Federal Aviation Administration

# Research, Engineering, and Development Advisory Committee (REDAC) Subcommittee on Aircraft Safety (SAS)

# Fall FY2020 Report

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## FY22 Budget Table ($K unless noted)

| FAA Research - FY2020 Report (Program Areas grouped by Domain) | FY18 Total Actuals | FY18 Contract Actuals | FY19 Total Actuals | FY19 Contract Actuals | FY20 Total Actuals | FY20 Contract Actuals | FY21 Total Request | FY21 Contract Request | FY22 Contract Target ** |
|---|---|---|---|---|---|---|---|---|---|
| **Aircraft Safety Assurance** | | | | | | | | | |
| Fire Research and Safety (A11A) | $7,200 | $3,212 | $7,200 | $2,787 | $7,491 | $2,879 | $7,136 | $2,513 | $2,862 |
| Propulsion and Fuel Systems (A11B) | $2,100 | $1,534 | $2,100 | $1,091 | $2,256 | $156 | $4,215 | $1,948 | $880 |
| Advanced Material/Structural Safety (A11C) | $10,500 | $9,250 | $14,720 | $13,203 | $13,693 | $9,657 | $1,003 | $0 | $600 |
| Continued Airworthiness - Systems (A11E.SYS) | $10,773 | $4,273 | $11,269 | $4,055 | $11,269 | $4,167 | $9,642 | $4,102 | $2,656 |
| Continued Airworthiness - Structures (A11E.STR) | | $2,765 | | $3,368 | | $3,376 | | $1,568 | $1,150 |
| Aircraft Catastrophic Failure Prevention Research (A11F) | $1,570 | $1,070 | $1,570 | $1,433 | $1,409 | $1,282 | $0 | $0 | $0 |
| Terminal Area Safety (A11H.TAS) | $2,080 | $778 | $2,790 | $1,330 | $3,119 | $1,790 | $3,162 | $1,631 | $0 |
| Domain subtotal = | $34,223 | $22,882 | $39,649 | $27,267 | $39,237 | $23,307 | $25,158 | $11,762 | $8,148 |
| **Digital Systems and Technology** | | | | | | | | | |
| Digital System Safety (A11D.SDS) | $5,197 | $3,392 | $4,767 | $2,902 | $4,500 | $2,806 | $4,931 | $3,319 | $0 |
| Domain subtotal = | $5,197 | $3,392 | $4,767 | $2,902 | $4,500 | $2,806 | $4,931 | $3,319 | $0 |
| **Environment & Weather Impact Mitigation** | | | | | | | | | |
| Aircrft Icing (A11D.AI) | $4,056 | $2,790 | $4,486 | $3,171 | $4,209 | $2,625 | $1,315 | $0 | $520 |
| Alternate Fuels for General Aviation (A11M)* | $0 | $0 | $1,900 | $758 | $1,900 | $726 | $2,524 | $2,242 | $4,800 |
| Domain subtotal = | $4,056 | $2,790 | $6,386 | $3,929 | $6,109 | $3,351 | $3,839 | $2,242 | $5,320 |
| **Human Performance & Aeromedical Factors** | | | | | | | | | |
| Flight Deck/Maintenance/System Integratio Human Factors (A11G) | $7,095 | $3,626 | $7,305 | $2,710 | $7,300 | $2,587 | $7,469 | $2,681 | $5,321 |
| Aeromedical Research (A11J) | $9,686 | $4,024 | $9,080 | $2,178 | $7,919 | $3,299 | $10,235 | $3,136 | $3,470 |
| Domain subtotal = | $16,781 | $7,650 | $16,385 | $4,888 | $15,219 | $5,886 | $17,704 | $5,817 | $8,791 |
| **Aviation Performance & Planning** | | | | | | | | | |
| System Safety Management (A11H.SSM) | $3,520 | $2,217 | $2,710 | $1,251 | $1,381 | $52 | $2,323 | $792 | $2,385 |
| Unmanned Aircraft Systems Research (A11L) | $24,035 | $20,931 | $24,035 | $21,503 | $24,035 | $21,740 | $24,035 | $22,436 | $10,305 |
| Domain subtotal = | $27,555 | $23,148 | $26,745 | $22,754 | $25,416 | $21,792 | $26,358 | $23,228 | $12,690 |
| **Total Aviation Safety RE&D Portfolio =** | $87,812 | $59,862 | $93,932 | $61,740 | $90,481 | $57,142 | $77,990 | $46,368 | $34,949 |
| % of total FAA RE&D Appropriation/Request | 46.5% | | 49.2% | | 46.9% | | 45.9% | | |
| Total FAA RE&D Appropriation/Request | $189M | | $191M | | 193M | | $170M | | $126.8M |

**NOTE: GA Fuels funded from NEXTGEN budget through FY18*

***NOTE: These numbers represent the initial FAA budget narratives and are subject to change*

# Domain: Aircraft Safety Assurance

## Program Area: Fire Research and Safety (A11A)

Technologies, procedures, test methods, and fire performance criteria that can prevent and, where necessary, mitigate aircraft fires and improve survivability during a post-crash fire.

### Project: Aircraft Fire Safety (A11A.FCS.1)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11A.FCS.1 | Reduction in fire fatalities and injuries in the event of an accident, and reduced risk of accidents due to fire, based on improved regulatory standards, and no reduction in fire safety as a result of new materials and technologies. Quantifying the improvements is difficult as the existing fatality rates are very low. However the potential for the operational environment to change significantly, e.g., UAM, with different potential fire sources, e.g., lithium batteries tends to offset the current level of safety for conventional aircraft and operation. | Aircraft Fire Safety (AIR/ANG-E2) | FY15 | FY30 |

#### *Project Output: Aircraft Fire Safety outputs delivered in FY20 (A11A.FCS.1)*

Assess the ramifications of carriage of hazardous goods on aircraft fire protection methods and equipment, and consider technical feasibility of addressing such goods at the aircraft level 2018-2023.

- Draft informational videos aimed at educating flight deck and cabin crews on the hazards associated with lithium batteries and potential mitigation strategies.
- Cooperative Research and Development Agreement (CRDA) between FAA and University of Dayton Research Institute (UDRI) to characterize fire hazards of new solid-state sulfur battery.
- Minimum performance standard (MPS) evaluation of a proposed Halon-alternative extinguishing agent in collaboration with industry. The agent successfully passed the MPS series of tests, including the additional “challenge fire” scenario containing mixed load cargo including lithium batteries and flammable liquids.
- Report entitled “Thermal Runaway Initiation Methods for Lithium Batteries”, which is intended to create a framework for a standardized test method for the classification of a lithium battery’s cell hazard due to thermal runaway.

Improved understanding of the role of non-traditional structural and cabin materials in accident survivability.

Completed FAA patent application for new and useful method of "Generating and Determining the Products of Premixed Combustion of Solid Materials" by modifying the FAA's patented microscale combustion calorimeter to allow high temperature (>1300°C) combustion of fire gases at controlled fuel/oxygen ratios. This will allow for the measurement of the toxic potency of smoke generated by cabin materials over the full range of fire conditions in aircraft cabin fires, from early stage (oxygen rich) to late stage (oxygen

starved), where toxic gases are produced. Provide support for the development of Advisory Circulars and training materials for the conduct of new test methods to support rulemaking in development

- Script for training video on the FAA-required insulation burn through test method.

Develop criteria and test methodologies for detection of fires inside unit load devices

- Report summarizing tests performed to evaluate state of the art detection technologies to detect fires within unit load devices.

## Program Resources ($K): Fire Research and Safety (A11A)

| FAA Research - FY2020 Report (Program Areas grouped by Domain) | FY18 Total Actuals | FY18 Contract Actuals | FY19 Total Actuals | FY19 Contract Actuals | FY20 Total Actuals | FY20 Contract Actuals | FY21 Total Request | FY21 Contract Request | FY22 Contract Target** |
|---|---|---|---|---|---|---|---|---|---|
| Aircraft Safety Assurance | | | | | | | | | |
| Fire Research and Safety (A11A) | $7,200 | $3,212 | $7,200 | $2,787 | $7,491 | $2,879 | $7,136 | $2,513 | $2,862 |

***NOTE: These numbers represent the initial FAA budget narratives and are subject to change*

| People | Facilities | Partnerships |
|---|---|---|
| • 22 GOV FTEs and 16 CTR FTEs in various technical disciplines including engineering, analytics, material science, chemistry, lab testing, etc. | • FAA Full Scale Fire Test Facility<br>• FAA Component Fire Test Facility<br>• FAA Fire Chemistry Lab<br>• FAA Material Fire Test Facility<br>• FAA Pressure Vessel<br>• B-747, B-737, and B-727 aircraft. | • FAA Office of Hazardous Materials (AXH),<br>• NIST<br>• ICAO<br>• SAE<br>• EASA<br>• UL<br>• Boeing<br>• International Aircraft Materials Fire Test Forum<br>• International Aircraft Systems Fire Protection Forum<br>• Airbus<br>• University of Maryland<br>• University of Massachusetts<br>• Rutgers University<br>• University of Cincinnati |

## Program Area: Propulsion and Fuel Systems (A11B)

This research develops and/or enhances technologies, procedures, test methods, and risk assessment methods to enhance airworthiness, reliability, and performance of engines, propellers, fuels, and fuel systems.

### Project: Advanced Damage Tolerance and Risk Assessment Methods for Engine Life-Limited Parts (A11B.PS.1)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11B.PS.1 | Develop advanced damage tolerance and risk assessment methods, data and tools that can be used to reduce the risk of failures of high energy rotors and other life-limited engine components. The research supports the development of several Advisory Circulars, see item #27 above, over the next several years for compliance to the new rule 33.70, and the development of methods and tools in the public domain of a state of the art capabilities for fleet risk assessment to meet the stated COS requirements of AC 39-8. | Advanced Damage Tolerance AIR/ANG-E2 | FY10 | FY21 |

#### *Project Output: Advanced Damage Tolerance and Risk Assessment Methods for Engine Life-Limited Parts outputs delivered in FY20 (A11B.PS.1)*

- Developed new capability in the DARWIN probabilistic damage tolerance-based engine design code to analyze cracks in cylinders and hollow shafts. This will significantly expand DARWIN's ability to address new classes of life-limited engine parts, such as shafts and casings. (4/20)
- Awarded new 4 year grant to initiate damage tolerance and risk assessment methods using DARWIN related to nickel rotor material anomalies. (8/20)
- Released DARWIN 10.0 Alpha which will include speed improvements and enhanced methods to account for residual stress. In addition, other features in 10.0 funded by the USAF and DARPA will provide enhanced analysis using small crack growth rates and crack initiation criteria for additive manufacturing processes. (9/20)

## Project: Improved Nondestructive Evaluation (NDE) to Prevent Uncontained Engine Failures (A11B.PS.4)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11B.PS.4 | This research supports the updating of several Advisory Circulars that will aid compliance of rule 33.70 and in assessing fleet risk to meet the stated COS requirements of AC 39-8. Development of advanced NDE tools, data, and related standards will be used by industry to detect flaws and reduce the risk of failures of high energy rotors and other life-limited engine components. Advanced NDE methods will enable the industry to better validate manufacturing processes by quantitatively assessing material properties such as grain size and residual stress levels. This information can also feed into predicative design tools, such as DARWIN, to more accurately assess engine life and failure mechanisms. | Improved Nondestructive Evaluation (NDE)<br><br>AIR/ANG-E2 | FY10 | FY29 |

### *Project Output: Improved Nondestructive Evaluation (NDE) to Prevent Uncontained Engine Failures outputs delivered in FY20 (A11B.PS.4)*

- Revised requirement to focus on inspection of nickel materials used for engine rotors and initiated a BAA solicitation to Improve Nickel Billet Inspection. (7/20)
- Demonstrated a laboratory NDE technique capable of determining residual stress profiles in nickel and titanium rotor alloys. (9/20)

## Program Resources ($K): Propulsion and Fuel Systems (A11B)

| FAA Research - FY2020 Report (Program Areas grouped by Domain) | FY18 Total Actuals | FY18 Contract Actuals | FY19 Total Actuals | FY19 Contract Actuals | FY20 Total Actuals | FY20 Contract Actuals | FY21 Total Request | FY21 Contract Request | FY22 Contract Target** |
|---|---|---|---|---|---|---|---|---|---|
| Aircraft Safety Assurance | | | | | | | | | |
| Propulsion and Fuel Systems (A11B) | $2,100 | $1,534 | $2,100 | $1,091 | $2,256 | $156 | $4,215 | $1,948 | $880 |

***NOTE: These numbers represent the initial FAA budget narratives and are subject to change*

| People | Facilities | Partnerships |
|---|---|---|
| • 1 FTE | • None | • AIA Rotor Integrity Steering Committee (RISC)<br>• Rotor Manufacturing (RoMan) Team<br>• Jet Engine Titanium Quality Committee (JETQC)<br>• Jet Engine Nickel Quality Committee (JENQC)<br>• AIA Nickel Inspection Team |

## Program Area: Advanced Materials / Structural Safety (A11C)

This research assesses safety implications and techniques associated with composites and structures that can help to reduce aviation fatalities.

### Project: Damage Tolerance of Composite Structures (A11C.SIC.1)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11C.SIC.1 | Composite Damage Tolerance research focuses on addressing critical damage threats ( durability concerns, environmental and aging effects, and fabrication defects), Continued Operational Safety Issues COS issues, large scale test & analysis protocol for composite/metal assemblies, and new design features (including materials & processes). Research outcomes will help FAA develop policy, regulatory guidance and industry standards to address these issues. | Damage Tolerance of Composite Structures<br><br>AIR/ANG-E2 | FY12 | FY23 |

#### *Project Output: Damage Tolerance of Composite Structures outputs delivered in FY20 (A11C.SIC.1)*

FY20 output is summarized below for ongoing SIC.1 research projects:

- Damage Tolerance Testing and Analysis Protocols for Full-Scale Composite Airframe Structures under Repeated Loading: FAA final technical report based on test data and analysis of results submitted to sponsor. Technical content from this report will be incorporated into the planned revision of the Composite Materials Handbook CMH-17 Vol 6a as proposed industry guidance on testing, analysis and certification of sandwich structures.
- Development and Evaluation of Fracture Mechanics Test Methods for Sandwich Composites - Damage Tolerance Test Method Development: Two proposed ASTM standards developed and submitted: 1) standard practices for sandwich open-hole flexure testing and 2) standard practices for Single Cantilever Beam (SCB) testing. These two ASTM standards are currently being balloted at the ASTM D30 committee level for publication.
- Moisture Diffusion in Sandwich Composites: This effort is a partnership with Boeing. Draft technical report submitted to sponsor.
- Disbond Failures of Sandwich Structures: Based on results of Phase 1 testing, draft technical content for CHM-17 Vol 3H section 8.7.4 Calculation of Strain Energy Release Rate for Interlinear Fracture Mechanics developed and submitted to the CHM-17 Safety Management Working Group chaired by the sponsor.

## Project: Advanced Materials Standardization Development (A11C.SIC.13)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11C.SIC.13 | In order to comply with congressional direction for use of the FY20 appropriation plus-up for the Advanced Materials and Structural Safety BLI, this requirement identifies proposed research activities to advance the use of new metallic and non-metallic additive manufactured material and fiber reinforced composite material into the commercial aviation industry. As mandated by the congress, research will be performed by COE JAMS. Research outcome promotes standardization in analysis, design, quality assurance/control, nondestructive inspection, use and certification of composite materials and non-metallic additive manufactured materials, thereby improving safety. | Advanced Materials<br><br>AIR/ANG-E2 | FY18 | FY20 |

### *Project Output: Advanced Materials Standardization Development outputs delivered in FY20 (A11C.SIC.13)*

Output of this research supports Certification Efficiency (CE) a key initiative identified by the FAA AVS Composite Strategic Plan. Based on test results of ongoing research activities, interim technical reports for the following project submitted to sponsor. Technical content from these reports will be incorporated into the planned revision of the Composite Materials Handbook CMH-17 as proposed industry guidance on testing, analysis and certification on emerging and new material systems:

- Polymer-Based Additive Manufacturing (PBAM) Guidelines for Aircraft Design and Certification
- Ceramic Matrix Composite (CMC) Materials Guidelines for Aircraft Design and Certification
- Advanced Fiber Reinforced Polymer Composite Materials Guidance for Aircraft Design Certification Process and Control
- Adhesive Bond Qualification Guidance for Aircraft Design and Certification

Additionally, industry steering committees, which review test data and provide feedback on research progress, established for the following projects:

- Factors Affecting Qualification & Certification of Additively Manufactured Metallic Parts
- Thermoplastic Welding Process Qualification Protocols for Aircraft Design and Certification
- Development of Higher Level Building Block Testing Standards
- Development of Guidance for a Technical Standard Order (TSO) for Composite Materials
- Investigation of Static Strength Variability Between Composites and Metallic with respect to Overload Factors

## Project: Bonded Repair Size Limits - Solid Composite Laminates (A11C.SIM.5)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11C.SIM.5 | The sponsor plans to use the outputs from this research for the development policy, regulatory guidance, and/or industry standards. This requirements allows the FAA to:<br>• Partner with manufacturers to ensure the fatigue, durability, damage tolerance and residual strength performance of bonded repair systems is well understood prior to introduction into service through test and analysis.<br>• Obtain material/material system data, analytical tool validation data, etc. necessary to assess if new regulatory material is required, and Support maintenance of legacy aircraft where bonded repair technologies are being implemented. | Bonded Repair Size Limits AIR/ANG-E2 | FY20 | FY20 |

### *Project Output: Bonded Repair Size Limits - Solid Composite Laminates outputs delivered in FY20 (A11C.SIM.5)*

Assess the fatigue and residual strength performance of bonded repair size limits (BRSL) for panel's representative of composite wing structures using the FAA's ABST fixture in the Structures and Materials Lab. This task leverages resources with Boeing to support this research and helped establish additional structural test capabilities for the FAA. For FY20, focus has been on solid laminates with various scarf configurations (Note – testing has been suspended due to the COVID pandemic). Output for this research is data supporting BRSL assessment methods for solid laminate to support FAA Guidance and for inclusion in Composite Materials Handbook -17 used to determine the adequacy of existing regulations in preserving safe airframe designs incorporating bonded repair technology.

## Program Resources ($K): Advanced Materials / Structural Safety (A11C)

| FAA Research - FY2020 Report (Program Areas grouped by Domain) | FY18 Total Actuals | FY18 Contract Actuals | FY19 Total Actuals | FY19 Contract Actuals | FY20 Total Actuals | FY20 Contract Actuals | FY21 Total Request | FY21 Contract Request | FY22 Contract Target** |
|---|---|---|---|---|---|---|---|---|---|
| **Aircraft Safety Assurance** | | | | | | | | | |
| Advanced Material/Structural Safety (A11C) | $10,500 | $9,250 | $14,720 | $13,203 | $13,693 | $9,657 | $1,003 | $0 | $600 |

***NOTE: These numbers represent the initial FAA budget narratives and are subject to change*

| People | Facilities | Partnerships |
|---|---|---|
| • 7 FTEs in various technical disciplines including engineering, analytics, material science, non-destructive evaluation, etc. | • FAA Aircraft Structural Test Evaluation and Research Lab (FASTER)<br>• FAA Structures and Materials Lab (SML) | • Academia (FAA Joint Centers of Excellence for Advance Materials, COE JAMS): Wichita State University, University of California, University of Washington, Oregon State University, Florida International University, University of Utah, Mississippi State University, Auburn University, Washington State University.<br>• Industry: Boeing, Hexcel, Cytec, United Airlines, Airbus, Textron Cessna, Delta Airlines, Spirit Aero systems, , TenCate-US, Bell-Texron. Sikorsky-Lockheed<br>• Consortia and SDOs: SAE International, ASTM, CMH-17, KART, AmericaMakes<br>• Government: NASA, Army, Air Force Research Lab<br>• International/Government: - The European Aviation Safety Agency (EASA), Transport Canada Civil Aviation (TCCA); (Academia) Technical University of Denmark |

## Program Area: Continued Airworthiness – Systems (A11E.SYS)

This research enhances the decision making processes and addressing safety risks related to aircraft structures, engines, and systems.

### Project: Novel and Unusual Electric Aircraft Systems (A11E.ES.7)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11E.ES.7 | New and modified airplanes utilizing More Electric Airplane (MEA) concepts and technologies are efficiently and safely certified. | Novel and Unusual Electric Aircraft Systems<br><br>(AIR/ANG-E2) | FY13 | FY21 |

#### *Project Output: Novel and Unusual Electric Aircraft Systems outputs delivered in FY20 (A11E.ES.7)*

Identify and quantify the short term and long term risks to current and future safety risk associated with more electric aircraft for aerospace applications including potential failure modes and effects. Describe mitigating factors (including test methods) that will constitute a safe Electrical energy storage and electrical system installation for aerospace. Also, investigate applications and associated risks with electrical primary propulsion systems.

- Phase 2 is also to investigate applications and associated risks with electrical primary propulsion systems. Identify acceptable test methods to quantify acceptable more electric power of various technology such as power sources for all electric and Hybrids aircrafts. Identify possible sources of energy and specific applications for current and proposed aircraft systems and sub-systems. Develop test plans for various applications. Exit criteria consist of a report that provides this information. (May 2020).
- Phase 3 Validate and execute the proposed test plans from phase 2 and develop reports with recommendations of additional certification standards to be considered by the FAA for approval on part 23, 25, 27 and 29 and submit to RTCA. (Sept 2021).
- Five contracts have been let and funded for FY19 and FY20, contracting was delayed by late distribution of funding and COVID but all contract are now in place.

## Project: Integrated Flight Path Control to Address GAJSC/FAA GA Safety Interventions (A11E.FCMS.8)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11E.FCMS.8 | The outcome will be design and certification requirements for a flight path control autopilots for light GA purposes. The resulting papers, reports, and technical guidance can be used by the FAA and industry to design systems, create industry standards, and field new designs similar to those already fielded in complex UAVs that refuse to crash, and in fly-by-wire aircraft but at lower cost. Ultimately, the outcome will be a significant reduction of CFIT and Loss of Control accidents in GA.The outcome will be design and certification requirements for a flight path control autopilots for light GA purposes. The resulting papers, reports, and technical guidance can be used by the FAA and industry to design systems, create industry standards, and field new designs similar to those already fielded in complex UAVs that refuse to crash, and in fly-by-wire aircraft but at lower cost. Ultimately, the outcome will be a significant reduction of CFIT and Loss of Control accidents in GA. | Integrated Flight Path Control<br><br>(AIR/ANG-E2) | FY17 | FY21 |

### *Project Output: Integrated Flight Path Control to Address GAJSC/FAA GA Safety Interventions outputs delivered in FY20 (A11E.FCMS.8)*

- Flight testing on the primary flight displays and advanced flight control systems
- Flight tests to determine stall characteristics, trim force changes, and free response, due to configuration changes on a variety of general aviation (GA) aircraft.
    - Technical Report: Flight Test Data Driven Development of Means of Compliance for Low-Speed Flight Characteristics of Part 23 Aircraft
    - Technical Report: Compliance to Support Certification of Advanced Flight Controls in General Aviation and Hybrid Vehicles
    - Paper: Proposed Part 23 Means of Compliance based on Flight Testing of Level 2 and Level 3 Aircraft

## Project: Transfer of New Technologies for Enhancement of GA Safety (A11E.FCMS.13)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11E.FCMS.13 | There are new and innovative safety systems available that could dramatically improve GA aircraft safety. Some of these systems are small, lightweight, and inexpensive. Lessons learned from previous research shows that these new safety devices can easily be retrofit into existing GA aircraft.<br>1. Demonstrate device integration on manned aircraft.<br>2. Validate the intended safety function is met.<br>3. Develop streamlined certification compliance requirements.<br>4. Publish advisory circular or share results with ASTM/other industry group for incorporation into industry standard. | Transfer of New Technologies for Enhancement of GA Safety<br><br>(AIR/ANG-E2) | FY22 | FY25 |

### *Project Output: Transfer of New Technologies for Enhancement of GA Safety outputs delivered in FY20 (A11E.FCMS.13)*

- Interagency Agreement between FAA and NASA Ames for Evaluation of Novel Aircraft Pilot Interface Concepts
  - Technical Report: Initial Investigations into Alternate Certification Approaches Using Run-Time Assurance for Small Aircraft Autopilots
  - Technical Report: EZ-Fly Prime Concept Demonstrator Flown on Variable Stability Navion
  - Conference Paper: A Decomposition Framework for Describing Advanced Air Mobility Mission Functions
  - Conference Presentation: Mission Task Element Development Process: An Approach to Handling Qualities FAA Certification

## Project: Strategies for Adoption and Certification of Intelligent Systems (A11E.FCMS.20)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11E.FCMS.20 | The R&D will concentrate on automation in the context of safe flight path augmentation, automation for safety risk controls, aiding pilot decision making, reducing pilot workload, performing dynamic consistency checks, providing run time assurance for complex systems, and similar concepts. | Strategies for Adoption and Certification of Intelligent Systems<br><br>(AIR/ANG-E2) | FY20 | FY23 |

*Project Output: Strategies for Adoption and Certification of Intelligent Systems outputs delivered in FY20 (A11E.FCMS.20)*

- Library of Mission Task Elements for certification of new and novel small aircraft designs.

## Project: A Systems Approach to Automated Flight Decks (A11E.FCMS.22)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11E.FCMS.22 | This research will be used to create and improve evaluation criteria, procedures, and requirements, which will be used by certification personnel, inspectors, and human factors specialists. Some examples include:<br>• Collecting empirical data for updating FAA guidance and industry standards.<br>• Creating job aids and checklists to assist engineers and inspectors in the field | A Systems Approach to Automated Flight Decks<br>(AIR/ANG-E2) | FY20 | FY25 |

*Project Output: A Systems Approach to Automated Flight Decks outputs delivered in FY20 (A11E.FCMS.22)*

- Survey of the current state of vehicle automation capabilities in civil and military aviation.

## Project: Wire Strike Avoidance (A11E.RS.5)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11E.RS.5 | This program if successful will diminish wire strikes and fatalities by implementing procedures and/or improving the certification basis for new helicopters and/or revealing new technology to alert pilots to the proximity of wires. | Wire Strike Avoidance<br>(AIR/ANG-E2) | FY18 | FY20 |

## *Project Output: Wire Strike Avoidance outputs delivered in FY20 (A11E.RS.5)*

**Rotorcraft Wire Strike Avoidance Research**

The main objective of this research is to increase rotorcraft safety with respect to wire strike events. The proposed tasks to reach this objective include the following:

- Surveying the existence of wire databases, as well as the various types of cables and wires present in the U.S. that may be hit by a rotorcraft
- Benchmarking the current state-of-the-art in wire strike prevention and protection technologies, in particular, sensor systems and wire cutter systems
- Determining suitable sensors for detecting cables and warning the pilot of their proximity to the rotorcraft
- Studying the feasibility of incorporating a detailed wire database into avionics/EFB systems to create a "wire proximity warning system"
- Determining the factors influencing the lack of wire strike protection systems on lightweight rotorcraft
- Developing an analysis tool based on fracture mechanics to evaluate the effectiveness of a wire cutter system
- Designing and constructing a prototype wire cutter for lightweight rotorcraft

**Phase 0**: Technical Report: "A survey of wire strike prevention and protection technologies for helicopters" (completed January 2019)

**Phase 1**:

- Task 1: Feasibility of Wire Database Development (October 2020)
- Task 2: Identification of Suitable Electronic Flight Bag for incorporation of Wire Database (November 2020)
- Task 3: Wire Cutter physics-based Modeling and Wire Cutter Preliminary Design (October 2020)
- Task 4: Assessment of Existing Wire Detection and Proximity Warning Systems (October 2020)

**Update for Phase 1:**

- Created a wire database using Washington DC and Vermont publicly accessible geographical data, including high-resolution imagery and utility pole coordinates, and use as training data set. Applied deep learning methods and various previous research (e.g. Facebook Engineering and Development Seed work) to high-resolution imagery of other parts of the country to predict wire network.
- Contacted Electronic Flight Bag manufacturers identified in Phase 0 to determine software and display requirements for wire database implementation.
- Developed a physics-based model and simulation of wire impact for wire modeled as multibody of finite cylindrical elements and consider kink-wave propagation upon impact.
- Created a Technology Capability Comparison Table to assess existing wire detection and proximity warning systems and their applications to various wire types.
- Developed an Operators' Questionnaire relating wire strike and distributed it at the 2020 Heli-Expo (January 2020)
- Research results was presented the 2020 FAA COE for GA PEGASAS Annual Meeting (June 2020)

**Phase 2**:

- Task 1: Wire Database Creation and Implementation (September 2021)
- Task 2: Wire Database and Sensors Information Fusion (September 2021)
- Task 3: Wire Cutter System Design for Lightweight Helicopters (September 2021)
- Task 4: Sensor Package Design (September 2021)

**Update for Phase 2:**

- Completed the development of Phase 2 proposal (March 2020). The proposal was evaluated and a research grant award is being processed.

**Phase 3**:

- Prototype construction and testing of wire cutter system and sensor package (FY22)

## Program Resources ($K): Continued Airworthiness – Systems (A11E.SYS)

| FAA Research - FY2020 Report (Program Areas grouped by Domain) | FY18 Total Actuals | FY18 Contract Actuals | FY19 Total Actuals | FY19 Contract Actuals | FY20 Total Actuals | FY20 Contract Actuals | FY21 Total Request | FY21 Contract Request | FY22 Contract Target** |
|---|---|---|---|---|---|---|---|---|---|
| **Aircraft Safety Assurance** | | | | | | | | | |
| Continued Airworthiness - Systems (A11E.SYS) | $10,773 | $4,273 | $11,269 | $4,055 | $11,269 | $4,167 | $9,642 | $4,102 | $2,656 |
| Continued Airworthiness - Structures (A11E.STR) | | $2,765 | | $3,368 | | $3,376 | | $1,568 | $1,150 |

***NOTE: These numbers represent the initial FAA budget narratives and are subject to change*

| People | Facilities | Partnerships |
|---|---|---|
| • 5 FTEs in various technical disciplines including engineering, mathematics, material science, sensor technology, etc. | • FAA Air Fault Evaluation Lab/More Electric Aircraft Lab, POWER Lab, Electric Flight Controls Test Capabilities | • NASA<br>• Embry Riddle Aeronautical University (ERAU)<br>• Massachusetts Institute of Technology (MIT) |

## Program Area: Continued Airworthiness – Structures (A11E.STR)

This research enhances the decision making processes & addressing safety risks related to aircraft structures, engines, and systems.

### Project: MMPDS Support and Design Values for Emerging Materials (A11E.SIM.4)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11E.SIM.4 | Standardized acceptable design and certification compliance data and tools necessary to enable the FAA to operate in cost effective and efficient manner, while providing a level-playing field and uniform standards for all certification agents. | MMPDS Support and Design Values for Emerging Materials (AIR/ANG-E2) | 2010 | 2025 |

#### *Project Output: MMPDS Support and Design Values for Emerging Materials outputs delivered in FY20 (A11E.SIM.4)*

Provide for the planning, coordination, and implementation activity which is necessary to develop and maintain the core MMPDS Process and Handbook in establishing statistically-based allowable that comply with material strength requirements in §2X.613.

- Major activities for FY20 include the spring and fall MMPDS General Coordination Committee Meetings to approve agenda items for inclusion in the handbook and database.
- Output from this research are annual updates of MMPDS Handbook and Derivative Products, September 2020

### Project: Damage Tolerance and Durability Issues for Emerging Technologies (A11E.SIM.5)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11E.SIM.5 | Provide data to address certification and continued airworthiness issues arising from industry introduction of emerging metallic structures technology including advanced materials and new fabrication and construction methods. | Damage Tolerance and Durability Issues<br>(AIR/ANG-E2) | 2012 | 2025 |

### *Project Output: Damage Tolerance and Durability Issues for Emerging Technologies outputs delivered in FY20 (A11E.SIM.5)*

This requirement addresses certification and continued airworthiness issues arising from the introduction of emerging materials and construction methods (additive material manufacturing, friction stir welding, advanced metallic alloys and hybrids, bonded structure) used for aircraft structures in new fatigue critical applications. The FAA needs to maintain a proactive role and stay involved with industry as they introduce advances in materials and new fabrication and construction methods. Data is needed to allow the FAA to assess the continued relevance of existing regulations, impose additional safety standards (via Special Conditions/rulemaking), and provide additional regulatory guidance as needed to maintain the current level of safety afforded by the existing airworthiness standards. Research leverages FAA resources with other government agencies and industry through cooperative research and development agreements. The FAA's FASTER, ABST and Structures and Materials labs are being used to leverage resources with other stakeholders and are being used to conduct the research. There are several task areas and phases to this multi-year requirement. For FY20, the following activities will be undertake:

- Task 2: Advanced Metallic Fuselage Structure (ongoing research): In partnership with industry (Alcoa and Embraer), conduct a full-scale tests using the "FASTER Lab" on advanced metallic fuselage structure to access durability and damage tolerance of emerging technologies including unitized welded structure, new metallic alloys (Aluminum Lithium), and hybrid construction. Verify new analytical tools and explore applicable inspection methods including integrated Structural Health Monitoring (SHM). Testing was completed for a baseline fuselage panel fabricated using conventional materials and processes. Comparisons will be made to companion panels made with varying emerging technologies. For FY20, focus was placed on test and analysis of the second fuselage panel constructed using advanced aluminum-lithium. (Note: testing postponed due to COVID pandemic). Preliminary results reveal slower fatigue crack growth in the second panel. Output from this research is data to support certification, and continued airworthiness of these emerging materials, structures and fabrication methods.
- Task 3: Assessment of Aluminum Lithium (Al-Li) for Primary Structure (ongoing research): This task is being conducted in partnership with industry (Bombardier and Constellium) to assess the fatigue and fracture characteristics of advanced Al-Li at the coupon and small panel levels using the FAA's Structures and Materials lab. Preliminary results from Phase 1 testing on high-bend configured joints indicate that Al-Li had unique fatigue/crack growth characteristics compared to conventional aluminum alloys. The current phase 2 follow-on continues testing on more realistic lap-joint configurations representative of typical airframe structure. For FY20, focus has been on small lap-joint coupons. (Note – testing has been suspended due to COVID pandemic). Output from this research is data from test and analysis; used to determine the adequacy of existing regulations in preserving safe airframe designs incorporating aluminum-lithium.
- Task 4: Develop Property Standards for Emerging Process Intensive Materials (ongoing research): Working through the Emerging Technologies Task Group (ETTG) of the MMPDS, develop processes and procedures which would allow for the publication of design information relevant to "highly process dependent" metallic materials, e.g. Additive Manufacturing (AM), Friction Stir Welding, fiber/metallic laminates. Additional considerations are needed beyond the current MMPDS handbook requirements to develop design values for process intensive materials (PIM). For FY20, focus was on developing a framework for preliminary guidelines and requirements for data to generate properties for metal PIM. Output from this research is a second volume of the MMPDS for PIM.
- Task 5: Thermal Residual Stresses in Metal-Composite Hybrid Structure (new): According to ARAC committee that is assessing 25.571 requirements, data is needed to evaluate methods used by industry to account for thermally induced loads at metallic-composite interfaces in hybrid structure during full-scale test and analysis required for widespread fatigue damage substantiation. This task will leverage resources with other stakeholders including DOD, NASA, and Industry to configure a large scale test article of hybrid structure subject to thermal-mechanical cyclical loading using the FAA's Structures and Materials Lab. For FY20, benchmark and industry survey activities were undertaken to identify the types of hybrid structure, procedures used to conduct full-scale test, and analysis methods used to account for thermal loads, and identify partners for potential collaboration. Output for this research addresses ARAC recommendation - data to assess methods used to account for thermal load in hybrid structure during full-scale test.

## Project: Metal Additive Manufacturing for Aircraft, Engine, and Propeller Applications (A11E.SIM.8)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11E.SIM.8 | Ensure Additive Manufacturing (AM) technology is safely integrated into aircraft applications. This requirement would provide the directorates data on new metal AM technologies in order to develop policy and regulatory guidance materials that will support their application on new products and potential use on legacy aircraft, as well as by aftermarket and MROs. Develop guidance on the certification of AM parts of various levels of criticality. Proactively identify potential hazardous conditions and generate data to allow AM technology to be safely integrated into airplane applications. | Metal Additive Manufacturing (AIR/ANG-E2) | 2017 | 2025 |

### *Project Output: Metal Additive Manufacturing for Aircraft, Engine, and Propeller Applications outputs delivered in FY20 (A11E.SIM.8)*

This requirement includes multiple tasks focused on various aspects of metal additive manufacturing (AM). Each task is being conducted in partnership with industry, academia, and other government agencies. The outputs from the research will be used to assess the applicability of existing FAA regulations and guidance and develop the framework needed to safely certify AM parts. The tasks are:

- Powder Reuse for Fatigue and Fracture Applications: Powder bed AM systems leave a varying percentage (dependent on the volume of the parts being built) of powder unused during every build. While the unused powder has been exposed to temperature and environmental effects during the build cycle, it is possible to reuse it for future builds. The reuse of powder significantly improves the business case for this technology but can also affect powder quality and ultimately part performance. Because of the potential cost savings associated with powder reuse there has been significant effort dedicated to studying its effect on mechanical properties however much of that information is either proprietary or scatter through the public domain. A paper study previously conducted under this task on powder recycling research in the public domain showed that efforts have focused on static properties. Therefore the current research is focused on fatigue and fracture effects. FY20 Output: Draft final report summarizing the effect of powder reuse on fatigue behavior of Ti-6-4 alloy after 9 successive builds
- Evaluation of Structural Integrity Assessment Tools for Higher-Criticality Metal AM Parts: Evaluation of the potential structural integrity assessment methods and tools for higher-criticality AM parts, with a particular focus on the FAA-funded DARWIN software: FY20 Output: Grant award to start this research
- Design Properties for Metal AM: Metal AM materials are subject to more sources of variability compared to traditional wrought products like sheet, plate, bar, and rod. Additional consideration for establishing metal AM design values are needed beyond what the current MMPDS handbook requires so Volume 2 dedicated to process intensive materials like AM is being created. This task supports the development of Volume 2 content specific to metal AM. FY20 Output: MMPDS Fall Coordination Meeting agenda items on minimum content for public specifications and data requirements for metal AM
- Mechanical Property Variability of Laser Powder Bed Fusion: Metal AM is known to have a substantial amount of inherent variability in the build process that can affect part quality and consistency. This variability has been demonstrated to result in different material properties from sequential builds on one machine and on identical builds across multiple, similar (same make and model) machines. The purpose of this task is to quantify this variability within a tightly controlled set of builds across multiple machines at numerous partner organizations. Data will be generated on the Ti-6Al-4V alloy for static and fatigue mechanical properties. FY20 Outputs: Grant award to start this research is expected early in FY21.

## Project: Stitched Resin Composites (A11E.TBD.1)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11E. | In order to comply with congressional direction for use of the FY20 appropriation plus-up for the Continued Airworthiness BLI, this research focuses on technology readiness assessment of stitched resin infused composites. To that end, research outcome will help FAA to understand the knowledge gap for potential industry applications. Research will also produce test data that will help FAA to develop policy, regulatory guidance and industry standards to address the address the knowledge gap. As mandated by the congress, research will be performed by COE JAMS | Stitched Resin Composites<br><br>(AIR/ANG-E2) | 2020 | 2020 |

### *Project Output: Stitched Resin Composites outputs delivered in FY20 (A11E.)*

In FY20, FAA performer in close coordination with the program sponsors helped the Mississippi State University (JAMS core member) develop proposals for two research projects on stitched composites. MSU grant requests was fund certified by the FAA on June 5, 2020. These two grant requests are currently being coordinated with the FAA Administrator and the Office of the Secretary (OST) for final approval before awards can be issued.

## Program Resources ($K): Continued Airworthiness – Structures (A11E.STR)

| FAA Research - FY2020 Report (Program Areas grouped by Domain) | FY18 Total Actuals | FY18 Contract Actuals | FY19 Total Actuals | FY19 Contract Actuals | FY20 Total Actuals | FY20 Contract Actuals | FY21 Total Request | FY21 Contract Request | FY22 Contract Target** |
|---|---|---|---|---|---|---|---|---|---|
| Aircraft Safety Assurance | | | | | | | | | |
| Continued Airworthiness - Systems (A11E.SYS) | $10,773 | $4,273 | $11,269 | $4,055 | $11,269 | $4,167 | $9,642 | $4,102 | $2,656 |
| Continued Airworthiness - Structures (A11E.STR) | | $2,765 | | $3,368 | | $3,376 | | $1,568 | $1,150 |

***NOTE: These numbers represent the initial FAA budget narratives and are subject to change*

| People | Facilities | Partnerships |
|---|---|---|
| • 4 (3 filled and 1 open) FTEs in various technical disciplines including engineering, analytics, material science, non-destructive evaluation, etc. | • FAA Full-scale Aircraft Structural Test Evaluation and Research (FASTER) Lab<br>• FAA Structures and Materials Lab<br>• FAA Airframe Beam Structural Test (ABST) fixture | • Industry: Boeing, Airbus, Arconic, Bombardier, Constellium, Embraer, Textron, Spirit Aerospace<br>• Gov't: NASA, DoD, DHS<br>• Academia: Mississippi State University<br>• Consortia and SDOs: MMPDS, KART, AmericaMakes, |

## Program Area: Aircraft Catastrophic Failure Prevention Research (A11F)

Standardize analysis methods and tools for evaluating anticipated hazards and risks related to engine rotor burst and fan blade failure to assure that regulatory compliance findings are accurate and consistent.

### Project: Advanced Analysis Methods for Impact of Aircraft Materials from Rotor Burst and Blade Release (A11F.PS.1)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11F.PS.1 | Develop predictive analysis methods for assessing engine fragment impact into engine and fuselage materials to determine the containment and shielding capabilities of each for safety assessments and certification by analysis. This research supports ANE Policy 33.94, ANM 25.903 (d).1 and AC 20-128A related to the B767, A380 and B777 uncontained events, EASA/FAA rule making efforts for Open Rotor Engine concepts and electric propulsion systems. The policies, AC's, rules, and new rule making relevant to this research address engine containment and uncontained engine fragment threats and they have to be updated as new technologies, such as open rotor, are developed. Furthermore, this research is building a knowledge base with industry on what might be required in future rulemaking to address certification by analysis of engine and propeller components and aircraft configurations. | Advanced Analysis Methods for Impact of Aircraft Materials from Rotor Burst and Blade Release<br><br>AIR-6A1/ANG-E2 | FY13 | FY20 |

#### *Project Output: Advanced Analysis Methods for Impact of Aircraft Materials from Rotor Burst and Blade Release outputs delivered in FY20 (A11F.PS.1)*

A four phase plan was developed in conjunction with the original sponsor in 2013. Three phases of four have been completed from 2013 through 2018. The projected lack of funding programmed for FY2019 initiated a delay of the research plan. 2018 funds were used to fund two year grants to get past the 2019 projected shortfall. Phase 4 "Advanced Analysis Methods for Impact of Composite Aircraft Materials in Rotor Burst and Blade Release" (2019-2021) LSDYNA Metal Failure Analysis: Development continues on LS-DYNA impact models MAT_224, MAT_224_GYS, and MAT_264 for Aluminum 2024, Titanium 6-4, and Inconel 718. Work during Phase 3 identified the need for advanced testing capabilities of Digital Image Correlation and Infra-red imaging to improve model performance. Early testing in Phase 1 and 2 did not include these technologies so a significant amount of additional testing has been added to the program that will improve the correlation but also extend the program. Also additional test cases are needed to improve the model failure surface. This has created a continuation of the metals testing and analysis work. Certification by analysis guidance for metals will be updated at the conclusion of the work. In FY20 the following outputs were delivered

- Published FAA Report DOT/FAA/TC-19/41, P1 Aluminum 2024-T351 Input Parameters for *MAT_224 in LS-DYNA
- Published FAA Report DOT/FAA/TC-19/41, P3 Aluminum 2024-T351 Input Parameters for *MAT_224 in LS-DYNA, Part 3: Ballistic Impact Simulations of an Aluminum 2024 Panel Using *MAT_224 in LS-DYNA Considering Oblique Incidence and Attitude Angles of a Rectangular Projectile

- Published joint NASA/FAA Report NASA/TM—2020-220451 DOT/FAA/TC-19/40 Impact Testing of Inconel 718 for Material Impact Model Development
- LSDYNA Composite Failure Analysis: Second generation composite impact and failure modeling of T800/F3900 unidirectional composite continues as a joint effort between FAA and NASA. The LS-DYNA model MAT_213 is undergoing beta testing verification by industry. The complexity of the analysis may well require some modifications but at a minimum work will continue to evaluate more complex composite construction such as braids and weaves. In FY20 the following outputs were delivered
- Published FAA Report DOT/FAA/TC-19/50, P1 Development of a Tabulated Material Model for Composite Material Failure, MAT213, Part 1: Theory, Implementation, Verification & Validation
- Published FAA Report DOT/FAA/TC-19/50, P2 Development of a Tabulated Material Model for Composite Material Failure, MAT213, Part 2: Experimental Tests to Characterize the Behavior and Properties of T800-F3900 Toray Composite
- Published FAA Report DOT/FAA/TC-19/50, P3 Development of a Tabulated Material Model for Composite Material Failure, MAT213, Part 3: Implementation of Probabilistic Modeling Capability in the Tabulated Composite Failure Model MAT213
- Released MAT_213 v1.3.5 to LS-DYNA Aerospace Working Group MAT_213 Beta Users
- Rotor burst Vulnerability Analysis: This work is actively supporting an open ATSB recommendation and there are multiple NTSB investigations of uncontained failure being worked. The program is expected to be actively supporting the resolution of these recommendations. In FY20:
- Supported revision of Advisory Circular 20-128A
- Uncontained Engine Debris Damage Assessment Model (UEDDAM) v6 development and testing as method of compliance for AC 20-128 continued using FAA High Performance Computing facility
- Open Rotor Engine Designs and Electric Propulsion Propellers: Work will continue with industry, NASA and NAWC to improve shielding modeling design practices, weight assessment and installation.

This work is needed to support FAA policy on the engine and engine installation

## Program Resources ($K): Aircraft Catastrophic Failure Prevention Research (A11F)

| FAA Research - FY2020 Report (Program Areas grouped by Domain) | FY18 Total Actuals | FY18 Contract Actuals | FY19 Total Actuals | FY19 Contract Actuals | FY20 Total Actuals | FY20 Contract Actuals | FY21 Total Request | FY21 Contract Request | FY22 Contract Target** |
|---|---|---|---|---|---|---|---|---|---|
| Aircraft Safety Assurance | | | | | | | | | |
| Aircraft Catastrophic Failure Prevention Research (A11F) | $1,570 | $1,070 | $1,570 | $1,433 | $1,409 | $1,282 | $0 | $0 | $0 |

***NOTE: These numbers represent the initial FAA budget narratives and are subject to change*

| People | Facilities | Partnerships |
|---|---|---|
| • 1.33FTEs | • Via FAA CASSIE and High Performance Computing cluster. | • NASA<br>• LS-DYNA Aerospace Working Group – include Boeing, GE, P&W, RR and other industry OEMs<br>• Naval Air Warfare Center<br>• Academia: Ohio State University, George Mason University, Arizona State University, Central Connecticut State University, and University of Dayton |

## Program Area: Terminal Area Safety – TAS (A11H)

Anticipation of system-wide operational risks, Additional data-driven approaches, Lower accident rate due to loss-of-control, Fewer runway excursions and Improved helicopter safety, Support Risk-Based Decision Making for oversight of the Air Traffic Organization.

### Project: Enhanced Helicopter Vision Systems (EHVS) (A11H.TAS.5)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11H.TAS.5 | Helicopter Vision Systems research is required to assess new operational concepts for the use of vision systems in all-weather conditions and varied mission environments during critical phases of flight (approach, departure, takeoff, landing, and hover). Research into Enhanced Helicopter Vision Systems (EHVS) will examine performance criteria that will allow helicopters to achieve higher levels of safety and efficiency by using EHVS technologies. Research activities will contribute to the development of operational specifications (Ops Specs), policy (FAA Orders), guidance (Advisory Circulars), and regulatory material (i.e. rule changes). | Enhanced Helicopter Vision Systems<br><br>AFS/ANG-E2 | FY15 | FY23 |

#### *Project Output: Enhanced Helicopter Vision Systems (EHVS) outputs delivered in FY20 (A11H.TAS.5)*

- Conducted guided discussions with industry operators, trade associations, rotorcraft original equipment manufacturers, and vision systems manufacturers, culminating in a summary review report which identified:
  - Operations that would benefit from reduced visibility minima
  - Operations that were focused on enhancing safety
  - Industry interest in vision enhancing technologies and potential barriers to widespread adoption
- Coordinated the formation, staffing, and leadership of USHST Helicopter Safety Enhancement #91 – Enhanced Helicopter Vision Systems and aligned H-SE working group efforts to complement and enhance FAA research activities. Actively contributed to H-SE by developing content, materials, and products along with conducting outreach efforts and circulating draft reports for comment by H-SE members and steering committee champions.
- Presented results of recent vision systems research efforts during Rotor Safety Challenge Session “Vision within Reality” at 2020 HAI Heli Expo to educate the rotorcraft community and solicit their feedback on FAA’s efforts and approach to Vision Systems technologies.
- Participated in EUROCAE WG-79/RTCA SC-213 and provided content and criteria for the draft Combined Vision Systems (CVS) MASPS for Operational Credit.

## Project: Improving Go-Around Safety (A11H.TAS.7)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11H.TAS.7 | The purpose is to structure a logical go-around training curriculum that mitigates the operational go-around problems that have arisen. | Improving Go-Around Safety<br><br>AFS/ANG-E2 | FY18 | FY21 |

### *Project Output: Improving Go-Around Safety outputs delivered in FY20 (A11H.TAS.7)*

- Completed the report for Phase II of the research which includes 10 mitigations for go-around safety risks that were identified by collecting and analyzing data from the following sources (Completion date: July 14, 2020):
  - An airline pilot survey
  - Flight Operations Quality Assurance (FOQA) data metrics
  - Interviews with airline operators
  - Training, policy, and procedures documents and manuals
  - Training grades and instructor comments
  - Airline pilot reporting outlets (e.g. Aviation Safety Action Program (ASAP) reports, irregularity reports)
  - Aviation Safety Reporting System (ASRS) reports
- Awarded an option year on a contract to evaluate and refine 2-3 of the potential mitigations for go-around risks identified through data analysis (Completion date: July 14, 2020)
- Developed a multimedia training program to promote crew situational awareness during approach and a go-around (Expected completion date: September 30, 2020)
- Developed a multimedia training program to demonstrate the importance of visual scan, mode awareness, and energy management during approach and a go-around (Expected completion date: September 30, 2020)

## Project: Wet Runway Wheel Braking Testing (A11H.TAS.9)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11H.TAS.9 | Conduct testing to determine the reasons for significant reduced wet runway wheel braking in incidents and accidents as compared to definition of wet runway wheel braking in FAR 25.109/AC-25-7C, both grooved and non-grooved.<br><br>Reduced runway excursions on wet runway | Wet Runway Wheel Braking Testing<br><br>AFS/ANG-E2 | FY19 | FY21 |

### *Project Output: Wet Runway Wheel Braking Testing outputs delivered in FY20 (A11H.TAS.9)*

- Formed Machine Learning Working Group for Runway Friction in collaboration with industry and academia in order to provide support and carry out the work to investigate the use of big data analytics and machine learning methods for runway friction research as well as to provide data analytics support from flight testing activities.
- Completed the SE 2025 procurement process for flight testing capabilities.
- Contract will be awarded prior to FY21 to a vendor with flight testing capabilities ready to initiate flight testing efforts in order to determine the relationships between water depth, ground speed, runway characteristics, and the wet runway wheel braking coefficient.

## Project: Improved Helicopter Simulation Flight Models (A11H.TAS.10)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11H.TAS.10 | Higher-fidelity mathematical and performance models of helicopter flight dynamics during various mission segments and phases of flight. Increased safety resulting from increased use of simulators/flight training devices/advanced aviation training devices to better prepare pilots on how to avoid and recover from outside the envelope flight conditions (i.e. Auto rotations, VRS, LTE, etc.).<br>Successful research, incorporation of Helicopter Simulator Models with regulatory/guidance/policy updates for these technologies will support the USHST goal of a 20% reduction of the helicopter fatal accident rate by 2020 and the long-term vision of zero accidents by the USHST. These targets are dependent on industry adoption of these technologies and business case/commitment to retrofit existing simulators/flight training devices/advanced aviation training devices with these newer high-fidelity flight dynamics models. | Improved Helicopter Simulation Flight Models<br><br>AFS/ANG-E2 | FY20 | FY24 |

### *Project Output: Improved Helicopter Simulation Flight Models outputs delivered in FY20 (A11H.TAS.10)*

- Coordinated the formation, staffing, and leadership of USHST Helicopter Safety Enhancement #81 – Helicopter Simulation Model Fidelity Improvements and aligned H-SE working group efforts to complement and enhance FAA research activities. Actively contributed to H-SE by developing content, materials, and products along with conducting outreach efforts.
- Began a literature review comprising a list of current helicopter simulator/flight training device models' fidelity, any known or discovered simulator performance gaps, and candidate flight conditions/maneuvers that would benefit from increased model fidelity.
- Initiated a feasibility assessment of applying motion capture technologies and weather sensors for helicopter simulation and flight test profiles.
- Identified industry/academia partners for participating in model development, testing, and validation/verification of simulator models and their enhancements.

## Program Resources ($K): Terminal Area Safety – TAS (A11H)

| FAA Research - FY2020 Report (Program Areas grouped by Domain) | FY18 Total Actuals | FY18 Contract Actuals | FY19 Total Actuals | FY19 Contract Actuals | FY20 Total Actuals | FY20 Contract Actuals | FY21 Total Request | FY21 Contract Request | FY22 Contract Target** |
|---|---|---|---|---|---|---|---|---|---|
| **Aircraft Safety Assurance** | | | | | | | | | |
| Terminal Area Safety (A11H.TAS) | $2,080 | $778 | $2,790 | $1,330 | $3,119 | $1,790 | $3,162 | $1,631 | $0 |

***NOTE: These numbers represent the initial FAA budget narratives and are subject to change*

| People | Facilities | Partnerships |
|---|---|---|
| • 2.5 Govt. FTEs and 3 CTR FTE in various technical disciplines including engineering, computer science, statistics, safety and risk management, etc. | • FAA WJHTC NextGen Integration and Evaluation Capability<br>• FAA WJHTC Cockpit Simulation Facility<br>  ○ FAA WJHTC S76 Helicopter Simulator<br>• FAA Boeing 737 Simulator<br>• FAA Mike Monroney Aeronautical Center (MMAC) Flight Operations Simulation Lab<br>  ○ FAA Boeing 737 FFS<br>  ○ FAA Airbus A330/340 FFS<br>• NASA Ames Vertical Motion Simulator | • Air Medical Operators Association (AMOA)<br>• Collins Aerospace<br>• Elbit Systems/Universal Avionics Corporation<br>• EUROCAE/RTCA<br>• Georgia Institute of Technology<br>• HAI<br>• Helicopter OEM's: Sikorsky, Leonardo, Airbus Helicopters, Bell, Robinson<br>• Heli Offshore<br>• Honeywell<br>• Iowa University<br>• Life flight of Maine<br>• L3Harris<br>• Massachusetts Institute of Technology (MIT)<br>• NASA<br>• NJ State Police<br>• Rowan University<br>• United States Helicopter Safety Team (USHST)<br>• U.S. Coast Guard<br>• Thales<br>• REGA Air Ambulance MaxViThales |

# Domain: Digital System Safety

## Program Area: Digital System Safety (A11D.SDS)

This research enhances the understanding of risks of failures or malfunctions of software and digital systems.

### Project: Onboard Network Security and Integrity (Aircraft Systems Information Security Protection) (A11D.SDS.1)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11D.SDS.1 | The outcome of this research should provide insights into information security protection vulnerabilities of, and risks to, aircraft systems, components, networks, and interfaces that would provide a basis for rulemaking, policy, guidance, standards, training, and process for security. | Onboard Network Security and Integrity<br><br>AIR/ANG-E2 | FY215 | FY20 |

*Project Output: Onboard Network Security and Integrity (Aircraft Systems Information Security Protection) outputs delivered in FY20 (A11D.SDS.1)*

PHASE II

- Extend the Risk assessments to the development mitigation techniques FY 18-FY20.The second phase is to extend beyond risk assessments and to explore how AVS can utilize a systems based approach to determine the best policies and regulations which will reduce the specific ASISP risks being analyzed.

PHASE III

- Identify Recommended ASISP Strategies for aircraft certification, maintenance and continued operational safety FY19-FY20
- The third phase is to explore an AVS ASISP Safety Risk management process and integrate all of the components developed in phase I & II with all available resources. The effort will propose effective strategies which will leverage the efforts from other government agencies and industry stakeholders to reduce the associated ASISP risks for aircraft certification, maintenance and continued operational safety.

FY 20 Exit Criteria

- Report describing the FAA capability to conduct a threat analysis, determine the risk factors and utilize those elements in ASISP Safety Risk Management process
- In FY 19 & 20 the components of the entire ASISP Safety Risk Management process will be integrated and applied to test cases. Strategies will be proposed on how to integrate industry and government processes (FAA, DHS, TSA, FBI, etc.) and forums (A-ISAC, OEM ASISP labs, etc.) to reduce the risk from ASISP events. Specific mitigation techniques and tools will be explored or developed to meet the time demands of ASISP Risks. Integrating ASISP resources from the entire Aviation stakeholder will be a critical element to developing the best of practice policies and procedures through policy and regulations.
- In FY 20, using the established Safety Risk Assessment process, generate a report with the identification of PMD risks and proposed associated mitigations and recommendations for best practices for PMDs

Phases II and III were completed in FY20 as expected, but ahead of schedule. The research from Phases 1 & II was consolidated and integrated into a final product for use in conducting future ASISP/cyber Safety Risk Assessments (SRAs). This product is the SRA Methodology, which was completed on 30 June 2020. As directed by the AVS sponsor, the research was concluded at the end of 3QFY20, with the following 6 products delivered as the culmination of the multi-phase research effort:

- SRA Methodology v2.0 (primary research product and transferred information technology)
- Signed Air Traffic Services (ATS) over Internet Protocol Suite (IPS) Scope Agreement
- "Interim" SRA Part 1 (Initial Risk Assessment) report for ATS over IPS (also provided to Cyber Safety – Commercial Aviation Team (CS-CAT) 6/25)
- Requirements list for an SRA Methodology tool, including results for candidate commercial product Medini Analyze
- *Revised* Flight Management System (FMS) SRA Part 1 report (includes appendix with signed dissent and endorsement from AVS representatives)
- Final FMS SRA Part 2 (Mitigation) report (the FMS SRA was a joint risk assessment with Collins Aerospace, GE Aviation and Boeing)

## Project: Complex Digital Systems (A11D.SDS.6)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11D.SDS.6 | Expected outcome is new, less prescriptive, risk-based guidance for assurance approaches, methodologies, and techniques used to implement and criteria to assure complex digital systems. | Complex Digital Systems<br><br>AIR/ANG-E2 | FY20 | FY24 |

### *Project Output: Complex Digital Systems outputs delivered in FY20 (A11D.SDS.6)*

- Completed a technical report on Run-Time Assurance as an Alternate Concept to Contemporary Development Assurance Processes
- Completed a technical report on Machine Learning implementation in Airborne Systems and Assurance - Final Report AFE-87 Machine Learning (Assurance)
- Completed a technical report on Distributed Integrated Modular Avionics Systems (DIMA), Integrated Modular Avionics (IMA) Safety issues, and the application of MBSE/MBSA techniques to identify and mitigate risks.
- Completed a technical report on Assurance Case using Overarching Properties - A Primer on Argument.

## Program Resources ($K): Digital System Safety (A11D.SDS)

| FAA Research - FY2020 Report (Program Areas grouped by Domain) | FY18 Total Actuals | FY18 Contract Actuals | FY19 Total Actuals | FY19 Contract Actuals | FY20 Total Actuals | FY20 Contract Actuals | FY21 Total Request | FY21 Contract Request | FY22 Contract Target** |
|---|---|---|---|---|---|---|---|---|---|
| **Digital Systems and Technology** | | | | | | | | | |
| Digital System Safety (A11D.SDS) | $5,197 | $3,392 | $4,767 | $2,902 | $4,500 | $2,806 | $3,066 | $3,319 | $0 |

***NOTE: These numbers represent the initial FAA budget narratives and are subject to change*

| People | Facilities | Partnerships |
|---|---|---|
| • SDS – 2 GOV FTE's, Partnerships from other organizations and contractors in Systems Engineering, Computer Engineering, and Computer Science disciplines | • No local facilities | • NASA Langley<br>• Aerospace Vehicles Systems Institute (AVSI) which includes several OEMs, Suppliers, FAA. NASA, DOD, and academia. |

# Domain: Environment & Weather Impact Mitigation

## Program Area: Aircraft Icing (A11D.AI)

This research enhances the understanding of risks of failures or malfunctions of software and digital systems.

### Project: Research on Ice Crystal Icing Conditions to Address Fundamental Knowledge of High Altitude Icing on Turbine Engine Damage and Power loss (A11D.AI.1)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11D.AI.1 | Mitigate the hazardous impact of ice accretions on engine operation and core components, such as compressors, due to ice crystal ingestion. | Research on Ice Crystal Icing Conditions to Address Fundamental Knowledge of High Altitude Icing on Turbine Engine Damage and Power loss<br><br>(AIR/ANG-E2) | FY13 | FY20 |

#### *Project Output: Research on Ice Crystal Icing Conditions outputs delivered in FY20 (A11D.AI.1)*

Task 4

Develop and test a large-scale model rotating rig to investigate engine geometric scaling effects in a representative rotational field which includes compressor dynamics. Task 4 has been deleted due to termination of funding for this Project beyond FY20.

Task 5

Supporting information for developing guidance materials for means of compliance. This supporting information will be provided, but will be based exclusively on work with the small-scale rotating rig, which is ongoing and will continue in FY21 using FY19 and FY20 funding.

- Milestone: provide results of studies and coordinate support for developing regulatory compliance guidance materials (FY22).
- Output: Results for use in development of regulatory compliance guidance materials.

## Project: Safe Operations and Take-off in Aircraft Ground Icing Conditions (A11D.AI.2)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11D.AI.2 | The AI-02 R&D provides wind tunnel, cold chamber, and outdoor winter weather (snow) test methods and analysis tools which will promote safer winter weather ground operations. The outcome of this R&D also provides research results (data, analyses, and other information) that support the development of guidance that Flight Standards writes and includes in their annual notice for "FAA-Approved Deicing Program Updates." | Safe Operations and Take-off in Aircraft Ground Icing Conditions<br><br>(AFS/ANG-E2) | FY00 | FY22 |

### *Project Output: Safe Operations and Take-off in Aircraft Ground Icing Conditions outputs delivered in FY20 (A11D.AI.2)*

Task 1:

- Artificial Snow Generation System ("Snow machine"): Evaluate and improve the capability of a snow generation system ("snow machine") to simulate specified outdoor conditions.

Task 2:

- Aerodynamic Issues and cold-soaked fuel frost (CSFF): Investigate aerodynamic issues relating to performance of anti-icing fluids, contaminated and uncontaminated during take-off roll and characterize CSFF formed over cold-soaked fuel tanks prior to takeoff. Include wind tunnel testing, cold chamber testing.
- Output: Reports on analysis of data from wind tunnel testing, characterization of CSFF based on cold chamber Two CSFF AIAA conference papers have been published, and a final FAA report is due in FY21

Task 3:

- Operational issues: Work currently focuses on ground icing protection for vertical stabilizers. .
    - Milestones: Reports or briefings on ground icing protection for vertical stabilizers and on other technical and operational issues and their priority / importance to the safety and efficiency of ground operations in winter conditions. (May 2020)
    - Output: Reports on findings from investigations of selected technical and operational issues. Reports may include recommendations for advisory material to be incorporated into annual ground icing notice. (May 2020)

## Project: SLD Engineering Tools Development and Validation (A11D.AI.5)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11D.AI.5 | The outcome of this R&D will be to streamline and improve the methods of compliance for the new SLD regulations by providing new test capabilities, test methods, measurement of SLD conditions, and databases that can be used to support certification. The outcomes of this research will be incorporated into guidance materials such as AC 25-28 and other advisory circulars. | SLD Engineering Tools Development and Validation<br><br>(AIR/ANG-E2) | FY16 | FY20 |

### *Project Output: SLD Engineering Tools Development and Validation outputs delivered in FY20 (A11D.AI.5)*

This project was to be a multi-year effort funding through FY22. However, funding was terminated after FY20. This meant that major parts of the work could not be completed. In discussions with the sponsors, it was agreed that most of the funding for FY20 should be transferred to Urban Air Mobility (UAM) icing (AIlD.AI.6), a popup requirement proposed for FY20. This popup was approved (see below).

The following work continued. 2D numerical analysis with CFD for airfoils representative of straight wing aircraft used in General Aviation for SLD conditions.

- Output: Internal report describing methodology and preliminary results (April 2020)

Continue 2D numerical analysis with CFD to support determination for flight test of critical ice shapes, including lowest stall angle or maximum useable lift.

- Output: AIAA conference paper describing methodology and results (June 2020)

Continue research on a microwave-based method for determination of drop collection efficiency for SLD drops.

- Output: Internal report or presentation on progress of work. (Sept 2020)

## Project: Urban Air Mobility (UAM) Icing (A11D.AI.6)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11D.AI.6 | The AI-02 R&D provides wind tunnel, cold chamber, and outdoor winter weather (snow) test methods and analysis tools which will promote safer winter weather ground operations. The outcome of this R&D also provides research results (data, analyses, and other information) that support the development of guidance that Flight Standards writes and includes in their annual notice for "FAA-Approved Deicing Program Updates." | Urban Air Mobility (UAM) Icing<br><br>(AIR/ANG-E2) | FY20 | FY21 |

### *Project Output: Urban Air Mobility (UAM) Icing outputs delivered in FY20 (A11D.AI.6)*

This project is based on a "popup" requirement that was submitted for FY20. The funding was obtained from the A11D.AI.5, but not until well into the fourth quarter of FY20. Thus most of the research will be done in FY21. Three major tasks have been extracted from the list of all tasks for this project.

- Task 1. Define test article and data/instrumentation support for test. (FY2020Q4)
- Tasks 2. Conduct icing tunnel tests to determine ice accretions on UAM rotor/propeller.
  - Milestones:
    - Icing tunnel testing Penn State (-FY21Q1-Q2)
    - Icing tunnel RailTec Arsenal (FY21Q2-Q2)
- Task 3. Final report
  - Report addressing the following: Effects of ice accretions on aerodynamic performance and vibration on eVTOL rotors and propellers. Documentation of ice shedding on eVTOL rotors and propellers. Recommendation on how eVTOL can show safe exit from inadvertent icing encounter. Adequacy of scaling when icing plume does not cover full rotor/propeller diameter. Database for development of ice accretion computer codes for eVTOL rotors/propellers .New, innovative technologies for ice detection systems on UAM. Database for development of numerical codes to model rotor-downwash effects on air data systems and cooling inlets critical for electrical propulsion systems on UAM.

## Program Resources ($K): Aircraft Icing (A11D)

| FAA Research - FY2020 Report (Program Areas grouped by Domain) | FY18 Total Actuals | FY18 Contract Actuals | FY19 Total Actuals | FY19 Contract Actuals | FY20 Total Actuals | FY20 Contract Actuals | FY21 Total Request | FY21 Contract Request | FY22 Contract Target** |
|---|---|---|---|---|---|---|---|---|---|
| Environment & Weather Impact Mitigation | | | | | | | | | |
| Aircrft Icing (A11D.AI) | $4,056 | $2,790 | $4,486 | $3,171 | $4,209 | $2,625 | $0 | $0 | $520 |

***NOTE: These numbers represent the initial FAA budget narratives and are subject to change*

| People | Facilities | Partnerships |
|---|---|---|
| • 5 FTEs in various technical disciplines including engineering, analytics, atmospheric science, etc. | • FAA HPC (For CFD modeling) | • NASA Glenn Research Center<br>• Transport Canada<br>• National Research Council (NRC) of Canada<br>• Environment and Climate Change Canada (ECCC)<br>• ONERA (France) |

## Program Area: Alternate Fuels for General Aviation (A11M)

This research evaluates unleaded aviation gasolines to provide data to support FAA Authorization of the use of the unleaded fuel in general aviation engines and aircraft, using the authority granted to the FAA in the FAA Reauthorization Act of 2018 Public Law No: 115-254, Passed 10/05/2018.

### Project: Alternative Fuels for General Aviation A11M.PS.5

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11M.PS.5 | The safe deployment of alternative GA avgas and approved mitigating safety measures and/or equipment for exempted aircraft models. The issuance of ASTM fuel production specification(s), and the issuance of procedures and regulations (the PAFI process) for the qualification and authorization of new, future unleaded fuels. | Alternative Fuels for General Aviation (AIR/ANG-E2) | FY2019 | FY2029 |

#### *Project Outcome: Alternate Fuels for General Aviation outputs delivered in FY20 (A11M.PS.5)*

The FAA will perform this research to continue the current PAFI program and issue the following outputs in FY20.

- Seven (7) research reports on the PAFI Screening Information Request (SIR) fuel. These will include results of engine test cell testing at ground level and using altitude simulation capabilities as required by specific PAFI test plans. Reports will contain the results of engine performance, detonation, durability and other operating characteristics from the applicable requirements of FAA 14 CFR Parts 33.45, 33.47, 33.49, 33.55, and 33.57.
- Five (5) research reports on PAFI non-SIR fuel candidates from engine test cell testing at ground level and using altitude simulation capabilities. Reports will contain the results of engine performance, detonation, durability and other operating characteristics from the applicable requirements of FAA 14 CFR Parts 33.45, 33.47, 33.49, 33.55, and 33.57.
- Nineteen (19) reports on the chemical and physical properties of test fuels in accordance with ASTM International test standards. Reports also include elemental composition analysis of candidate unleaded fuels to ensure that fuel delivered for testing are consistent with proposed fuel formulation specifications.

## Program Resources ($K): Alternate Fuels for General Aviation (A11M)

| FAA Research - FY2020 Report (Program Areas grouped by Domain) | FY18 Total Actuals | FY18 Contract Actuals | FY19 Total Actuals | FY19 Contract Actuals | FY20 Total Actuals | FY20 Contract Actuals | FY21 Total Request | FY21 Contract Request | FY22 Contract Target** |
|---|---|---|---|---|---|---|---|---|---|
| **Environment & Weather Impact Mitigation** | | | | | | | | | |
| Alternate Fuels for General Aviation (A11M)* | $0 | $0 | $1,900 | $758 | $1,900 | $726 | $2,524 | $2,242 | $4,800 |

**NOTE: GA Fuels funded from NEXTGEN budget through FY18*

***NOTE: These numbers represent the initial FAA budget narratives and are subject to change*

| People | Facilities | Partnerships |
|---|---|---|
| • 5 GOV FTEs and 10.5 CTR FTEs in various technical disciplines including engineering, analytics, material science, chemistry, lab testing, etc. | • FAA Aviation Fuel Research Lab (AFRL)<br>• FAA Propulsion & airpOWer Engineering Research (POWER) Lab | • **INDUSTRY: Aircraft Owners and Pilots Association (AOPA),**<br>• **Experimental Aircraft Association (EAA)**<br>• **General Aviation Manufacturers Association (GAMA)**<br>• **National Business Aviation Association (NBAA )**<br>• **National Air Transportation Association (NATA)**<br>• **Afton Chemical**<br>• **Air BP /Air Repair**<br>• **ASTM**<br>• **AVFUEL Corp**<br>• **Calumet Specialty Products**<br>• **Cape Air**<br>• **Chevron**<br>• **Cirrus Aircraft**<br>• **Commemorative Air Force**<br>• **Continental Motors**<br>• **Dixie Services**<br>• **Enstrom Helicopter**<br>• **Epic Aviation**<br>• **Ethyl Corp**<br>• **Everts Air**<br>• **Exxon Mobil**<br>• **Haltermann Solutions**<br>• **Hartzell Propeller**<br>• **Innospec**<br>• **Lycoming Engines**<br>• **LyondellBasell**<br>• **McCauley Propeller**<br>• **Meggitt Polymers & Composites**<br>• **Mooney Aircraft**<br>• **National Research Council Canada (NRC)**<br>• **Phillips 66**<br>• **Piper Aircraft**<br>• **Precision Airmotive**<br>• **Precision Engines**<br>• **Robinson Helicopter Company**<br>• **Rotax Engines**<br>• **Shell Oil Products US**<br>• **Swift Fuels LLC**<br>• **Textron**<br>• **Aviation TOTAL**<br>• **ACADEMIA: Purdue University-PEGASAS Center of Excellence,**<br>• **Embry Riddle Aeronautical University**<br>• **GOVERNMENT: Transport Canada** |

# Domain: Human Performance & Aeromedical Factors

## Flight Deck/Maintenance/System Integration Human Factors (A11G)

This research enhances decision making related to human factors for flight deck systems, and establishing data to support risk management programs to address hazards in the maintenance environment.

### Project: Enhancing Aviation Safety through Advanced Procedures, Training & Checking Methods, to include Loss of Control Detection, Avoidance, and Recovery (A11G.HF.1)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11G.HF.1 | Increase terminal area safety, access, efficiency, capacity, and throughput in low visibility conditions using advanced vision systems, head-up displays, and head-mounted displays. Expanding the use of these technologies will enable more flight operations to occur in low visibility conditions with less ground infrastructure while maintaining an appropriate level of safety during approach, landing, taxi, and takeoff operations. | Enhancing Aviation Safety Through Advanced Procedures, Training & Checking Methods, to include Loss of Control Detection, Avoidance, and Recovery<br><br>(AFS/ANG) | FY18 | FY22 |

### *Project Output: Enhancing Aviation Safety through Advanced Procedures, Training & Checking Methods, to include Loss of Control Detection, Avoidance, and Recovery outputs delivered in FY20 (A11G.HF.1)*

- Research Area 2: Provide Scientific and Technical Data to Support Recommendations Training the Emerging Pilot Workforce
    - Activity: Review the learning science and best practices on effective training for millennials and future generations and provide recommendations. Project 2, Milestone 1, Due 1/15/2020
    - Activity: Examine emerging issues and trends for the emerging pilot workforce and identify training programs to address these issues. Project 2, Milestone 2, Due 3/1/2020

## Project: Avionics and New Technologies (A11G.HF.2)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11G.HF.2 | Create job aids and checklists to assist engineers and inspectors in the field. Collect empirical data for updating FAA guidance and industry standards. Create policies to assist applicants in finding compliance. | Avionics and New Technologies<br><br>(AIR/ANG-C1) | FY18 | FY20 |

### *Project Output: Avionics and New Technologies outputs delivered in FY20 (A11G.HF.2)*

This pop-up is intended to complete two projects:

1. To complete analysis for the Electronic Flight Bag (EFB) Survey project, and to coordinate with ALPA to complete the development of a final technical report.
2. To increase the scope of the General Guidance document to include anthropometry considerations

- Activity 1: Compile and analyze operational human factors data to identify potential human-system integration gaps.
- Activity 2: Document interim and final human factors research results.
- Activity 3: Conduct additional data analysis.
- Activity 4: Develop supplementary briefing materials to include results from additional data analysis and a summary paper.
    - General Guidance document update: Human Factors Considerations in the Design and Evaluation of Flight Deck Displays and Controls – a comprehensive, one-stop reference for human factors pilot/interface and avionics issues and guidance. Includes relevant FAA regulatory and guidance material, industry standards, military standards (MIL-STDs), best practices, and research reports. Incorporate information on anthropometry from latest industry and academic research reports
- Exit Criteria: Publish revised Human Factors Considerations in the Design and Evaluation of Flight Deck Displays and Control

## Project: Advanced Vision Systems (A11G.HF.4)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11G.HF.4 | Research is needed to characterize human factors/pilot performance considerations using Advanced Vision Systems, HUD, and HMD for new low visibility concepts of operation. This research will inform development of operational requirements, standards, conditions, limitations, mitigations, and authorizations for the use of these technologies. | Advanced Vision Systems (EFVS, EVS, SVS, CVS), Head-Up Displays (HUD), and Head Mounted Displays (HMD): Operational Standards & Approval Criteria<br><br>(AFS/ANG-C1) | FY15 | FY23 |

### *Project Output: Advanced Vision Systems outputs delivered in FY20 (A11G.HF.4)*

- Exit Criteria – Complete experiment design and test plan, collect data, analyze data, and complete final technical report. VGS/HMD on transport category simulation platform: Develop research design and test plan [FY 20]

## Project: Fatigue Mitigation in Flight Operations (A11G.HF.8)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11G.HF.8 | Reduced accident rate with pilot fatigue in flight operations as a causal or contributing factor. Flight Standards Service will be able to evaluate the effectiveness of fatigue risk management approaches utilized by certificate holders under CFR parts 121 and 117 to mitigate fatigue and improve flight crew member alertness. Possible revisions to various Advisory Circulars (e.g., AC 120-103 A) associated with the flight crew member duty and rest regulations will be made as determined by the continuous monitoring and analysis of the Fatigue Risk Management System (FRMS) database and research study results. | Fatigue Mitigation in Flight Operations<br><br>(AFS/ANG-C1) | FY15 | FY20 |

### *Project Output: Fatigue Mitigation in Flight Operations outputs delivered in FY20 (A11G.HF.8)*

Project 1

- Continue relevant data collection and entry into the FRMS database and develop pertinent research questions that will improve the FAA's understanding of pilot fatigue during flight operations exceeding the limitations of the 14 CFR part 117 regulations.
- Exit criteria: Expansion of the FRMS Database during FY2020 with a continued collection and entry of operationally relevant fatigue & performance measures for the evaluation of fatigue mitigation effectiveness. This enables the agency to develop specific safety performance indicators for use as future evaluation metrics.

Project 2

- Develop and refine a research study during FY2020 to characterize human factors/pilot performance considerations in flight operations involving short haul multiple segment workload and cumulative sleep loss across trip pairings.
- Exit criteria: Research study and a report documenting the results of an operational investigation into the effects of short haul multi-segment flight operations on pilot workload and cumulative sleep loss across trip pairings.

Project 3

- Develop and refine a research study to systematically evaluate the behavioral adaptation of pilots to multiple time zone shifts associated with long-haul and ultra-long-range flight operations. This research will better inform development of operational requirements, standards, conditions, and limitations, mitigations, and FRMS authorizations relevant to these flight operations issues.
- Exit Criteria: Research study and a report documenting the results of an operational investigation into the effects of multiple time zone shifts associated with long-haul and ultra-long-range flight operations on pilot's behavioral and physiological adaptations.

## Program Resources ($K): Flight Deck/Maintenance/System Integration Human Factors (A11G)

| FAA Research - FY2020 Report (Program Areas grouped by Domain) | FY18 Total Actuals | FY18 Contract Actuals | FY19 Total Actuals | FY19 Contract Actuals | FY20 Total Actuals | FY20 Contract Actuals | FY21 Total Request | FY21 Contract Request | FY22 Contract Target** |
|---|---|---|---|---|---|---|---|---|---|
| Human Performance & Aeromedical Factors | | | | | | | | | |
| Flight Deck/Maintenance/System Integratio Human Factors (A11G) | $7,095 | $3,626 | $7,305 | $2,710 | $7,300 | $2,587 | $7,469 | $2,681 | $5,321 |

***NOTE: These numbers represent the initial FAA budget narratives and are subject to change*

| People | Facilities | Partnerships |
|---|---|---|
| • FAA project managers and principal investigators along with researchers and industry partners through contracts and agreements that include Human Factors Subject Matter Experts, Flight Deck Professionals, and Air Traffic Controllers | • Civil Aerospace Medical Institute (CAMI)<br>• William J Hughes Technical Center (WJHTC)<br>• Private Industry | • Industry<br>• NASA<br>• Volpe<br>• Radio Technical Commission for Aeronautics (RTCA)<br>• Universities |

## Program Area: Aeromedical Research (A11J)

Provide up-to-date guidance and standards to enhance human safety, security, and survivability in civilian aerospace operations.

### Project: CAMI Aerospace Medical Systems Analyses (A11J.AM.1)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11J.AM.1 | The principal contributions of aerospace medical research to the enhancement of NAS operations are: (a) Continued Operational Safety – by maximizing the strengths of the human link in the NAS and minimizing inherent human weakness to prevent accidents and improve safety through evidence-based medicine, (b) Risk Management – by identifying hazards and investigating injury and death patterns in civilian flight accidents towards an aeromedical safety management system, and (c) Certification Standards and Policy – by formulating criteria that will lead to improved knowledge management and decision-making processes in aerospace medicine, aircraft certification, flight standards, and accident investigation & prevention programs. | CAMI Aerospace Medical Systems Analyses (AAM/AAM) | FY20 | FY22 |

#### *Project Output: CAMI Aerospace Medical Systems Analyses outputs delivered in FY20 (A11J.AM.1)*

The AM-1 requirement will focus on two research tasks:

- Assess the effect on aeromedical safety, if any, resulting from BASICMED regulations and
- Assess drug use prevalence and types of drugs found in tissues of deceased pilots involved in air transportation accidents from 2014 through 2019.

The specific sponsor outcomes expected from the key research tasks listed for this requirement are:

- Provide safety data on the newly created BASICMED flight operations. It will include a discussion of the effects of the modified regulations to ensure the continued safety of the flying public.
- Enhance drug abatement and medical certification programs by providing information regarding the relationship between accidents and levels of drug and alcohol exposure (including possibly none).

## Project: CAMI Aerospace Medical Accident Prevention & Investigation (A11J.AM.2)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11J.AM.2 | The principal contributions of aerospace medical research to the enhancement of NAS operations are: (a) Continued Operational Safety – by maximizing the strengths of the human link in the NAS and minimizing inherent human weakness to prevent accidents and improve safety through evidence-based medicine, (b) Risk Management – by identifying hazards and investigating injury and death patterns in civilian flight accidents towards an aeromedical safety management system, and (c) Certification Standards and Policy – by formulating criteria that will lead to improved knowledge management and decision-making processes in aerospace medicine, aircraft certification, flight standards, and accident investigation & prevention programs. | CAMI Aerospace Medical Accident Prevention & Investigation (AAM/AAM) | FY20 | FY20 |

### *Project Output: CAMI Aerospace Medical Accident Prevention & Investigation outputs delivered in FY20 (A11J.AM.2)*

The specific sponsor outcomes expected from the key research tasks listed for this requirement are:

- Discover gene expression responses to hypobaric and norm baric environments and will result in (a) a greater understanding of gene expression changes in response to altitude exposure – 18,000 ft. is a higher altitude than previously studied, (b) enhanced altitude training strategies, and (c) guidance that may be necessary to improve hypoxia-related life support systems.
- Identify markers for time awake vs. markers for cognitive impairment; quantify more accurate expression markers; and establish a foundation to develop operational tests covering the spectrum of sleep deprivation.

## Project: CAMI Human Protection & Survival (A11J.AM.3)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11J.AM.3 | The AM-3 requirement focused on one research task: EFFECT OF CABIN SEAT PITCH AND ALTERNATIVE SEAT CONFIGURATIONS ON EVACUATION – FLEXSIM, all other research was halted and delayed due to the pandemic, the associated maximum telework policy, and the social distancing requirements. | CAMI Human Protection & Survival (AAM/AAM) | FY20 | FY20 |

### *Project Output: CAMI Human Protection & Survival outputs delivered in FY20 (A11J.AM.3)*

- The principal contributions of aerospace medical research to the enhancement of NAS operations are: (a) Continued Operational Safety – by maximizing the strengths of the human link in the NAS and minimizing inherent human weakness to prevent accidents and improve safety through evidence-based medicine, (b) Risk Management – by identifying hazards and investigating injury and death patterns in civilian flight accidents towards an aeromedical safety management system, and (c) Certification Standards and Policy – by formulating criteria that will lead to improved knowledge management and decision-making processes in aerospace medicine, aircraft certification, flight standards, and accident investigation & prevention programs. The specific sponsor outcomes expected from the key research tasks listed for this requirement are:
    - This study will assess the impact on evacuation of various cabin seat pitches and alternative seat configurations, quantitatively. Additional data will be collected from this project for addition to a database to provide valid data for future aircraft evacuation modeling efforts. This research was deemed as congressionally mandated in response to legislation included in the FAA's Reauthorization Act of 2018. It was given priority, and thus caused other research to be delayed.
    - Additional research tasks were delayed due to maximum required telework policies and social distancing guidelines as required by the public health emergency.

## Project: Expanded use of Analytical Modeling in Cabin Safety Applications (A11J.FCS.8)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11J.FCS.8 | Improve safety and efficiency by providing the necessary guidance for the expanded use of analytical modeling. | Expanded use of Analytical Modeling in Cabin Safety Applications<br><br>(AIR/AAM) | FY20 | FY22 |

### *Project Output: Expanded use of Analytical Modeling in Cabin Safety Applications outputs delivered in FY20 (A11J.FCS.8)*

This requirement will explore the potential applications for analytical modeling in various cabin safety areas, and establish criteria for validation, as well as credibility of models for use in certification. Modeling could overcome some of the limitations (e.g., cost, risk) to physical testing. This project could begin in FY18 using internal resources to identify the potential applications of analytical modeling.

- In FY20, define the research needs for the various application areas identified in the first phase, and identify performing organization
- This project has been delayed, due to the public health emergency.

## Project: Occupant Protection for Legacy Rotorcraft (A11J.RS.1)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11J.RS.1 | New safety equipment/technology that can be retrofitted onto legacy rotorcraft to decrease fatalities. | Occupant Protection for Legacy Rotorcraft<br><br>(AIR/AAM) | FY18 | FY20 |

### *Project Output: Occupant Protection for Legacy Rotorcraft outputs delivered in FY20 (A11J.RS.1)*

Phase 2:

- Evaluate by test and/or computer modeling the safety benefit provided by the restraint/seat/airframe modifications identified in Phase 1:
  - Work with industry partners to develop and test the effectiveness of restraint system and airframe improvements.
  - Work with industry partners to develop and test the effectiveness of airbag or inflatable restraint systems for rotorcraft use
  - Work with industry partners to develop and test the effectiveness of energy absorbing seats and seat cushions.
  - Work with industry partners to develop and test the effectiveness of safety features based on new technology.
- Phase 2 will begin in FY19 and extend through FY20. Due to delays caused by the current pandemic, the end of this phase will be extended in FY21.
  - Exit Criteria (Phase 2): For each element (a thru d) the potential safety improvements have been evaluated by test or modeling.
  - Milestone (Phase 2): For each element (a thru d) modifications shown to provide significant safety benefits have been identified.
  - Metric (Phase 2): For each element, specific seat/restraint/airframe modifications have been evaluated and results have been summarized in a technical report.

Phase 3

- Will begin in FY20: Support development of guidance material based on research findings.
  - Exit Criteria (Phase 3): Guidance material describing the seat/restraint/airframe modifications that provide significant benefit is completed.
  - Milestone (Phase 3): Guidance material developed for each element (a thru d).
  - Metric (Phase 3): Draft guidance material provided to sponsoring office.

## Project: Cabin Air Quality (A11J.FCMS.2)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11J.FCMS.2 | FAA regulatory guidance will result in eliminating the use of a subjective means of contaminant detection. It will improve identification of the source of fume/smoke/air contaminant events. FAA guidance could lead to improvements in airline operators troubleshooting procedures to minimize and avoid repeat diversions/air turn-backs. In addition, FAA regulatory guidance may result in a decrease in the number of diversions and air turn-backs from unidentified fume/smoke events. | Cabin Air Quality<br><br>AIR/ANG-E2 | FY19 | FY25 |

### *Project Output: Cabin Air Quality outputs delivered in FY20 (A11J.FCMS.2)*

- The proposed multi-year research was developed by the RITE/ACER COE and FAA to provide the most cost effective response to the congressional mandate. It will provide new data to successfully address the intent of the congressional mandate.
- Contract has been awarded as of 7/2020. Kickoff meeting for the project was held the week of 7/30/2020.

## Program Resources ($K): Aeromedical Research (A11J)

| FAA Research - FY2020 Report (Program Areas grouped by Domain) | FY18 Total Actuals | FY18 Contract Actuals | FY19 Total Actuals | FY19 Contract Actuals | FY20 Total Actuals | FY20 Contract Actuals | FY21 Total Request | FY21 Contract Request | FY22 Contract Target** |
|---|---|---|---|---|---|---|---|---|---|
| Human Performance & Aeromedical Factors | | | | | | | | | |
| Aeromedical Research (A11J) | $9,686 | $4,024 | $9,080 | $2,178 | $7,919 | $3,299 | $10,235 | $3,136 | $3,470 |

***NOTE: These numbers represent the initial FAA budget narratives and are subject to change*

| People | Facilities | Partnerships |
|---|---|---|
| • 29 In-House at the Civil Aerospace Medical Institute (CAMI): 23 GOV FTE; 6 CTR FTE<br>• Physicians, Scientists, and Engineers: Associate (19%); Baccalaureate (71%), Master (49%), and Doctorate (27%).<br>• Disciplines: Medicine, Human Factors, Cabin Safety, Genomics, Bioinformatics, Biodynamics, Physiology, Physics, Mathematics, Computer Science, and Knowledge Management | > 20 at CAMI<br>• 747 Aircraft Environment Research Facility (AERF)<br>• Flexible Aircraft Cabin Evacuation Simulator (FlexSim)<br>• Water Survival Research Facility (WSRF)<br>• Biodynamics Impact Sled<br>• Anthropomorphic Test Device Staging Area<br>• Altitude Chambers (Research and Training)<br>• Forensic Toxicology Analytical Research Laboratory<br>• Functional Genomics Research Laboratory<br>• Friedberg Numerical Sciences Laboratory | • 40 National: OK Medical Research Foundation, Naval Medical Research Unit-D, USAFSAM, Wichita State University. Walter Reed Army Institute of Research, SW Research Institute, Medical College of Wisconsin, University of Michigan Transportation Research Institute, Cleveland Clinic Foundation, Transportation Safety Institute, United States Helicopter Safety Team (USHST), National Oceanic and Atmospheric Administration (NOAA), US Dept. of Homeland Security, National Transportation Safety Board, US Customs and Border Protection, Airlines for America, Cleveland Clinic, ASME, NASA., Children's Hospital of Philadelphia Research Institute, Center for Child Injury Prevention Studies (CChiPS), NHTSA, Aerospace Medical Association (AsMA), NIOSH, UTMB Health, MedAire, SAFE Association, General Aviation Joint Steering Committee, Canadian Royal Air Force, US Marshals, etc.…<br>• 40 International: Airbus; Bahamas CAA; European Aviation Safety Agency; German Aerospace Center; Intl. Cabin Safety Res. Tech. Gp.; ICAO; Natl. U. of Colombia; Republic of Korea Radio Research Agency; Royal Canadian AF; SAE International; Czech Technical U.; University degli Study di Udine, Italy. |

# Domain: Aviation Performance & Planning

## Program Area: System Safety Management – SSM (A11H)

Anticipation of system-wide operational risks, Additional data-driven approaches, Lower accident rate due to loss-of-control, Fewer runway excursions and Improved helicopter safety, Support Risk-Based Decision Making for oversight of the Air Traffic Organization.

### Project: Helicopter Flight Data Monitoring and Analysis (A11H.SSM.9)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11H.SSM.9 | This effort encompasses research to provide analysis of helicopter risk through flight data monitoring for the vertical lift community. The efforts described herein allow the FAA to lead by developing analysis tools, metrics, and capabilities used by industry and government safety teams, including the USHST (Helicopter Safety Team), in pursuit of reducing the fatal accident rate for rotorcraft/vertical lift. | Helicopter Flight Data Monitoring and Analysis<br><br>AVP/ANG-E2 | FY20 | FY23 |

#### *Project Output: Helicopter Flight Data Monitoring and Analysis outputs delivered in FY20 (A11H.SSM.9)*

- Actively contributed to H-SE developed content, materials, and products along with conducting outreach efforts for USHST Safety Enhancement #82 – Helicopter Flight Data Monitoring, provide government and industry quantitative data for training and outreach (such as FAAST safety briefings), and monitor data for effectiveness of implemented Safety Enhancements.
- Published a DOT/FAA Technical Report *A Review of Flight Data Monitoring Risk Management, and Safety Management Tools for Rotorcraft Operations*, which includes:
  - Helicopter Flight Data Monitoring Tools, Techniques, and Data Analysis methods uncovered and used in the research effort
  - Helicopter FOQA data processing software programs
  - Risk and Safety Management techniques/tools that benefit from augmentation with HFDM data
  - Recommendations for improving the state of the art and applying aviation safety analysis via flight data monitoring approaches to rotorcraft data
  - New HFDM data sources
- Participated in fall 2019 ASIAS Info share Rotorcraft Breakout Session and ASIAS Rotorcraft Issue Analysis Team (IAT) Meetings.
- Presented Rotor Safety Challenge Session “Good Data Drives Good Decisions” at 2020 HAI Heli Expo and numerous other safety seminars to educate the rotorcraft community on Helicopter Flight Data Monitoring.

## Project: Safety Oversight Management System (SOMS) (A11H.SSM.11)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11H.SSM.11 | SOMS is a tool to integrate and analyze information from AOV oversight activities of the ATO. AOV will use the analytical capability for early identification of emerging safety trends in the NAS and for timely and effective safety oversight of the ATO. | Safety Oversight Management System<br><br>AOV/ANG-E2 | FY17 | FY20 |

### *Project Output: Safety Oversight Management System (SOMS) outputs delivered in FY20 (A11H.SSM.11)*

Phase 3 – Prototype Development (Oct 2019 – Sep 2020)

1. Developed case studies for SOMS use
2. Presented case studies for SOMS use and demonstration of SOMS prototype
3. Updated SOMS prototype
    - Output - Milestone – SOMS prototype complete
4. Demonstrated updated SOMS prototype
    - Output: Milestone – Updated SOMS prototype demonstration
5. Prepared Technology transfer documentation
    - Output: Deliverable - SOMS Technology Transfer Package
6. Conducted Initial technology transfer: Release 3 (R3) SOMS Prototype
    - Output: Milestone – SOMS Initial Technology Transfer Complete (9/27/20)

## Program Resources ($K): System Safety Management – SSM (A11H)

| FAA Research - FY2020 Report (Program Areas grouped by Domain) | FY18 Total Actuals | FY18 Contract Actuals | FY19 Total Actuals | FY19 Contract Actuals | FY20 Total Actuals | FY20 Contract Actuals | FY21 Total Request | FY21 Contract Request | FY22 Contract Target** |
|---|---|---|---|---|---|---|---|---|---|
| **Aviation Performance & Planning** | | | | | | | | | |
| System Safety Management (A11H.SSM) | $3,520 | $2,217 | $2,710 | $1,251 | $1,381 | $52 | $2,323 | $792 | $2,385 |

***NOTE: These numbers represent the initial FAA budget narratives and are subject to change*

| People | Facilities | Partnerships |
|---|---|---|
| • 7.5 GOV FTE; 10 CTR FTEs in various technical disciplines including engineering, computer science, statistics, safety and risk management | • Computing and Analytics Shared Services Environment (CASSIE)<br>• FAA WJHTC S76 Helicopter Simulator | • Air Medical Operators Association (AMOA)<br>• EIT Avionics<br>• Five-Alpha<br>• Georgia Institute of Technology<br>• Helicopter Association International (HAI)<br>• Helicopter OEM's: Sikorsky, Leonardo, Airbus Helicopters, Bell, Robinson<br>• Heli Offshore<br>• Helicopter Safety Advisory Committee (HSAC)<br>• Helicopter Tour Operations Committee (HTOC)<br>• Life flight of Maine<br>• LZ-Control<br>• NASA<br>• National Emergency Medical Services Pilots Association (NEMSPA)<br>• Rowan University<br>• Spider tracks<br>• Tour Operators Program of Safety (TOPS)<br>• Truth Data<br>• United States Helicopter Safety Team (USHST)<br>• U.K. Civil Aviation Authority (CAA) |

## Program Area: Unmanned Aircraft Systems Research (A11L)

Develop certification standards, policy, and guidance needed to safely integrate UAS into the NAS.

### Project: DAA Multi Sensor Surveillance Data Fusion Strategies (A11L.UAS.2)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11L.UAS.2 | Recognizing the need to merge various surveillance sensors for use in Detect and Avoid (DAA) algorithms, this effort was initiated to evaluate tracking and fusion strategies to support UAS DAA surveillance. Utilizing the products developed (sensor models, simulation environment and reference tracker) for SC-228 Phase One MOPS, continue research and development of sensor models, sensor fusion and tracking algorithms in order to support requirements development for RTCA SC-228 DAA Phase 2 MOPS. | DAA Multi Sensor Surveillance Data Fusion Strategies<br><br>(AUS/ANG-C2) | FY14 | FY20 |

#### *Project Output: DAA Multi Sensor Surveillance Data Fusion Strategies outputs delivered in FY20 (A11L.UAS.2)*

DAA Phase 2

- MOPS the research task team is required to provide support and deliverables for the following:
- Develop new and/or update existing sensor models to improve sensor performance modelling.
- Develop a reference tracker (Class 1 system) that meets surveillance performance requirements of RTCA SC-228 Phase 2 MOPS
- Continue research and development of additional sensor fusion strategies and tracker algorithms to improve tracker performance.
- Whitepaper: Altitude error model.at present conducting sensitivity analysis to understand impact and need for such a model to be included for future simulation efforts
- Study: Investigate performance of vertical rate data from equipment of multiple manufacturers. At present, vertical rate data is noisy and not used for alerting. Goal of study is to understand whether a particular filter or smoothing algorithm could be applied in order to make it usable.
- Develop an end to end simulation environment.
- Then, conduct simulations as required to support requirements development for surveillance performance to support SC-228 Phase 2 DAA and SC-147 ACAS Xu MOPS development.
- Participate in RTCA SC-228 and SC-147 work group meetings and sub-groups as required.
- RTCA Deliverable: Provide reports from studies conducted, software models/code and associated design document to committee members

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11L.UAS.7 | The sponsor intends to use the results of this research to support UAS operations over moving vehicles in the NAS. | Operations Over Moving Vehicles<br><br>(AUS/ANG-C2) | FY19 | FY21 |

*Project Output: Operations Over Moving Vehicles outputs delivered in FY20 (A11L.UAS.7)*

- Aviation Literature Review of Operations over Moving Vehicles
  - General Use Cases Report Delivered
  - Risk Assessment of Use Cases Delivered
  - Final Report Delivered

## Project: sUAS Beyond Visual Line of Sight Separation Requirements and Testing (A11L.UAS.22)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11L.UAS.22 | The sponsor intends to use the results of this research to support the development of requirements and identify feasible candidate technologies, including sensor types and algorithms, for the development of an industry consensus minimum performance standard (such as an ASTM standard) for Detect and Avoid systems for small UAS. The research will also support new FAA rulemaking that will detail the requirements and limitations for sUAS operating BVLOS. The research will also provide the information necessary to make "equivalent level of safety" determinations and respond to petitions for exemption to 14 CFR, Part 107 from the sUAS community prior to formal rulemaking for BVLOS operations. The research will also assist the FAA in evaluating UAS type certification applications for UAS designed to operate BVLOS. | sUAS Detect and Avoid Requirements Necessary for Limited Beyond Visual Line of Sight (BVLOS) Operations<br><br>(AUS-300/ANG-C21) | FY15 | FY20 |

*Project Output: sUAS Beyond Visual Line of Sight Separation Requirements and Testing outputs delivered in FY20 (A11L.UAS.22)*

- Task 1: Development of an Operational Framework for sUAS BVLOS Operations – New Use Cases, Industry Focus, and Framework Expansion
- Separation Framework Report Delivered
- UAF Flight Test Report Delivered

## Project: UAS High Performance Command and Control (C2) Link Systems and Networks (A11L.UAS.23)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11L.UAS.23 | This research supports development of certification guidance and industry standards forC2 Link and Auto flight Interoperability. | UAS High Performance Command and Control (C2) Link Systems and Networks (AIR/ANG-C2) | FY20 | FY22 |

### *Project Output: UAS High Performance Command and Control (C2) Link Systems and Networks outputs delivered in FY20 (A11L.UAS.23)*

- Interoperability Performance between BRLOS C2 Link and (Auto Flight System) AFGCS with Different Levels of Automation. The FAA and the RTCA SC-228 have identified robust UAS Automatic Flight Guidance and Control System (AFGCS) and the reliable interoperability of UAS AFGCS and the CNPC Data Link System are necessary to support the safe and efficient integration of the UAS into the NAS. This research addresses AFGCS flight guidance for the aircraft, now that some of the flight guidance is on the ground. This research also addresses how the CNPC Data Link System safely interoperates with the UAS AFGCS with different levels of automation. To achieve these objectives, this research addresses:
    - Task 1 (FY20, 12 months): Validate by simulation and flight testing functional performance of UAS Pilot-On-The-Loop (POTL) AFGCS with different levels of automation.
    - Task 1 (FY21, 12 months): Validate by simulation and flight testing interoperability performance of the POTL AFGCS with different levels of automation and C2 Link System, including the CNPC Link System transaction expiration time to support AFGCS Flight Plan update operations in controlled airport, continental, oceanic, and remote airspace, as well as in uncontrolled airspace.

## Project: UAS Flight Data Research in Support of ASIAS (Aviation Safety Information and Analysis Sharing) Program (A11L.UAS.43)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11L.UAS.43 | Establish basic capabilities in ASIAS to receive, house, and analyze unmanned aircraft FDM data by 2021. These basic capabilities will support objectives of widespread unmanned aircraft flight data collection, metrics, data analysis and sharing that provide useful safety information to the aviation community to support risk mitigation activities and reduce fatal accidents. In addition, the capabilities will leverage data analysis, collection, and storage capabilities that incorporate analysis of data from the UAS test sites and other UAS operations. The UAS capabilities developed for ASIAS will, to the maximum extent possible, use existing governance, analysis and sharing methodologies in place for the CAST/part 121 community, that rely on data in a secure environment, de-identification of data, and sharing information with the mitigating community. Research will produce an initial set of parameters and metrics to inform and expand future ASIAS precursor measures across various mission types. | UAS Flight Data Research in Support of ASIAS (Aviation Safety Information and Analysis Sharing) Program<br><br>(AVP/ANG-E2) | FY19 | FY21 |

### *Project Output: UAS Flight Data Research in Support of ASIAS (Aviation Safety Information and Analysis Sharing) Program outputs delivered in FY20 (A11L.UAS.43)*

Phase 1

- Review current FDM programs. This phase seeks to review current state-of-the-art of Unmanned Aircraft FDM (UFDM), explore safety benefits from UFDM, and explore the associated list of parameters, exceedances, and recording rates. Exit Criteria - Initial collection of UFDM data and a minimum standard List of UFDM parameters. Milestones - Determine baseline of UFDM, collect and analyze UFDM data, develop a minimum standard List of FDM parameters. Metrics - FDM data from at least three unmanned aircraft operators/manufacturers, complete list of UFDM parameters. (Jul. 2019).

Phase 2

- Develop methodology and agreements for UFDM. This phase seeks to develop the methodology for UFDM participation in ASIAS. Exit Criteria - Signed agreements with the unmanned aircraft community. Milestones - Develop methodology for UFDM participation in ASIAS, establish agreements with community participants, and conduct UAS Outreach efforts. Metrics - Agreements with UAS operators / manufacturers from at least two different communities. (Jan. 2020)

Phase 3

- Collect and integrate unmanned aircraft FDM data. This phase focuses on collecting UFDM data on a routine and regular basis within research efforts supporting ASIAS and to collaborate with a mitigation partner for UAS safety issues. Exit Criteria - Expansion of UAS research supporting ASIAS to additional participants with increased analysis capabilities. Milestones - Collect additional UFDM data, examine technologies and techniques required to integrate UFDM into ASIAS, develop additional UAS analysis tools and techniques. Metrics - Methodology and integration plan for UFDM in ASIAS. (Sep. 2020)

## Project: Air Carrier Operational Considerations for Unmanned Aircraft Systems (A11L.UAS.44)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11L.UAS.44 | This research addresses safety concerns specific to Air Carrier Operations for UAS to include air carrier staffing, training, testing, duty and rest requirements. It could help establish a separate rulemaking activity specific to air carrier operations. | I Air Carrier Operational Considerations for Unmanned Aircraft Systems<br><br>(AFS/ANG-C1) | FY19 | FY21 |

### *Project Output: Air Carrier Operational Considerations for Unmanned Aircraft Systems outputs delivered in FY20 (A11L.UAS.44)*

Milestone 4

- Design experiment to expand, refine and/or validate the prior related research results to fill the gaps in air carrier remote/manned crew requirements. Tasks (Milestone 4) -Design experiment options and document them along with pros and cons in a white paper. Choose an experiment (or multiple) to move forward with and document the research plan in a report. Exit Criteria (Milestone 4) - Research plan finalized with sponsor approval for experiment(s) to conduct the experiment (Contract Award + 12 months FY20).

Milestone 5

- Design experiment to expand, refine and/or validate the prior research results on air carrier remote pilot knowledge and skills testing. Tasks (Milestone 5) – Design experiment options and document them along with pros and cons in a white paper. Choose an experiment (or multiple) to move forward with and document the research plan in a report. Exit Criteria (Milestone 5) – Research plan finalized with sponsor approval for experiment(s) to conduct the experiment (Contract Award + 12 months FY20).

Milestone 6

- Design experiment to expand, refine and/or validate the prior related research results on UAS air carrier remote pilot duty and rest requirements to include fatigue issues. Tasks (Milestone 6) -Design experiment options and document them along with pros and cons in a white paper. Choose and experiment (or multiple) to move forward with and document the research plan in a report. Exit Criteria (Milestone 6) - Research plan finalized with sponsor approval for experiment(s) to conduct the experiment (Contract Award + 12 months FY20).

## Project: Minimum Detect and Avoid (DAA) Display and Flight Path Information (A11L.UAS.47)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11L.UAS.47 | This research requirement is crucial in determining the minimum necessary DAA information needed by a UAS pilot to successfully execute a maneuver to remain well clear. The research will identify the rationale behind type(s) of traffic display information necessary or beneficial to a UAS pilot as well as the type of flight path guidance data required to perform the DAA function. | Minimum Detect and Avoid (DAA) Display and Flight Path Information (AFS-80/ANG-C1) | FY17 | FY21 |

### *Project Output: Minimum Detect and Avoid (DAA) Display and Flight Path Information outputs delivered in FY20 (A11L.UAS.47)*

- Preliminary analysis on Evaluation of Preventative Alert Functions Delivered
- Final Report Delivered

## Project: UAS Flight Data Collection and Analysis (A11L.UAS.50)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11L.UAS.50 | Expand flight data collection and analysis methods to develop ability for data mining and alignment of flight test data and objectives to UAS integration milestones. | UAS Flight Data Collection and Analysis (AUS/ANG-C2) | FY18 | FY22 |

### *Project Output: UAS Flight Data Collection and Analysis outputs delivered in FY20 (A11L.UAS.50)*

This research will build upon the capabilities established through A11L.UAS.6.This research will construct a framework for data collection and analysis. Prior examples will be used to identify both best practices and gaps that will need to be filled. The data system shall include:

- Data mining capability – go back and tag existing data based on an established categorization/classification system and maintain this for new/futures flight data collected.
- Ability to align UAS flight data to research objectives. This system would enable users to cross-check needs for UAS data/research with flight data stored in the system as well as analysis to determine if the data meets the need and whether additional data/testing would be required.
- Milestones and deliverables include:
    - Develop best practices for data collection and a data categorization and classification system, including data mining capability. Identify systems best suited for housing and analyzing the data. Include considerations of UAS Integration activities. 9/30/19
    - Collect and integrate UAS flight test data on an ongoing basis.
    - Tag data according to system developed above.
    - Produce an annual summary report describing flight tests, data, searches, categorization, and uses/inquiries of data. This annual report will inform key documents and decisions including annual updates to the FAA's UAS Implementation Plan, FAA UAS Integration Research Plan, and FAA UAS R&D portfolio development. FY20 report deliverable due no later than 9/30/20.

## Project: eCommerce, Emerging UAS Network and Implications on NAS Integration (A11L.UAS.52)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11L.UAS.52 | 1. Knowledge, understanding and availability of sUAS network data for operations usage and safety risks implications.<br>2. Understanding of emergent network, interactions with NAS infrastructure including manned air transportation, environmental implications and associated regulations requirements for both users and the FAA;<br>3. Critical foundation for forecasting UAS for the entire NAS using emergent business trends, and network.<br>4. Framework incorporating risk-adjusted benefit and cost for UAS integration | eCommerce, Emerging UAS Network and Implications on NAS Integration<br><br>(APO/ANG-C2) | FY17 | FY19 |

### *Project Output: eCommerce, Emerging UAS Network and Implications on NAS Integration outputs delivered in FY20 (A11L.UAS.52)*

- Interim Report Delivered

## Project: Minority Outreach -- UAS as a STEM Minority Outreach Learning Platform for K-12 Students (A11L.UAS.53)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11L.UAS.53 | The FAA COE/ASSURE is conducting STEM minority outreach activities using UAS as the central learning platform. | Minority Outreach -- UAS as a STEM Minority Outreach Learning Platform for K-12 Students<br><br>(AUS/ANG-C2) | FY20 | FY20 |

### *Project Output: Minority Outreach -- UAS as a STEM Minority Outreach Learning Platform for K-12 Students outputs delivered in FY20 (A11L.UAS.53)*

At least one new ASSURE University will use the materials created in previous project parts to conduct outreach and will tailor the approaches to the specific underrepresented communities in their geographic areas. The proposed activities will fall under three basic categories:

- UAS Roadshows:
  - Each university will conduct at least 2 roadshows. Roadshow #1 should be completed by December 2019. Roadshow # 2 should be completed by March 2020.
- UAS Summer Camps:
  - Each university will hold at least one summer camp by July 2020.
- Optional other UAS STEM Outreach Activities as appropriate. The details of these activities will be in the PREP.
- The long-term goal of the project is to ignite an interest in UAS/STEM and, therefore, nurture part of the possible future UAS workforce. Target Audience: K-12.
- The following best practices shall be used in the STEM outreach activities:
  - Culturally representative approaches will be used. The building blocks will be modified to address specific cultural communities. This will require an understanding of the underlying dynamics of each area and why certain groups are under-represented.
  - Representative, diverse role models will be used for each event.
  - Existing networks and resources will be leveraged to the best extent possible.
  - Active/participatory learning approaches will be used.
  - All activities will be age appropriate.
  - Each university will create a Transition Plan that lays out ways in which STEM related activities will continue after this specific project has completed. The aim of this project is to be a seed that inspires ongoing STEM interest, not just a year of events.
  - The project will include evaluation mechanisms for each project activity.

## Project: SARP Collision Avoidance and Well Clear (A11L.UAS.56)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11L.UAS.56 | Recommendations for collision avoidance/well clear for UA-to-UA operations supporting safe UAS integration. | SARP Collision Avoidance and Well Clear (AUS-300/ANG-C2) | FY19 | FY19 |

### *Project Output: SARP Collision Avoidance and Well Clear outputs delivered in FY20 (A11L.UAS.56)*

- NMAC for sUAS to sUAS Interaction Presentation Delivered

## Project: UAS Automation and Intelligent Systems (A11L.UAS.61)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11L.UAS.61 | This research requirement will identify the core technology capabilities for the safe integration of automation for command and control of the UA, navigation of the UA through the airspace, and pilot compliance with clearances and instructions issued to the UAS pilot from ATC. | UAS Automation and Intelligent Systems (AUS/ANG-C1) | FY20 | FY22 |

### *Project Output: UAS Automation and Intelligent Systems outputs delivered in FY20 (A11L.UAS.61)*

There are two tasks: (1) Human operator considerations, (2) System certification criteria. Phase 1 for both tasks are the same and will be conducted under one contract.
Task 1:

- Phase 1: Identify state-of the-art in automation across all modes of transportation as well as for military and civilian applications to provide a picture of what advances in automation have been made and what is still needed. Specifically, identify the feasibility of current automation concepts (i.e., identify the difference between marketing hype and technology capabilities). As part of this survey, review core flight path augmentation technology and identify their current and planned future capabilities. Identify policy gaps for the approval of these automated concepts.
    - Exit Criteria (Phase 1): Draft report identifying the current state-of-the-art and areas where policy is needed.
- Phase 2: Based on the technology survey in Phase 1, identify key human factors considerations and research gaps for the ground station, which would allow the UAS operator to fly remotely. Develop research plan based on the findings.

  - Exit Criteria (Phase 2): Completion of plan describing the designed experiment to expand, refine and/or validate the prior related research results. (C + 5 months)
- Phase 3: Conduct designed experiment and related analysis as defined and agreed from Phases 1 and 2.
  - Exit Criteria (Phase 3): Completion of one or more related experiments designed to answer the research questions by expanding, refining and/or validating results of prior work in this area according to the agreed plan from previous phases.
  - Completion of technical report, acceptable to sponsor, detailing results of experiment and implications for supporting regulatory guidance.

Task 2:

- Phase 2: Develop research plan to evaluate automation technology identified in Phase 1 for UAS.
  - Exit Criteria (Phase 2): Completion of plan describing the designed experiment to expand, refine and/or validate the prior related research results.
- Phase 3: Conduct designed experiment and related analysis as defined and agreed from Phases 1 and 2.
  - Exit Criteria (Phase 3): Completion of one or more related experiments designed to answer the research questions by expanding, refining and/or validating results of prior work in this area according to the agreed plan from previous phases.
- Phase 4: Apply findings to manned aviation. This task will be conducted as part of separate FY20 research requirements and will not be included in the cost estimate submitted here.

## Project: Disaster Preparedness and Response (A11L.UAS.68)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11L.UAS.68 | The sponsor intends to use the results of this research to support UAS involved in emergency management preparedness in the NAS. | Disaster Preparedness and Response (AUS-300/ANG-C2) | FY19 | FY21 |

### *Project Output: Disaster Preparedness and Response outputs delivered in FY20 (A11L.UAS.68)*

- Surveys of First Responders and Government Agencies Delivered
- Final Report Delivered

## Project: Integrated Expanded and Non-Segregated UAS Operations into the NAS: Impact on Traffic Trends and Safety (A11L.UAS.69)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11L.UAS.69 | Integrating Expanded and Non-Segregated UAS Operations into the NAS: Impact on Traffic Trends and Safety | Integrating Expanded and Non-Segregated UAS Operations into the NAS: Impact on Traffic Trends and Safety<br><br>(APO-100/ANG-C2) | FY18 | FY21 |

### *Project Output: Integrated Expanded and Non-Segregated UAS Operations into the NAS: Impact on Traffic Trends and Safety outputs delivered in FY20 (A11L.UAS.69)*

- Research Task Plan Delivered

## Project: Establish risk-based thresholds for approvals needed to certify UAS for safe operation (A11L.UAS.71)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding | Contract Actual ($K) |
|---|---|---|---|---|---|
| A11L.UAS.71 | The sponsor intends to use the results of this research to support the expansion of UAS integration into the NAS. The research will provide the information necessary to make "equivalent level of safety" determinations and respond to petitions for exemption to 14 CFR, Part 107 from the sUAS community prior to formal rulemaking for UAS operations. The research will also assist the FAA in evaluating UAS type certification applications for UAS designed for beyond part 107 operations. | Establish risk-based thresholds for approvals needed to certify UAS for safe operation (AUS-300/ANG-C2) | FY18 | FY21 | $0 |

### *Project Output: Establish risk-based thresholds for approvals needed to certify UAS for safe operation outputs delivered in FY20 (A11L.UAS.71)*

- Research Task Plan Delivered
- Literature Review of UAS Pilot Training and Airworthiness Delivered

## Project: Propose viable criteria and thresholds for assessment of risk-based safety case submissions that will contribute to a repeatable process resulting in streamlined safety analysis (A11L.UAS.73)

| Control Account Number | Outcome | Project (Sponsor/ Performer) | First FY Funded | Last FY Funding |
|---|---|---|---|---|
| A11L.UAS.73 | The sponsor intends to use the results of this research to support the expansion of UAS integration into the NAS. The research will provide the information necessary to make "equivalent level of safety" determinations and provide guidance on Part 107 waivers. The research will also assist the FAA in evaluating UAS type certification applications for UAS designed for beyond part 107 operations. | Propose viable criteria and thresholds for assessment of risk-based safety case submissions that will contribute to a repeatable process resulting in streamlined safety analysis (AUS-300/ANG-C2) | FY18 | FY21 |

*Project Output: Propose viable criteria and thresholds for assessment of risk-based safety case submissions that will contribute to a repeatable process resulting in streamlined safety analysis outputs delivered in FY20 (A11L.UAS.73)*

- Research Task Plan Delivered

## Program Resources ($K): Unmanned Aircraft Systems Research (A11L)

| FAA Research - FY2020 Report (Program Areas grouped by Domain) | FY18 Total Actuals | FY18 Contract Actuals | FY19 Total Actuals | FY19 Contract Actuals | FY20 Total Actuals | FY20 Contract Actuals | FY21 Total Request | FY21 Contract Request | FY22 Contract Target** |
|---|---|---|---|---|---|---|---|---|---|
| **Aviation Performance & Planning** | | | | | | | | | |
| Unmanned Aircraft Systems Research (A11L) | $24,035 | $20,931 | $24,035 | $21,503 | $24,035 | $21,740 | $24,035 | $22,436 | $10,305 |

***NOTE: These numbers represent the initial FAA budget narratives and are subject to change*

| People | Facilities | Partnerships |
|---|---|---|
| • FAA Center of Excellence (COE) for UAS<br>• FAA Aviation Safety including: UAS Integration Office (AUS), Aviation Safety (AVS), Aircraft Certification (AIR), Small Airplane Directorate (ACE) , Flight Standards (AFS)<br>• 8 Federal FTEs as Subject matter experts in UAS detect and avoid capability, air carrier operations, human factors, and safety data collection | • FAA William J. Hughes Technical Center<br>• FAA Civil Aerospace Medical Institute (CAMI)<br>• FAA UAS Test Sites: North Dakota DOC, State of Nevada, New Mexico State University, University of Alaska Fairbanks, Texas A&M University Corpus Christi, Virginia Polytechnic Institute & State University, Griffiss International Airport (NY) | • NASA<br>• United States Helicopter Safety Team (USHST)<br>• UAS Center of Excellence<br>• Alliance for System Safety of UAS through Research Excellence (ASSURE): 23 leading research institutions and a hundred leading industry, academic, and government partners. |