 2. Human Factors, 6. NAS Modernization, 8. Weather Delays, 11. Economic Development.

Estimated Flight Hours: 200

Estimated Mod/Integration Hours: 100

Special Equipment Required AGATE, SATS and AWIN avionics and Multi Function Displays.

Outside Participation: NASA Langley, AGATE, SATS and AWIN Program Offices.

Location: WJH Technical Center, NASA Langley

Date: See APPENDIX B.

Deliverables: Flight Evaluation Reports relevant to the equipment to be evaluated.

Evaluation Overview: Flight evaluations will be conducted with pilots of various personal pilot experience, from relatively low (up to several hundred hours) flight time GA pilots up to and including high (over several thousand hours) flight time GA pilots. Subject pilots (and the data that results from their flights) will be categorized by their capabilities and flight time experience, including ratings such as IFR, commercial, CFI, ATP, etc. Pilots will first fly the aircraft without the use of any SATS in general visual flight rules flight in order to become familiar and proficient with the aircraft. An approved safety pilot will be used to ensure the complete safety of the subject pilot data collection flights. Subject pilots will be asked to perform the Practical Test Standards that are used to qualify pilots for the Private Pilot test. Additional evaluation data will be collected that more specifically addresses the capabilities of SATS, particularly cross country flying in higher traffic air space, situational awareness, and simulated IFR operations. Flights will be conducted in varying lighting conditions (remaining day VFR). SATS airports will be incorporated into the flight evaluations.

Initial SATS support will be to test and evaluate the highway-in-the-sky function of the Sierra Flight Systems primary flight display. In a typical test scenario, the aircraft will fly a SATS flight plan, including arrival and departure from a SATS airport, with reference solely to the highway-in-the-sky display for guidance.

8.5.1 Composite Propeller Performance Flight Test

Negotiations are under way with Global Aircraft to install and evaluate the performance of a low cost composite propeller. The propeller promises higher cruise speed with reduced noise and vibration.

Composite Propeller Flight Test Specifics

Goal: Determination performance gains with new generation composite propeller.

Impacted ARA Goals: 1. Aviation Safety, 11 Economic Development.

Estimated Flight Hours: 100

Estimated Mod/Integration Hours: 10

Special Equipment Required Global Aircraft Composite Propeller, Sound Level Meter.

Outside Participation: Global Aircraft, Inc.

Location: WJH Technical Center.

Date: See APPENDIX B.

Deliverables: After action flight test report.

Comments: This activity can be conducted concurrently with other research initiatives. The aircraft will have to be"baselined" prior to the installation of the evaluation propeller. Estimate 25-40 flight hours for "baselining". Ideal weather conditions are required in order to obtain valid baseline data.

8.5.2 GPS Required Navigational Performance (RNP) Flight Evaluation

The aircraft will be flown in the Washington, DC Class B airspace VFR corridor to determine the RNP of GPS as a primary means of navigation.

RNP Flight Test Specifics

Goal: Determination of GNP RNP in the Washington, DC Class B Airspace.

Impacted ARA Goals: 1. Aviation Safety, 2. Human Factors, 6. NAS Modernization.

Estimated Flight Hours: 20

Estimated Mod/Integration Hours: 10

Special Equipment Required GPS Navigation Receiver with Moving Map Display.

Outside Participation: Washington National, Dulles, Andrews and Baltimore Approach Control.

Location: Washington, DC Class B Airspace (VFR corridor).

Date: See APPENDIX B.

Deliverables: After action flight test report.

Comments: Sponsored by National Resource Specialist for Flight Standards Tom Emrich and the RTCA Certification Task Force.

8.6 Antenna Radiation Pattern Evaluation

The purpose of evaluation of the Antenna Radiation Pattern Evaluation is to aid in the identification of methods to reduce fatal accident rates due to aircraft systems failures. The Antenna Radiation Pattern Evaluation will assist aircraft and avionics developers in product development relative to composite aircraft and aircraft manufactured with a combination of materials, including the aluminum and composite combination.

Antenna performance on composite aircraft is a recognized challenge. The radiation pattern of each antennae mounted on the GlaStar needs to be investigated and compared with comparable installations on metal skinned aircraft.

Antenna Radiation Pattern Test Specifics

Goal: Determination of antenna radiation patterns on composite aircraft, aid in the identification of methods to reduce fatal accident rates due to aircraft systems failures
ARA Goals Supported: 1. Aviation Safety, 6. NAS Modernization.
Estimated Flight Hours: 0
Estimated Mod/Integration Hours: 50
Special Equipment Required Antennae, Radiation Meters.
Outside Participation: Antenna Manufacturers.
Location: WJH Technical Center.
Date: See APPENDIX B.
Deliverables: Antenna Radiation Pattern Test
Evaluation Overview: The unique construction of the aircraft (steel tube, aluminum wings and stabilizer and composite skin) lends itself well to this investigation. ACT-340 will work closely with ACT-330, the Communication/Infrastructure Branch, in the conduct of electromagnetic measurements of antenna radiation patterns and avionics systems performance. Test plan to be developed jointly between ACT-340 and ACT-330.

9.0 Public Displays, Support and Maintenance

9.1 Aircraft Public Display

The aircraft will be displayed at major EAA conventions and other public venues beneficial to FAA program requirements and goals. Public display of the aircraft represents a valuable opportunity to solicit user feedback on installed technology and to survey users for additional research.

Aircraft Display Schedule:

EAA AirVenture Oshkosh

Location: Oshkosh, WI

Date: 7/26-8/1/00

Estimated Flight Hours: 20 hours round-trip.

Deliverable: After action report. Pilot surveys collected by FAA or partners.

EAA Sun n Fun

Location: Lakeland, FL

Date: 4/19/00-4/15/00

Estimated Flight Hours: 20 hours round-trip.

Deliverable: After action report. Pilot surveys collected by FAA or partners.

AOPA Fly In, FDK

Location: Frederick, MD

Date: 6/3/00

Estimated Flight Hours: 4 hours round-trip

Deliverable: After action report. Pilot surveys collected by FAA or partners. Press coverage.

AOPA Annual Convention

Location: Atlantic City, NJ

Date: 10/21-23/99

Estimated Flight Hours: 10 hours demo flights.

Deliverable: After action report. Pilot surveys collected by FAA or partners. Press Coverage.

NBAA Annual Convention

Location: Atlanta, GA

Date: 10/12-14/99

Estimated Flight Hours: 20 hours round-trip.

Deliverable: After action report. Press Coverage.

SAE GA Conference

Location: Wichita, Kansas

Date: May 9th – 11th, '00

Estimated Flight Hours: TBD; Aircraft likely will not deploy to Wichita, Kansas.

Deliverable: After action report. Manufacturer surveys.

9.2 Aircraft Hangar and Maintenance Support

While remote from FAA facilities, and while operated in support of FAA programs, provisions must be made for the aircraft to be stored in a hangar and maintained. Primary responsibility for aircraft maintenance will be borne by the FAA while in FAA "bail" custody. The EAA will conduct the aircraft annual condition inspection when the required inspection comes due. EAA and AND-520 will be responsible for establishing and coordinating the basing and provisioning of the aircraft whenever it is released from bail from the WJH Technical Center.

The GlaStar's 2000 annual condition inspection will be performed by the EAA at Oshkosh in August or September 2000.

Maintenance and equipment modifications will include 'safe for flight' releases and a record of the actions performed. A record of aircraft custody transfers between the FAA and EAA will also be maintained in accordance with the program Cooperative Agreement. The General Aviation Avionics Flight Test Bed Team will be fully informed at all times of the location and status of the aircraft.

10.0 Project Management, Reporting and Products

10.1 Products and Reporting

Each flight event of the GlaStar aircraft will have a written product documenting the activity and results. For tests and evaluations, a formal technical report or Quick Look Report will be prepared and published.

10.2 Project Management

The General Aviation Avionics Flight Test Bed Team will be jointly responsible for executing this plan. AND-520 is responsible for program planning, direction and execution. ACT-340 will ensure execution of flight test planning and evaluation, cost, schedule and technical risk management of the project. ACT-370 is responsible for configuration management of all equipment in the aircraft, including flight test modifications. ACT-370 will provide flight test pilots for each flight and evaluation and overall flight safety. Funding resources for this project will be provided by AND-520. The determination of overall project goals, including identification of specific items to be evaluated and broad definitions of aircraft modifications, will be the joint determined by the General Aviation Avionics Flight Test Bed Team. AND-520 will serve as the project coordinator and FAA public relations focal point.

The EAA will serve as the point of contact to the flying public. The EAA will have responsibility for interaction with EAA membership and the public. The EAA will perform membership surveys and will have contributory responsibility for all research accomplished

on the aircraft. This responsibility will vary dependent on the research being performed and will be coordinated in advance. Subject pilots are likely to be provided by EAA.

It must be emphasized that the operation of this aircraft is a cooperative venture among these organizations. All communications and discussions with external parties related to potential commitments or issues for the GlaStar Project will be shared with all members of this cooperative venture.

APPENDIX A

Flight Operations Contingency

The Aircraft Avionics Branch, ACT-370 is where the R&D Flight Test Program is conducted for the FAA. When the GlaStar is under bail to the FAA, it will be operated by ACT-370. In the unlikely event that ACT-370 is unable to support flight operations of the aircraft, the aircraft will be signed over to EAA in accordance with the terms of the bail in the Cooperative Agreement, (Number 97-G-022). Further data collection flights will continue as prescribed by ACT-340 in the test plans and procedures for the system under test. In this situation, EAA will provide safety pilots to continue data collection. All EAA provided safety pilots will undergo data collection training at the WJH Technical Center in advance of engaging in data collection activities. ACT-340 will remain responsible for data collection, analysis, and reporting of all data.

APPENDIX B

Test Schedule FY 2000

SYSTEM	COMPLETION DATE
Sierra Flight Display And Lift Reserve Indicator (LRI)	December, 1999
FISDL (ARNAV Two-way System only)	April, 2000 (SUN-N-FUN)
Low Cost Heads-up-display (HUD)	July, 2000 (AirVenture)
Required Navigation Performance	September, 2000
Aircraft Annual	October, 2000 (EAA will accomplish following AirVenture)

To Be Determined (TBD) and/or Conducted In Conjunction With Other Tests:

Composite Propeller/HUD potential, AGATE/SATS/AWIN (Highway In The Sky), and Antenna Radiation Pattern Evaluation Test

* Note: This is possible because changing from a *Metal Propeller* to the *Composite Propeller* will require 5 hours of flight testing (i.e., Major Modification).