Federal Aviation Administration

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

FY2022 Aviation Safety Research Portfolio Output Report

Contents

FY2022 AVS Portfolio Funding Profile

AVS Portfolio Funding Profile ($K unless noted)

FAA Research - FY2022 Report (Program Areas grouped by Domain)	FY20 Total Actuals	FY20 Contract Actuals	FY21 Total Actuals	FY21 Contract Actuals	FY22 Total Actuals	FY22 Contract Actuals	FY23 Total Request	FY23 Contract Request	FY24 Contract Target **
Aircraft Safety Assurance									
Fire Research and Safety (A11A)	$7,491	$2,879	$7,136	$2,513	$7,576	$2,321	$8,150	$2,504	$2,629
Propulsion and Fuel Systems (A11B)*	$2,256	$156	$4,215	$1,948	$3,121	$783	$7,042	$3,275	$3,550
Advanced Material/Structural Safety (A11C)	$13,693	$9,657	$14,720	$13,717	$1,678	$13,405	$3,000	$1,745	$1,280
Continued Airworthiness - Systems (A11E.SYS)	$11,269	$4,167	$11,269	$4,103	$8,829	$2,941	$12,430	$5,154	$2,516
Continued Airworthiness - Structures (A11E.STR)		$3,376		$3,195		$1,842		$3,205	$1,695
Aircraft Catastrophic Failure Prevention Research (A11F)*	$1,409	$1,282	$1,565	$1,565	N/A	N/A	N/A	N/A	N/A
Domain subtotal =	**$36,118**	**$21,517**	**$38,905**	**$27,041**	**$21,204**	**$21,292**	**$30,622**	**$15,883**	**$11,670**
Digital Systems and Technology									
Digital System Safety (A11D.SDS)	$4,500	$2,806	$3,861	$2,888	$3,689	$1,855	$5,287	$3,336	$4,825
Domain subtotal =	**$4,500**	**$2,806**	**$3,861**	**$2,888**	**$3,689**	**$1,855**	**$5,287**	**$3,336**	**$4,825**
Environment & Weather Impact Mitigation									
Aircrft Icing (A11D.AI)	$4,209	$2,625	$2,565	$431	$2,472	$1,213	$3,353	$2,075	$2,525
Alternate Fuels for General Aviation (A11M)	$1,900	$726	$2,524	$2,243	$4,986	$5,017	$6,000	$12,011	$10,367
Domain subtotal =	**$6,109**	**$3,351**	**$5,089**	**$2,674**	**$7,458**	**$6,230**	**$9,353**	**$14,086**	**$12,892**
Human Performance & Aeromedical Factors									
Flight Deck/Maintenance/System Integratio Human Factors (A11G)	$7,300	$2,587	$7,469	$2,682	$14,301	$9,116	$15,292	$9,150	$9,139
Aeromedical Research (A11J)	$7,919	$3,299	$10,235	$3,135	$13,257	$6,272	$14,000	$4,832	$6,824
Domain subtotal =	**$15,219**	**$5,886**	**$17,704**	**$5,817**	**$27,558**	**$15,388**	**$29,292**	**$13,982**	**$15,963**
Aviation Performance & Planning									
System Safety Management/Terminal Area Safety (A11H)	$4,500	$1,842	$5,485	$2,648	$7,898	$3,645	$10,111	$6,958	$5,968
Unmanned Aircraft Systems Research (A11L)	$24,035	$21,740	$24,035	$22,437	$22,077	$19,589	$15,000	$11,797	$17,657
Domain subtotal =	**$28,535**	**$23,582**	**$29,520**	**$25,085**	**$29,975**	**$23,234**	**$25,111**	**$18,755**	**$23,625**
Total Aviation Safety RE&D Portfolio =	**$90,481**	**$57,142**	**$95,079**	**$63,505**	**$89,884**	**$67,999**	**$99,665**	**$66,042**	**$68,975**
% of total FAA RE&D Appropriation/Request	46.9%		48.0%		34.8%				
Total FAA RE&D Appropriation/Request	$193M		$198M		$258.5M				

**NOTE: Aircraft Catastrophic Failure Prevention Research was incorporated into Propulsion and Fuel Systems Budget Narratives starting in FY19.*

***NOTE: These numbers represent the initial FAA budgeting and are subject to change.*

Domain: Aircraft Safety Assurance

Program Area: Fire Research and Safety (A11A)

BLI Scope: Fire Research and Safety

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)

CA#	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 tend to offset the current level of safety for conventional aircraft and operation.	Jeff Gardlin/ Dave Blake	FY15	FY30

Project Outputs: Aircraft Fire Safety (A11A.FCS.1) outputs delivered in FY22

- Report in publication DOT/FAA/TC-22/22 Microscale Flammability Criterion for Constituents of Aircraft Cabin Materials
- Report "Evaluation of Lithium Battery Thermal Runaway Propagation", DOT/FAA/TC-TN21/54, published in January 2022
- Draft report "Evaluation of VERDAGENT® Against the FAA Minimum Performance Standard for Aircraft Cargo Compartment Halon Replacement Fire Suppression Systems" delivered to sponsor for review in May 2022
- Technical thesis "Inserting Concentrations" of Fire Extinguishing Agents on Lithium Battery Flammable Gases" published June 2022
- Draft report "Evaluation Of Lithium Battery Thermal Runaway Vent Gas Combustion Hazard" submitted for technical editing April 2022
- Technical thesis "Early Aircraft Cargo Compartment Fire Detection inside of Unit Loading Devices using Ultra High Frequency Radio Frequency Identification and Temperature Sensing Tags" to be completed in Q4 FY22

- Technical thesis "Effect of Active Cargo Containers on Aircraft Smoke Transport" to be completed in Q4 FY22
- Journal article "The Effect of Weber Number on Spray and Vaporization Characteristics of Liquid Jets Injected in Air Crossflow" published in Journal of Fluids Engineering, June 2022. This work was performed to validate numerical models for simulating the FAA Next Generation Fire Test Burner

BLI Funding Profile: Fire Research and Safety (A11A)

Program Area Funding ($K unless noted) FAA Aviation Safety Research FY2022 REDAC Output Report	FY20 Total Actuals	FY20 Contract Actuals	FY21 Total Actuals	FY21 Contract Actuals	FY22 Total Actuals	FY22 Contract Actuals	FY23 Total Request	FY23 Contract Request	FY24 Contract Target
Aircraft Safety Assurance									
Fire Research and Safety (A11A)	$7,491	$2,879	$7,136	$2,513	$7,576	$2,321	$8,150	$2,504	$2,629

Collaboration: Fire Research and Safety (A11A)

Collaboration/Partnerships	FAA Office of Hazardous Materials (AXH), FAA Civil Aeromedical Institute (CAMI), Interagency Advanced Power Group (IAPG), NIST, ICAO, SAE, EASA, ICCAIA, Boeing, Airbus, University of Cincinnati, Drexel University, University of Maryland, University of Massachusetts, Rutgers University, UN Dangerous Good Panel
Facilities	FAA Full Scale Fire Test Facility, FAA Component Fire Test Facility, FAA Fire Chemistry Lab, FAA Material Fire Test Facility, FAA Pressure Vessel, B-757, B-747, B-737, and B-727 aircraft

Program Area: Propulsion and Fuel Systems (A11B)

BLI Scope: Propulsion and Fuel Systems

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: Damage Tolerance and Durability Issues (A11B.PS.1 (A11E.SIM.16 Area 3))

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11B.PS.1 (A11E.SIM. 16 Area 3)	Area 1: This requirement would provide data on new technologies in order to help develop policy and regulatory guidance materials that will support their application on new products and potential use on legacy aircraft. The requirement will also ensure the safe and efficient implementation of new technologies in aircraft products by providing data on the basic characteristics of these new technologies. The sponsor plans to use the outputs from this research for the development of rulemaking, policy, regulatory guidance, and industry standards. This requirements allows the FAA to: • Partner with manufacturers to ensure the fatigue, durability, damage tolerance and residual strength performance of new material systems is well understood prior to introduction into service through fracture mechanics test and analysis. • Obtain material/material system data, analytical tool validation data, etc. necessary to assess if new regulatory material is required, and • Support certification of new products and maintenance of legacy aircraft where new technologies are being implemented. Area 2: Research from all phases will result in: • Data, methods, and tools to provide more robust fatigue evaluations and risk analysis and risk management for in-service findings. • Software available to all FAA engineers and DERs. • Data to help rewrite part 23 requirements, develop industry consensus standards for both fatigue evaluation and risk analysis, and revise existing and develop new policy and guidance material. • Earlier FAA recognition of age-related safety concerns and more efficient resolution of those concerns resulting in increased prevention and mitigation of age-related accidents and incidents. • Improved general aviation community understanding of risk due to fatigue issues Area 3: The outcome of this research will be a reduction of uncontained engine rotor failures through the development of advisory circulars, data, and an acceptable methodology and tool (DARWIN) that facilitates compliance to the damage tolerance requirements of 33.70.	Walt Sippel, Michael Reyer, Tim Mouzakis/ John Bakuckas, Sohrob Mottaghi, Dave Galella	FY12	FY25

Project Outputs: Damage Tolerance and Durability Issues (A11B.PS.1 (A11E.SIM.16 Area 3)) outputs delivered in FY22

- Completed implementation in DARWIN of a capability that enables bi-variant crack growth solutions to be used with its auto-modeling features. Bi-variant crack growth solutions provide improved accuracy and auto-modeling enables rapid generation of fracture models to support life and risk calculations more robustly than those built manually
- Improved User Interfaces to improve user access to analysis input, output, and computational options to enhance efficiency, facilitate results interpretation, and reduce the potential of user error. Output is an improved DARWIN GUI. An improved GUI was included in DARWIN version 10.0 released 04/22. The improvements better enable 3D Visualizations and Speed Enhancement for Large 3D FE Models
- Technology Transfer - Outputs are meetings, telecoms, reporting, publications, presentations, and a DARWIN training workshop. Draft final report concluding grant with Southwest Research Institute that modified the DARWIN probabilistic engine design code to analyze rotor blade slots features. DARWIN version 10.0 was released 04/22 which includes a new capability for risk assessment of axial blade slots in accordance with upcoming FAA Advisory Circular AC33.70-5

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

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11B.PS.4	Reduction of uncontained nickel and titanium rotor failures through development and application of improved inspection systems and requirements.	Tim Mouzakis/ Dave Galella	FY22	FY27

Project Outputs: Improved Nondestructive Evaluation (NDE) to Prevent Uncontained Engine Failures (A11B.PS.4) outputs delivered in FY22

- Output: nickel test materials and parts. The Alloy 718 material to fabricate the nickel billet calibration standard was delivered to Southwest Research Institute in April. The calibration standard with programmed flat bottom holes is being fabricated and should be completed by August. This calibration standard will be used to test the higher sensitivity multi-zone ultrasonic system on production nickel billets

Project: Advanced Analysis Methods for Impact of Aircraft Materials from Rotor Burst and Blade Release (A11B.PS.2 (formerly A11F.PS.1))

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
(A11B.PS.2 (formerly A11F.PS.1))	Develop predictive analysis methods for assessing engine fragment or blade impact into engine and fuselage materials to determine the containment and shielding capabilities of each for safety assessments and certification. This research supportsAIR-6A0 Part 33.94 requirements policy, AIR670 Part 25.903 (d).1 and a revision to AC 20-128A. It is expected to become a part EASA/FAA rule making efforts for Open rotor Engine concepts, electric propulsion systems, and E-VTOL aircraft as new products apply for certification through the Innovation program under AIR-600.	Tim Mouzakis/ Daniel Cordasco	FY13	FY24

Project Outputs: Advanced Analysis Methods for Impact of Aircraft Materials from Rotor Burst and Blade Release (A11B.PS.2 (formerly A11F.PS.1)) outputs delivered in FY22

- Inconel 718 MAT_224 LS-DYNA material model input set completed and released to industry through the Aerospace Working Group (AWG) in Q2
- FAA report TCTT-22/21 to be completed in Q4, "The Influence of Strain Rate, Temperature Effects, and Instabilities in Failure Modeling for Metal Alloys."
- FAA report TC-19/41 P2 to be completed in Q4, "Aluminum 2024-T351 Input Parameters for *MAT_224 in LS-DYNA Part 2: Additional tests to determine plastic heating and ductile fracture behavior under combined loading"
- MAT_213 composite material model implemented into LS-DYNA R13 commercial software release in Q1 in partnership with ANSYS. Eight MAT_213 specific quality assurance test cases were created and released to the AWG
- FAA report TC-21/56 published in Q3, "T800-F3900 Composite Stacked Ply Laminate Testing and Modeling Using MAT_213"
- MAT_213 composite material model implemented into LS-DYNA R13 commercial software release in Q1 in partnership with ANSYS. Eight MAT_213 specific quality assurance test cases were created and released to the AWG
- FAA report TC-21/56 published in Q3, "T800-F3900 Composite Stacked Ply Laminate Testing and Modeling Using MAT_213"

- FAA, GE, and Naval Air Warfare center began analysis of the aerodynamic effects on blade release trajectories for a production representative open rotor (unducted) single fan engine. This is necessary to determine fuselage shielding coverage and cross-engine debris vulnerability. Preliminary simulations and an airflow delivery and diffuser system were completed in Q3
- LS-DYNA AWG meeting held virtually on March 14-16 with updates to industry on new impact and failure models available in LS-DYNA for metal and composite materials. Updates included revisions to Modeling Guidelines Document and Quality Assurance test cases
- LS-DYNA is a finite element analysis software tool widely used for dynamic analysis by the aerospace, automotive, and defense industries. The Aerospace Working Group (AWG) for Engine Related Impact and Failure (ERIF) is a collaborative industry and government group dedicated to advancing capability for turbine engine fragment impact modeling

BLI Funding Profile: Propulsion and Fuel Systems (A11B)

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**NOTE: Aircraft Catastrophic Failure Prevention Research was incorporated into Propulsion and Fuel Systems Budget Narratives starting in FY19.*									

Collaboration: Fire Research and Safety (A11B)

Collaboration/Partnerships	AIA-Rotor Integrity Subcommittee (RISC); Rotor Manufacturing (RoMan) Sub-team; Jet Engine Titanium Quality Committee (JETQC); Jet Engine Nickel Quality Committee (JENQC); AIA Inspection Team; USAF-AFRL, NASA. LS-DYNA Aerospace Working Group (AWG) – include Boeing, GE, P&W, RR and other industry OEMs NASA, Naval Air Warfare Center, ANSYS Inc.
Facilities	FAA High Performance Computer (HPC)

Program Area: Advanced Material/Structural Safety (A11C)

BLI Scope: Advanced Material/Structural Safety

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

Project: Continued Operational Safety (COS) and Certification Efficiency (CE) for Emerging Composite Technologies and Applications (A11C.SIC.12)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11C.SIC.12	This is primarily to develop public information and standards that are otherwise not available within industry, promoting standardization and consistency which ultimately leads to increased safety in new material applications.	Cindy Ashforth/ Ahmet Oztekin	FY17	FY25

Project Outputs: Continued Operational Safety (COS) and Certification Efficiency (CE) for Emerging Composite Technologies and Applications (A11C.SIC.12) outputs delivered in FY22

- Discontinuous Fiber Composites (DFC) were selected as the new material technology to be evaluated for this project. In FY22, work continued for characterization of DFC structures and use that info to help development of certification guidelines for DFC structures. In this context, a statistical analysis of experimental modulus and strength for high flow DFC coupons is underway

Project: Certification and Maintenance Protocols for Bonded Joints (A11C.SIC.14)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11C.SIC.14	A comprehensive guideline that identifies key characteristics, key process parameters, recommended test matrices for a building block approach, and industry best practices for design, certification, and maintenance of bonded joints and bonded repairs that will be published in a technical center report and CMH-17, with reference in an update to AC 20-107B.	Cindy Ashforth/ Ahmet Oztekin	FY22	FY25

Project Outputs: Certification and Maintenance Protocols for Bonded Joints (A11C.SIC.14) outputs delivered in FY22

- Adhesive bond qualification project: Static response of bonded joints with varying degrees of cure and environmental conditions above glass transition/cure temperature was evaluated. Testing was completed to evaluate effects of post-cure thermal exposure on the degree of cure of adhesives. Results will be documented in an FAA technical report on bond process qualification guidelines and development methodologies to assist with the bonded joint certification process. 2) Nanomechanical characterization of bond line project: Tests were completed to measure mechanical properties of adhesively bonded composite structure at elevated temperatures to understand effect of aging on bond line. Results will be documented in an FAA Technical report on the effect of ageing (in-service flight cycles) on the mechanical properties of adhesively bonded composite structure at room temperatures

Project: Non-Metallic Additive Manufacturing (A11C.SIC.15)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11C.SIC.15	The outcomes support industry standardization activities which are critical to safe integration of new AM materials. Without this framework information, each applicant develops their own material and process controls which are inconsistent and may not be adequate or equivalent to existing expectations for traditional metallic and composite materials. There may be long-term aging mechanisms we do not yet understand. This effort to produce publicly available data is critical to the aviation industry's overall understanding of these new materials and their limitations.	Cindy Ashforth/ Ahmet Oztekin	FY22	FY24

Project Outputs: Non-Metallic Additive Manufacturing (A11C.SIC.15) outputs delivered in FY22

- AA/ASTM AM COE Standards Development (Polymer AM): AM guidance documents are being developed for publication by ASTM for polymer material extrusion based on lessons learned in ULTEM 9085 qualification: An ASTM Guide on Material Extrusion was developed and was up for ballot in May-June 2022

Project: Advanced Materials Standardization (A11C.SIC.19)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11C.SIC.19	In order to comply with congressional direction for use of the FY22 appropriation plus-up funds for the Advanced Materials and Structural Safety BLI, this project identifies proposed research activities to advance the use of new metallic and non-metallic additively manufactured material and fiber reinforced composite material into the commercial aviation industry. As directed by congress, research will be performed by the COE JAMS. Research outcome will be used by the sponsor to promote standardization in use and certification of composite materials and new advanced material technologies such as additive manufacturing, thereby improving safety. This includes plans to revise existing guidelines and develop new ones in the areas of material and process qualification, certification practices, quality control, design substantiation, and repairs. Research output will also support industry standardization efforts for advanced materials in the form of material and process specifications, test standards, and analytical methods.	Cindy Ashforth/ Ahmet Oztekin	FY22	FY24

Project Outputs: Advanced Materials Standardization (A11C.SIC.19) outputs delivered in FY22

- Ceramic Matric Composite (CMC) Materials Guidance for Aircraft Design and Certification, Development of a qualification framework for oxide/oxide composites, Development of shared database and specifications for an oxide/oxide composite, Durability and long-term safety test plan for oxide/oxide composites
- Certification Guidance for Resin Infused Fiber Reinforced Composites (Stitched and Unstitched); Conducted a literature review and industry wide survey to capture in-depth information of current research and usage of resin infused composites with a special focus on “stitched” applications, Documented findings in a “state of the industry” report, Established industry steering committee to review research findings and provide feedback
- Conducted a literature review and industry wide survey to capture in-depth information of current research and usage of resin infused composites with a special focus on “stitched” applications; Documented findings in a “state of the industry” report; Established industry steering committee to review research findings and provide feedback

- Results from testing seating materials with liquid disinfectants has been published in an FAA Technical Report; The SAE Seat Committee issued an update to their recommendations for disinfecting methods based on our research results

Project: Advancement of Metal Additive Manufacturing (AM) Materials (A11C.SIM.1)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11C.SIM.1	Ensure metal AM technology is safely and efficiently integrated into aircraft, engine, and propeller applications. Proactively identify potentially hazardous conditions in order to prevent fatal accidents due to material defects or manufacturing flaws such as those detailed in the background section above. Promote certification efficiency through industry standardization efforts.	Cindy Ashforth/ Kevin Stonaker	FY19	N/A

Project Outputs: Advancement of Metal Additive Manufacturing (AM) Materials (A11C.SIM.1) outputs delivered in FY22

- Completed static and fatigue testing of specimens built while varying select key process variables including laser power, hatch spacing, laser spot size, and filter cleanliness. Posttest inspection and analysis are still ongoing
- Completed preliminary X-ray CT (XCT) specimens with varying defect distributions. Those specimens were used to establish the test matrix for the program. Build, test, and inspection of the full complement of specimens are ongoing
- Completed literature review on the integrity of as-printed surfaces using LS-PBF. Also completed preliminary XCT specimens with varying surface roughness values. The XCT information was used along with other surface roughness measurement techniques to establish the test matrix for the program. Build, test, and inspection of the full complement of specimens are ongoing

BLI Funding Profile: Advanced Material/Structural Safety (A11C)

Program Area Funding ($K unless noted) FAA Aviation Safety Research FY2022 REDAC Output Report	FY20 Total Actuals	FY20 Contract Actuals	FY21 Total Actuals	FY21 Contract Actuals	FY22 Total Actuals	FY22 Contract Actuals	FY23 Total Request	FY23 Contract Request	FY24 Contract Target
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Collaboration: Advanced Material/Structural Safety (A11C)

Collaboration/Partnerships	Academia (FAA Joint Centers of Excellence for Advance Materials, COE JAMS): Wichita State University, University of California San Diego, University of Washington, Washington State University, Oregon State University, Florida International University, University of Utah, Mississippi State University, Auburn University. Industry: Boeing, Hexcel, Toray, Cytec, Airbus, Spirit Aero systems, Bombardier, SAE International, ASTM, CMH-17, America Makes, TenCate-US, Bell Helicopters, Sikorsky, Leonardo Helicopters. Government: NASA, Army, Air Force Research Lab International/Government: - The European Aviation Safety Agency (EASA), Transport Canada Civil Aviation (TCCA); (Academia) Technical University of Denmark
Facilities	FAA Aircraft Structural Test Evaluation and Research Lab (FASTER), FAA Structures and Materials Lab (SML)

Program Area: Continued Airworthiness – Structures/Systems (A11E-STR/SYS)

BLI Scope: Continued Airworthiness – Structures

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

Project: Effect of Turbulence on Aircraft Structural Loading (A11E.SIM.11)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11E.SIM.11	From the reports based on this research, AVS will be able to update existing ACs and other standards/guidance as they relate to exceedance criteria.	Michael Reyer/ Sohrob Mottaghi	FY19	FY25

Project Outputs: Effect of Turbulence on Aircraft Structural Loading (A11E.SIM.11) outputs delivered in FY22

- A Generic longitudinal model of a Rigi aircraft subjected to vertical guts velocity was developed for the purpose of simulation. Some sample turbulence environment was generated based on the available data in the literature

Project: Development of Control Surface and Stabilizer Freeplay Limits (A11E.SIM.13)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11E.SIM.13	Revise AC 25.629-1B "Aeroelastic Stability Substantiation of Transport Category Airplanes" and eliminate need for issue papers. Published a FAA guidance material, with newly developed Freeplay criteria for transport airplanes, and stop using limits published in Military handbooks, such as JSSG-2006, "The Department of Defense Joint Service Specification Guide - Aircraft Structures" (which has replaced MIL-A-8870C).	Wael Nour/Sohrob Mottaghi	FY19	FY25

Project Outputs: Development of Control Surface and Stabilizer Freeplay Limits (A11E.SIM.13) outputs delivered in FY22

- Build a fully aeroelastic model with capability to introduce controlled degrees of Freeplay into the control surfaces. Initiate developing aeroelastic numerical model of the test model. Initiate gathering the existing non-linear aeroelastic models and initiate performing finite element analysis (FEA) and computational fluid dynamic (CFD) analysis
- A mechanism to introduce controlled degrees of Freeplay was design. This mechanism allows for modification of Freeplay during wind-tunnel testing. The model fixture was also design. Numerical analysis of the model was performed

Project: Reliability of Structural Health Monitoring (A11E.SIM.14)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11E.SIM.14	Accepted Industry standard that can be used by the FAA to develop guidance on SHM validation when used on transport category aircraft that are DT compliant.	Greg Schneider/ Paul Swindell	FY22	FY24

Project Outputs: Reliability of Structural Health Monitoring (A11E.SIM.14) outputs delivered in FY22

- Industry working group formed with the collaboration of the SAE Aerospace Industry Steering Committee for SHM

Project: Damage Tolerance and Durability Issues (A11E.SIM.16)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11E.SIM.16	Area 1: This requirement would provide data on new technologies in order to help develop policy and regulatory guidance materials that will support their application on new products and potential use on legacy aircraft. The requirement will also ensure the safe and efficient implementation of new technologies in aircraft products by providing data on the basic characteristics of these new technologies. The sponsor plans to use the outputs from this research for the development of rulemaking, policy, regulatory guidance, and industry standards. This requirements allows the FAA to: • Partner with manufacturers to ensure the fatigue, durability, damage tolerance and residual strength performance of new material systems is well understood prior to introduction into service through fracture mechanics test and analysis. • Obtain material/material system data, analytical tool validation data, etc. necessary to assess if new regulatory material is required, and • Support certification of new products and maintenance of legacy aircraft where new technologies are being implemented. Area 2: Research from all phases will result in: • Data, methods, and tools to provide more robust fatigue evaluations and risk analysis and risk management for in-service findings. • Software available to all FAA engineers and DERs. • Data to help rewrite part 23 requirements, develop industry consensus standards for both fatigue evaluation and risk analysis, and revise existing and develop new policy and guidance material. • Earlier FAA recognition of age-related safety concerns and more efficient resolution of those concerns resulting in increased prevention and mitigation of age-related accidents and incidents. • Improved general aviation community understanding of risk due to fatigue issues Area 3: The outcome of this research will be a reduction of uncontained engine rotor failures through the development of advisory circulars, data, and an acceptable methodology and tool (DARWIN) that facilitates compliance to the damage tolerance requirements of 33.70.	Walt Sippel, Michael Reyer, Tim Mouzakis/ John Bakuckas, Kevin Stonaker	FY12	FY25

Project Outputs: Damage Tolerance and Durability Issues (A11E.SIM.16) outputs delivered in FY22

- Released Version 17 of the MMPDS Handbook, which included 6 new alloys and updates to several guidelines items
- Held 39th and 40th MMPDS Coordination meetings in March and September, respectively. Over 80 representatives from government agencies, material suppliers, and material users world-wide participated
- Established the Emerging Technologies Task Group (ETTG) within MMPDS (co-chaired by FAA) to develop a Volume 2 for process intensive materials, such as metal additive manufacturing (AM), which require additional guidance over that published in the current handbook

Project: Metallic Materials Properties Development and Standardization (MMPDS) Support and Design Values for Emerging Materials (A11E.SIM.4)

CA#	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. This requirement leverages FAA resources through government – industry consortia in the development of the Metallic Materials Properties Development and Standardization (MMPDS), recognized worldwide as the premier source of metallic allowable. As part of the FAA's charter to maintain international leadership role, fulfill commitments to manage and develop metallic material and joint design standards on which aerospace industry depends. This requirement supports the introduction of new metallic materials and joining processes. For these emerging materials, research is being conducted under the Damage Tolerance and Durability Issues for Emerging Technologies requirement to better define specification controls and key material properties needed for design. Once identified and agreed to, the material properties will be maintained under this requirement, MMPDS.	Mark James/ John Bakuckas	FY12	FY30

Project Outputs: Metallic Materials Properties Development and Standardization (MMPDS) Support and Design Values for Emerging Materials (A11E.SIM.4) outputs delivered in FY22

- Released Version 17 of the MMPDS Handbook, which included 6 new alloys and updates to several guidelines items
- Held 39th and 40th MMPDS Coordination meetings in March and September, respectively. Over 80 representatives from government agencies, material suppliers, and material users world-wide participated
- Established the Emerging Technologies Task Group (ETTG) within MMPDS (co-chaired by FAA) to develop a Volume 2 for process intensive materials, such as metal additive manufacturing (AM), which require additional guidance over that published in the current handbook

BLI Funding Profile: Continued Airworthiness – Structures (A11E)

Program Area Funding ($K unless noted) FAA Aviation Safety Research FY2022 REDAC Output Report	FY20 Total Actuals	FY20 Contract Actuals	FY21 Total Actuals	FY21 Contract Actuals	FY22 Total Actuals	FY22 Contract Actuals	FY23 Total Request	FY23 Contract Request	FY24 Contract Target
Aircraft Safety Assurance									
Continued Airworthiness - Systems (A11E.SYS)	$11,269	$4,167	$11,269	$4,103	$8,829	$2,941	$12,430	$5,154	$2,516
Continued Airworthiness - Structures (A11E.STR)		$3,376		$3,195		$1,842		$3,205	$1,695

Program Area: Continued Airworthiness – Systems (A11E-STR/SYS)

BLI Scope: Continued Airworthiness – Systems

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

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

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11E.FCMS.13	• Demonstrate device integration on manned aircraft. • Validate the intended safety function is met. • Develop streamlined certification compliance requirements. • Publish advisory circular or share results with ASTM/other industry group for incorporation into industry standard.	Dave Sizoo/ Robert McGuire	FY18	FY24

Project Outputs: Transfer of New Technologies for Enhancement of General Aviation (GA) Safety (A11E.FCMS.13) outputs delivered in FY22

- Published FAA Technical Report DOT/FAA/TC-21/48: "Neural Network Based Runway Landing Guidance for General Aviation Auto Land." This research used machine learning to demonstrate how visual landing systems can perform landing assistance in General Aviation aircraft by identifying airport runways
- Published FAA Technical Report DOT/FAA/TC-21/28: "Visual 3D Weather Display for Preflight Planning." The technology developed under this research created a preflight planning tool that visually displays weather conditions in 3D along a planned flight trajectory. This capability directly translates to improved flight safety and situational awareness
- Published FAA Technical Report DOT/FAA/TC-21/28: "Develop a Method of Compliance to Support Certification of Advanced Flight Controls in General Aviation and Hybrid Vehicles." This research provides the FAA with a proposed method for certification of advanced flight controls in general aviation, urban air mobility and hybrid vehicles
- Published FAA Technical Report DOT/FAA/TC-21/12: "Flight Test Data Driven Development of Means of Compliance for Low-Speed Flight Characteristics of Part 23 Aircraft." The present project was focused on evaluating the effects of different sensory modes in angle-of-attack warning systems (visual, aural, and haptic) along with the stall characteristics of common single-engine, Part 23 aircraft, in order to develop a means of compliance. The report presents the proposed means of compliance for flight characteristics of GA airplanes and documents the underlying flight test data
- Published FAA Technical Report DOT/FAA/TC-21/19: "Developing Means of Compliance for eVTOL Vehicles: Phase I Final Report." This research defined a new process for the certification means of compliance that is designed to address the emerging markets for personal

air vehicles and urban air taxis. The key element of this approach is the introduction Handling Qualities Task Elements (HQTEs) that ultimately become part of the means of compliance with Federal Aviation Administration Part 23 regulations

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

CA#	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.	Matthew Fuller/ Alanna Randazzo	FY18	FY22

Project Outputs: Wire Strike Avoidance (A11E.RS.5) outputs delivered in FY22

- Design wire cutter and sensor package. Work will be completed September 2022 and final report delivered

Project: Integrated Flight and Propulsion Control (A11E.RS.8)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11E.RS.8	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.	Rotorcraft Standards Branch/ Alanna Randazzo	FY19	FY22

Project Outputs Integrated Flight and Propulsion Control (A11E.RS.8) outputs delivered in FY22

- Completed research contract with CDI in May 2022. Final report delivered and currently in Tech Center editing process. Follow on contract with CDI awarded June 2022 to continue this research
- Research contract with Embry Riddle to conclude Sept 2022. Final report will be delivered at that time

BLI Funding Profile: Continued Airworthiness – Systems (A11E)

Program Area Funding ($K unless noted) FAA Aviation Safety Research FY2022 REDAC Output Report	FY20 Total Actuals	FY20 Contract Actuals	FY21 Total Actuals	FY21 Contract Actuals	FY22 Total Actuals	FY22 Contract Actuals	FY23 Total Request	FY23 Contract Request	FY24 Contract Target
Aircraft Safety Assurance									
Continued Airworthiness - Systems (A11E.SYS)	$11,269	$4,167	$11,269	$4,103	$8,829	$2,941	$12,430	$5,154	$2,516
Continued Airworthiness - Structures (A11E.STR)		$3,376		$3,195		$1,842		$3,205	$1,695

Collaboration: Continued Airworthiness – Structures/Systems (A11E-STR/SYS)

Collaboration/Partnerships	Aviation Specialties Unlimited (ASU), PEGASAS Center of Excellence for General Aviation, Georgia Institute of Technology, NASA Ames, NASA Armstrong, NASA Langley, Battelle, Boeing, Arconic, Embraer, Bombardier, Constellium, Wichita State University, Southwest Research Institute, NASA, University of Texas at San Antonio, Textron Aviation, Rutgers University, University of Washington, Politecnico de Milano, Wichita State University MagniX, DENSO, Boeing, Airbus, Dassault, Joby, Acme Aero, EaglePicher, Teledyne, EP Systems, S&T Systems, University of Dayton Research Institute, SAE, NASA (Johnson and Glenn), EASA, Propulsion Power Systems Alliance
Facilities	FAA Full-scale Aircraft Structural Test Evaluation and Research (FASTER) Lab, FAA Structures and Materials Lab (SML), Aircraft Beam Structural Test (ABST) Fixture, FAA Arc Fault Evaluation Lab/More Electric Aircraft Lab, POWER Lab, Electric Flight Controls Test Capabilities, FAA's Sikorsky S76-D Helicopter Simulator at the William J. Hughes Technical Center's Cockpit Simulation Facility

Domain: Digital Systems & Technology

Program Area: Digital System Safety (A11DS)

BLI Scope: Digital System Safety

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

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

CA#	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.	Barbara Lingberg/ Alanna Randazzo	FY20	FY24

Project Outputs: Complex Digital Systems (A11D.SDS.6) outputs delivered in FY22

- Research outputs for this topic will include reports documenting the WCET estimation concepts and procedures along with a prototype tool. Final report is expected by the end of FY22

BLI Funding Profile: Digital System Safety (A11DS)

Program Area Funding ($K unless noted) FAA Aviation Safety Research FY2022 REDAC Output Report	FY20 Total Actuals	FY20 Contract Actuals	FY21 Total Actuals	FY21 Contract Actuals	FY22 Total Actuals	FY22 Contract Actuals	FY23 Total Request	FY23 Contract Request	FY24 Contract Target
Digital Systems and Technology									
Digital System Safety (A11D.SDS)	$4,500	$2,806	$3,861	$2,888	$3,689	$1,855	$5,287	$3,336	$4,825

Collaboration: Digital System Safety (A11DS)

Collaboration/Partnerships	NASA Langley, Aerospace Vehicles Systems Institute (AVSI), FAA ATO Navigation Programs, GPS Program, U.S. Space Force, Air Force Research Laboratory (AFRL), Integrated Mission & Avionics Test & Evaluation Division, Naval Air Warfare Center, Patuxent River Naval Air Station
Facilities	N/A

Domain: Environment and Weather Mitigation

Program Area: Aircraft Icing (A11DA)

BLI Scope: Aircraft Icing (A11DA)

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

CA#	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.	Alan Strom/ James T. Riley	FY17	FY24

Project Outputs: Research on Ice Crystal Icing Conditions to Address Fundamental Knowledge of High-Altitude Icing on Turbine Engine Damage and Power loss (A11D.AI.1) outputs delivered in FY22

- Testing was conducted during the summer of 2021 that resulted in five AIAA paper submissions. These include “Ice Crystal Environment - Modular Axial Compressor Rig: FAA 2021 Research Campaign”, “Ice Crystal Environment - Modular Axial Compressor Rig: Comparison of Ice Conditions after 1 and 2 Stages”,” Ice Crystal Environment - Modular Axial Compressor Rig: The Importance of TWC on Ice Crystal Icing Accretion”, and “Ice Crystal Environment - Modular Axial Compressor Rig: FAA 2021 Research on Heat Flux at the Icing Surface”
- Final preparations are underway for a July 2022 High Aerisol - High Ice Water Content (HIWC) flight campaign out of Jacksonville, Florida to collect data needed by the ICI Aviation Regulatory Advisory Committee to improved and better validated certification envelope for ICI conditions. Energy changes in a control volume

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

CA#	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."	Charles Enders/ Warren Underwood	FY10	FY24

Project Outputs: Safe Operations and Take-off in Aircraft Ground Icing Conditions (A11D.AI.2) outputs delivered in FY22

- Cold Soaked Fuel Frost (CSFF) simulation testing was done on aluminum and composite surfaces. The data has been analyzed and a report has been written
- The first year of frozen contamination testing on an updated vertical tail was completed in February. The testing included airflow characterization, aerodynamic rake testing, and simulated takeoff runs while contaminated with light freeing rain, and snow. The data is being analyzed and the report is expected to be completed this year
- The first year of research was conducted to develop holdover times for simultaneously occurring icing conditions. The data from this testing has been analyzed and holdover times for snow mixed with freezing fog, snow mixed with freezing fog and freezing mist, and snow mixed with ice crystals will be published in August 2022

BLI Funding Profile: Aircraft Icing (A11DA)

Program Area Funding ($K unless noted) FAA Aviation Safety Research FY2022 REDAC Output Report	FY20 Total Actuals	FY20 Contract Actuals	FY21 Total Actuals	FY21 Contract Actuals	FY22 Total Actuals	FY22 Contract Actuals	FY23 Total Request	FY23 Contract Request	FY24 Contract Target
Environment & Weather Impact Mitigation									
Aircrft Icing (A11D.AI)	$4,209	$2,625	$2,565	$431	$2,472	$1,213	$3,353	$2,075	$2,525

Collaboration: Aircraft Icing (A11DA)

Collaboration/Partnerships	National Research Council Canada (NRC), Environment & Climate Change Canada (ECCC), Transport Canada (TC), Australian Bureau of Meteorology (BOM), French Aerospace Lab (ONERA), Italian Aerospace Research Center (CIRA), UK Met office, Meteo-France, German Meteorological Office (DWD), Aviation Planning Services (APS), NOAA National Severe Storms Laboratory (NSSL) , NOAA Global Systems Laboratory (GSL), NASA (Glenn, Langley, and Armstrong), National Center for Atmospheric Research (NCAR), Boeing, Airbus, Bombardier, University of Illinois, Penn State, Baylor University, Nagoya University (Japan)
Facilities	The National Research Council of Canada (NRC) for icing tunnel testing, FAA CASSIE (For CFD modeling)

Program Area: Alternate Fuels for General Aviation (A11M)

BLI Scope: Alternate Fuels for General Aviation (A11M)

The alternative fuels for general aviation program perform research supporting the Piston Aviation Fuels Initiative (PAFI) to resolve the number one issue facing general aviation today. That is to identify and qualify (through testing) alternative replacement fuel(s) that will maintain the safety of the GA fleet before regulatory and/or market forces eliminate the availability of current leaded aviation gasoline.

Project: Alternative Fuels for General Aviation *(A11M.PS.5)*

CA#	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.	Monica Merritt/ Dave Atwood	FY21	FY29

Project Outputs: Alternative Fuels for General Aviation (A11M.PS.5) outputs delivered in FY22

- Due to program delays, over 430 ASTM analysis are presently planned by the end of FY22

BLI Funding Profile: Alternate Fuels for General Aviation (A11M)

Program Area Funding ($K unless noted) FAA Aviation Safety Research FY2022 REDAC Output Report	FY20 Total Actuals	FY20 Contract Actuals	FY21 Total Actuals	FY21 Contract Actuals	FY22 Total Actuals	FY22 Contract Actuals	FY23 Total Request	FY23 Contract Request	FY24 Contract Target
Environment & Weather Impact Mitigation									
Alternate Fuels for General Aviation (A11M)	$1,900	$726	$2,524	$2,243	$4,986	$5,017	$6,000	$12,011	$10,367

Collaboration: Alternate Fuels for General Aviation (A11M)

Collaboration/Partnerships	Aircraft Owners and Pilots Association, American Association of Airport Executives, American Petroleum Institute, ASTM, Commemorative Air Force, Experimental Aircraft Association, General Aviation Manufacturers Association, Helicopter Association International, National Air Transportation Association, National Business Aviation Association, Afton, Air BP, Air Repair, AVFUEL Corp, Avint, Bemidji Aviation, BP, BRP-ROTAX, Calumet, Cape Air, Chevron, Cirrus, Continental Motors, Dixie Services, Enstrom Helicopter, Epic Aviation, Ethyl Corp, Everts Air, Exxon Mobil, GAMI, Haltermann, Hartzell Propeller, Innospec, Lycoming Engines, Lyondell, McCauley Propeller, Meggitt, Mooney Aircraft, Phillips 66, Piper Aircraft, Precision Airmotive, Precision Engines, Radial Engines Ltd, Robinson Helicopter, Rotax Engines, Shell, Swift Fuels, Textron Aviation, TOTAL, Total Energies Aviation, Twin Cessna Flyer, VP Racing Fuels, World Fuel Services, ACADEMIA: Embry Riddle, Purdue PEGASAS COE, GOVERNMENT: Environment and Climate Change Canada, European Union Aviation Safety Agency, National Research Council Canada, Transport Canada, US Environmental Protection Agency
Facilities	FAA Aviation Fuel Research Lab (AFRL), FAA Propulsion & airpOWer Engineering Research (POWER) Lab

Domain: Human and Aeromedical Factors

Program Area: Flightdeck/Maintenance/System Integration Human Factors

BLI Scope: Flightdeck/Maintenance/System Integration Human Factors (A11G)

This research will use human factors principles to focus on the impact of systems, procedures, training, advanced technologies, and new/novel concepts of operations on human performance. This human-centered approach will address the issues associated with regulatory aspects of design, training, operations, and maintenance, including complex systems and human-system integration, and it will provide strategic solutions to improve aviation safety.

Project: Maintenance Human Factors to Support Risk-Based Decision Making and Maintenance Safety Culture (A11G.HF.10)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11G.HF.10	This research will result in research products that industry can apply to their operations. The research products will be made available to industry through various avenues as appropriate, including Technology Transfer methods and the FAA website.	Jackie Black/ Carla Hackworth	FY17	FY19

Project Outputs: Maintenance Human Factors to Support Risk-Based Decision Making and Maintenance Safety Culture (A11G.HF.10) outputs delivered in FY22

- Procedural Noncompliance in Aviation Maintenance: A Multi-Level Review of Contributing Factors and Corresponding Mitigations (OAM Technical Report DOT/FAA/AM-22/01)

BLI Funding Profile: Flightdeck/Maintenance/System Integration Human Factors (A11G)

Program Area Funding ($K unless noted) FAA Aviation Safety Research FY2022 REDAC Output Report	FY20 Total Actuals	FY20 Contract Actuals	FY21 Total Actuals	FY21 Contract Actuals	FY22 Total Actuals	FY22 Contract Actuals	FY23 Total Request	FY23 Contract Request	FY24 Contract Target
Human Performance & Aeromedical Factors									
Flight Deck/Maintenance/System Integratio Human Factors (A11G)	$7,300	$2,587	$7,469	$2,682	$14,301	$9,116	$15,292	$9,150	$9,139

Collaboration: Flightdeck/Maintenance/System Integration Human Factors (A11G)

Collaboration/Partnerships	Civil Aerospace Medical Institute (CAMI), Boeing, United Airlines
Facilities	Civil Aerospace Medical Institute (CAMI)

Program Area: Aeromedical Research (A11J)

BLI Scope: Aeromedical Research (A11J)

The aerospace medicine research program is executed at the FAA's Civil Aerospace Medical Institute (CAMI) in support of the agency's aviation safety mission. The research program focuses on safety sensitive personnel, airline passenger, and commercial space flight participant health, safety, and performance in current and forecasted future civilian aerospace operations. CAMI researchers conduct aerospace-relevant applied research in the biomedical, biodynamics and survivability/cabin safety sciences. A unique portfolio of capabilities allows CAMI to transition validated knowledge and effective technologies to enable innovation in aerospace operations and mitigate and prevent aeromedical hazards associated with aerospace mishaps.

Project: FY22 CAMI Aerospace Medical Accident Prevention & Investigation (A11J-AM.2)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11J-AM.2	The sponsor will consider the results of this study, including biological and any other indicators of sleep loss-induced performance degradation, for further use in field-based testing. These findings will be used to guide development and/or revision of data-driven recommendations for pursuing future research, technology transfer, or regulatory efforts.	Dr. Michael Berry/ Stacey Zinke-McKee	FY19	FY27

Project Outputs: FY22 CAMI Aerospace Medical Accident Prevention & Investigation (A11J-AM.2) outputs delivered in FY22

- This study aims to a. Identify markers for time awake vs markers for cognitive impairment; b. Quantify more accurate expression markers; and c. Based on the discoveries in b., establish a foundation to develop operational tests covering key elements of life-related sleep deprivation. These findings will aid the development of the genomics "black box." 1. Delivery of 1/2 of subject samples. 2. Award of sequencing contract to Baylor College of Medicine Human Genome Sequencing center. 3. Acquisition of DOT-provided computational resource for data analysis (EST 4Q22)

BLI Funding Profile: Aeromedical Research (A11J)

Program Area Funding ($K unless noted) FAA Aviation Safety Research FY2022 REDAC Output Report	FY20 Total Actuals	FY20 Contract Actuals	FY21 Total Actuals	FY21 Contract Actuals	FY22 Total Actuals	FY22 Contract Actuals	FY23 Total Request	FY23 Contract Request	FY24 Contract Target
Human Performance & Aeromedical Factors									
Aeromedical Research (A11J)	$7,919	$3,299	$10,235	$3,135	$13,257	$6,272	$14,000	$4,832	$6,824

Collaboration: Aeromedical Research (A11J)

Collaboration/Partnerships	Aerospace Medical Association, American Society of Mechanical Engineers, Baylor College of Medicine, Brigham and Women's Hospital, Canadian Royal Air Force, Center for Child Injury Prevention Studies, Customs and Border Protection, Department of Homeland Security, General Aviation Joint Steering Committee, International Cabin Safety Research Technical Group, International Civil Aviation Organization, Medical College of Wisconsin, MedAire, National Air and Space Administration (NASA), National Highway Traffic Safety Administration, National Institute for Occupational Safety and Health, National Oceanic and Atmospheric Administration, National Transportation Safety Board, Naval Medical Research Unit-D, Oklahoma Medical Research Foundation, SAE International, SAFE Association, Southwest Research Institute, Transportation Safety Institute, United States Helicopter Safety Team, United States Marshals, United States Navy, Wichita State University.
Facilities	> 20 at CAMI: 747 Aircraft Environment Research Facility (AERF), Flexible Aircraft Cabin Evacuation Simulator, FlexSim), Water Survival Research Facility (WSRF), Biodynamics Impact Sled, Anthropomorphic Test Device, Staging Area, Altitude Chambers (Research and Training), Functional Genomics Research Laboratory, Friedberg Numerical Sciences Laboratory

Domain: Aviation Performance & Planning

Program Area: System Safety Management (A11H.SSM)

BLI Scope: System Safety Management/Terminal Area Safety (A11H)

Lead in the development and deployment of innovative practices and technologies that improve the safety and performance of the nation's transportation system. Improve airport and heliport operations, air traffic and airspace management capabilities and deliver air navigation services oversight decision support tools. Additionally, advance safety data collection, risk analysis, and prototype risk-based decision-making capabilities by improving modeling capabilities and enhanced analysis capabilities.

The System Safety Management program is designed to improve safety by developing data collection methods, advancing data and risk analysis techniques, and creating prototypes for risk-based decision-making capabilities to identify and analyze emerging safety issues in a collaborative nature with aviation stakeholders.

Project: Adapting a NAS-Wide, Top-Down Safety Risk Model to Accommodate Bottom-Up Safety Assessment (A11H.SSM.25)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11H.SSM.25	Over the past years SSMT has worked with stakeholders (both internal and external to the FAA) to evaluate ISAM's capabilities and build requirements to develop ISAM in a direction consistent with stakeholders' safety analysis needs. ISAM offers the ability to use a "common ruler" framework for stakeholders conducting safety risk analyses. Through the development of updated operational ISAM software to include risk assessment incorporating contextual, conditional, and common cause failures, ISAM can be used in a variety of risk-informed decision-making scenarios (e.g., rulemaking, procedural changes, technology implementation, new entrants) using a common baseline. ISAM's cross-organizational and NAS-wide approach to risk analysis supports the FAA's ongoing goals to reduce commercial and general aviation fatalities	Laura Bachurski/ ANG-E272	FY21	FY23

Project Outputs: Adapting a NAS-Wide, Top-Down Safety Risk Model to Accommodate Bottom-Up Safety Assessment (A11H.SSM.25) outputs delivered in FY22

- The first technical report, which describes how to model accident/incident/mishap event data in ISAM and details the research processes, methodologies, techniques, and results, is scheduled to deliver by August 31, 2022
- The second technical report, which reviews state-of-the-art methods for representing contextual, conditional, and common cause failures; assesses each method pros and cons for use in this application; and make recommendations and its rationale for the selection, is scheduled to deliver by September 30, 2022

Project: Aircraft Network Security Program (ANSP) Sector Risk Profile Tool - Surface Safety (SRPT-Surface) (A11H.SSM.26)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11H.SSM.26	As an integral part of the implementation of the FAA Integrated Oversight Philosophy, AOV will be able to determine the appropriate surveillance, in terms of frequency and scope. The risk profile may be used to plan other safety oversight activities. It is commonly used to adjust the frequency and scope of surveillance, as well as to focus on specific areas requiring attention. AOV will be able to find patterns in airport operating environments, procedures, and system performance that predict the potential for negative safety occurrences. Using forecasting functions in the tool, AOV can apply proactive or predictive surveillance actions and allocate oversight resource more efficiently to ensure the safe delivery of air traffic services. The model and machine learning algorithms developed for runway operations can be easily adapted to support AOV's monitoring and surveillance on other NAS operations, which will significantly improve NAS safety performance.	Frank Wondolowski/ Dr. Huasheng Li	FY21	FY24

Project Outputs: Aircraft Network Security Program (ANSP) Sector Risk Profile Tool - Surface Safety (SRPT-Surface) (A11H.SSM.26) outputs delivered in FY22

- Delivered a technical report that contains Initial data model and Concept of Operations (ConOps) to guide the development of the SRPT-Surface Safety
- Delivered a technical report documenting the descriptive safety analytic models, machine learning algorithms, and safety performance indicators for runway safety monitoring and surveillance. In September 2022, a technical report will be delivered along with case study demonstration

BLI Funding Profile: System Safety Management/Terminal Area Safety (A11H)

Program Area Funding ($K unless noted) FAA Aviation Safety Research FY2022 REDAC Output Report	FY20 Total Actuals	FY20 Contract Actuals	FY21 Total Actuals	FY21 Contract Actuals	FY22 Total Actuals	FY22 Contract Actuals	FY23 Total Request	FY23 Contract Request	FY24 Contract Target
Aviation Performance & Planning									
System Safety Management/Terminal Area Safety (A11H)	$4,500	$1,842	$5,485	$2,648	$7,898	$3,645	$10,111	$6,958	$5,968

Collaboration: System Safety Management/Terminal Area Safety (A11H)

Collaboration/Partnerships	NASA, United States Helicopter Safety Team (USHST), Vertical Flight Society (VFS), Helicopter Association International (HAI), Vertical Aviation Safety Team (VAST), PEGASAS COE for General Aviation, Georgia Institute of Technology, Rowan University, Sikorsky, Airbus Helicopters, Leonardo, United States Coast Guard, Five-Alpha, LZ Control, TruthData, HeliOffshore, Helicopter Safety Advisory Committee (HSAC), RTCA SC-213/EUROCAE WG79, Universal Avionics/Elbit Systems, Astronics/MaxViz, Iowa University Operator Performance Laboratory (OPL), Dept. of Defense (multiple segments), L3/Harris, VRM Simulations, Flight Safety, CAE, Saab, University of Liverpool
Facilities	FAA's Computing and Analytics Shared Services Environment (CASSIE), FAA's Sikorsky S76-D Helicopter Simulator at the William J. Hughes Technical Center's Cockpit Simulation Facility, Rowan University's CAVE Virtual/Augmented Reality Laboratory

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

BLI Scope: Unmanned Aircraft Systems (UAS) Research (A11L)

The FAA's annual five-year UAS Integration Research Plan is supported by this RED BLI and other appropriations. This BLI supports a one FAA and one AVS approach to safe and efficient integration of UAS into the NAS. UAS research is the foundation of FAA/AVS UAS integration activities, and is phased by operational capabilities, providing a streamlined pathway to safe UAS integration. UAS research informs the development of rules, policies, procedures, standards, decisions, and other outcomes needed to safely integrate UAS into the NAS.

Project: Safety Case Methodology: Operations over people and means of compliance (A11L.UAS.07)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.07	This requirement is intended to be a long-term research effort starting at the WJHTC and transitioning to the FAA's Center of Excellence (COE).	Sabrina Saunders-Hodge/ William Oehlschlager	FY19	FY21

Project Outputs: Safety Case Methodology: Operations over people and means of compliance (A11L.UAS.07) outputs delivered in FY22

- Final Report - Safety Case Methodology Final Report, a summary of the process to develop the Final Test Plan, execute testing, develop the safety case, and validate the safety case to the FAA COR. The contractor must provide a face-to face briefing to FAA stakeholders of results of the Safety Case Methodology Final Report. Delivered on 1/14/2022

Project: Small UAS Detect and Avoid Requirements Necessary for Limited Beyond Visual Line of Sight (A11L.UAS.22)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.22	The output of this research will be used to inform possible regulations and guidelines for DAA systems for sUAS. It will help inform the current progress of any industry standards to ensure that the FAA weighs in on how any DAA operational classes are handled in the NAS.	Sabrina Saunders-Hodge/ Nick Lento	FY17	FY21

Project Outputs: Small UAS Detect and Avoid Requirements Necessary for Limited Beyond Visual Line of Sight (A11L.UAS.22) outputs delivered in FY22

- Task 5: Development of a Testing Plan. The plan will consider characteristics of recommended well clear definitions, DAA systems, and UA as appropriate and involve flight testing for verification. It will be presented to ASTM Special Committee 38 to support development of a sUAS DAA testing methodology standard. Committee feedback will be acquired
- Exit Criteria: Testing plan report provided to both the FAA and ASTM. Delivered 5/13/2022
- Task 6: Testing of a) the recommended DAA testing plan and b) candidate DAA systems to include:
    - Conduct Flight Tests
    - Testing of Well Clear Definition
    - Testing of Separation Framework
    - Testing of DAA Test Plan
    - Revision of SMS/SRM Output
- Exit Criteria: Flight test summary reports at set intervals from each test site – nominally each 6-month period. Delivered 5/13/2022

Project: High Visual Contrast for UAS (A11L.UAS.31)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.31	With the wide variation of sizes and flight characteristics of UAS, this research will explore ways to increase the visibility of UAS for people on the ground and, more importantly, pilots of manned aircraft.	Stephen Plishka/ James Knight	FY18	FY20

Project Outputs: High Visual Contrast for UAS (A11L.UAS.31) outputs delivered in FY22

- Final Report documenting field study findings. Delivered 3/31/2022

Project: Unmanned Flight Data Monitoring and Analysis (A11L.UAS.43)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.43	Maintain a reduced risk of collision between manned and unmanned aircraft, in spite of the exponential increase in quantities of unmanned systems, unmanned operations, and interactions between manned and unmanned aircraft.	Walt Hogan/ Cliff Johnson	FY18	FY22

Project Outputs: Unmanned Flight Data Monitoring and Analysis (A11L.UAS.43) outputs delivered in FY22

- Task 1: Collect flight data on a routine and regular basis within research efforts supporting ASIAS
- Collaborate with government, military, industry, and academic partners in organizations such as Unmanned Aircraft Safety Team (UAST) to identify and prioritize the risk
- Report on the diverse types of data collected attached to a spreadsheet output of the 1000 or more lines of flight data delivered 4/4/2022.
- Task 2 expected FY22 Q4

Project: UAS Safety Case Development, Process Improvement, and Data Collection (A11L.UAS.50)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.50	The outcome of this fully functioning comprehensive system for collecting, storing, analyzing, and mining UAS flight test data in support of UAS integration objectives will be better informed rulemaking and standards, and better-informed decisions based on existing data and data still needed, ultimately leading to the safe integration of UAS in the NAS. The data collection and analysis it enables will allow for safety case(s) for UAS operations leading to repeatable UAS operational approvals.	Paul Rumberger/ Nick Lento	FY18	FY22

Project Outputs: UAS Safety Case Development, Process Improvement, and Data Collection (A11L.UAS.50) outputs delivered in FY22

- Task 1: Initial Build of the Test Data Collection and Analysis System (TDCAS). Delivered 6/15/2022
- Task 2: Exercise System using Advanced Operations. Delivered 6/15/2022
- Task 3: Develop linkage to industry consensus standards, OOP NPRM, other rulemaking, and FAA SMS risk management guidance. Delivered 5/11/2022
- Task 4: Validation of the Test Data Collection and Analysis System (TDCAS) - BVLOS. Delivered 6/30/2022

Project: ASSURE Center of Excellence (COE) Management Budget (A11L.UAS.51)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.51	Successful and efficient management of activities administered through ASSURE will enable R&D that will inform the FAA's rulemaking, policy, procedures, and other processes required to integrate UAS safely and efficiently into the National Airspace System.	Sabrina Saunders-Hodge/ Nick Lento	FY17	FY25

Project Outputs: ASSURE Center of Excellence (COE) Management Budget (A11L.UAS.51) outputs delivered in FY22

- Administration of ASSURE. Delivered 2022, Continuing support of the COE

Project: Safety Research Facility: Low Altitude Detect and Avoid (DAA) & Remote ID Standards Validation / Validation of Remote Identification Standards - Safety Research Center (A11L.UAS.55)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.55	Specific, tailored RDT&E capability to accomplish FAA goals for UAS integration research.	Sabrina Saunders-Hodge/ Nick Lento	FY17	FY19

Project Outputs: Safety Research Facility: Low Altitude Detect and Avoid (DAA) & Remote ID Standards Validation / Validation of Remote Identification Standards - Safety Research Center (A11L.UAS.55) outputs delivered in FY22

- Remote ID - Task 3: Simulation, Demonstration & Analysis Plan. Delivered 2/17/2022

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

CA#	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.	Michelle Yeh/ Ashley Awwad	FY18	FY20

Project Outputs: UAS Automation and Intelligent Systems (A11L.UAS.61) outputs delivered in FY22

- Deliver final technical report after comment and review. Delivered 12/14/2021
- Draft technical report at the completion of Phase 1. Delivered 12/14/2021
- Report on collection and analysis of data from the VMS Pilot Usability study. Delivered 12/8/2021
- Implementation of novel V/STOL aircraft pilot interface concept(s) in Vertical Motion Simulator (VMS). Delivered 5/27/2022
- Novel V/STOL aircraft pilot interface in medium fidelity simulator for industry representative eVTOL aircraft. Delivered 5/27/2022

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

CA#	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.	Sabrina Saunders-Hodge/ Nick Lento	FY21	FY21

Project Outputs: Disaster Preparedness and Response (A11L.UAS.68) outputs delivered in FY22

- Selection of specific use cases and mock ConOps and ORAs created and delivered for the FAA approved use cases from Task 1. Delivered 5/31/2022
- Report detailing the common risks from the approved use cases with a look at the waivers/exemptions needed for those operations. Delivered 5/1/2022
- Report detailing how the management of manned aircraft flight coordination would change if UAS are utilized instead. Delivered 5/31/2022

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

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.69	Phase 1: Evaluation of data and establish quantitative impact of expanded operations: Will provide summaries of all available data and establish quantitative relationships between existing trends and explain shifts due to different aspects of integration activities such as waivers, LAANC, IPP, and other regulatory relaxations. Phase 2: Establish scope of non-segregated operations: Scoping and types of UAS and likelihood of non-segregated operations with anticipated timeline in different class of airspaces and provide a detailed list of equipment that users may need and procedures that the FAA will have to put in place in order to facilitate these non-segregated operations. Sponsor Outcome Date: December, 2021 Phase 3: de minimis risk likelihood and comparable framework: Using risk profile information and data from Phases 1-2, characterize the risk of UAS-manned aircraft interactions based on UAS and ATC data, establish de minimis framework and provide concrete suggestions towards revising SMS.	Michael Lukacs/ Nick Lento	FY21	FY22

Project Outputs: Integrating Expanded and Non-Segregated UAS Operations into the NAS: Impact on Traffic Trends and Safety (A11L.UAS.69) outputs delivered in FY22

- Phase 1 Technical Report (Data Set Assessment and Data Needs for ConOps Evaluation Interim Report). Delivered Sept 2020
- Phase 2 Technical Report (Forecast of the Future Scope of UAS Operations). Delivered June 2022
- Phase 3 Technical Report (Risk Framework). Delivered June 2022
- Final Report (of Phase 1-3 results). Delivered June 2022

Project: Science and Research Panel (SARP) Co-Chair (A11L.UAS.70)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.70	Recommendations for collision avoidance/well clear for UA-to-UA operations supporting safe UAS integration.	Sabrina Saunders-Hodge/ Nick Lento	FY18	FY20

Project Outputs: Science and Research Panel (SARP) Co-Chair (A11L.UAS.70) outputs delivered in FY22

- Final Report. Delivered 5/31/2022

Project: Safety Risks and Mitigations for UAS Operations On and Around Airports FY22 (A11L.UAS.72)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.72	Verified the potential risks with regards to UAS operations on and around airports to include potential changes to FAA regulations (such as 7110.65) and industrial standards.	Myron Gilmore/ Linda Chen/ Nick Lento	FY20	FY23

Project Outputs: Safety Risks and Mitigations for UAS Operations On and Around Airports FY22 (A11L.UAS.72) outputs delivered in FY22

- A set of FAA SMS based list of unmitigated hazards and mitigations. Describe the mitigation strategy. Expected delivery FY22 Q4
- An SMS panel report in a format similar to FAA SMS for each use case. Expected delivery FY22 Q4
- Report summarizing the flight tests. Expected delivery FY22 Q4

Project: Develop Risk-Based Training and Standards for Waiver Review and Issuance (A11L.UAS.73)

CA#	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. In order to properly proceed, the research starts with an assessment of potential uses and identifying the FAA's immediate needs. This allows for the rapid technological advances that are occurring in the UAS community. Following that initial step, the research necessary research will be prioritized. At the time of this writing, enabling BVLOS operations represent the most urgent need. Based on funding and updated needs as the research is executed, the prioritized tasks will be complete.	Sabrina Saunders-Hodge/ Nick Lento	FY18	FY20

Project Outputs: Develop Risk-Based Training and Standards for Waiver Review and Issuance (A11L.UAS.73) outputs delivered in FY22

- Task 3: Reporting. Write the final report that captures the findings of this research. Delivered 2/11/2022
- Task 5: Program Management and Completed Final Report. Delivered 2/11/2022

Project: Establish Pilot Proficiency Requirements (A11L.UAS.74)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.74	Report(s) describing recommended UAS crewmember training and certification requirements, and recommended UAS crewmember.	Sabrina Saunders-Hodge/ Nick Lento	FY18	FY20

Project Outputs: Establish Pilot Proficiency Requirements (A11L.UAS.74) outputs delivered in FY22

- An accepted report outlining the human factors limitations to monitoring multiple UAS, including the identification of potential hazards, mitigations, and controls for the mitigations. Expected delivery FY22 Q4
- A report providing model development, model representations, and model predicted results of human factors outcomes for a pilot manipulating controls for multiple sUAS. Expected delivery FY22 Q4

Project: Urban Air Mobility: Safety Standards, Aircraft Certification and Impact on Market Feasibility and Growth Potentials (A11L.UAS.76)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.76	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, UAM operations. The research will also assist the FAA in evaluating autonomous systems. In order to properly proceed, the research starts with an assessment of potential uses and identifying the FAA's immediate needs. This allows for the rapid technological advances that are occurring in the UAS community. Following the initial steps, the necessary research will be prioritized. At the time of this writing, enabling autonomous operations represent the most urgent need. Based on funding and updated needs as the research is executed, the prioritized tasks will be updated over time.	Saunders-Hodge/ Nick Lento	FY20	FY21

Project Outputs: Urban Air Mobility: Safety Standards, Aircraft Certification and Impact on Market Feasibility and Growth Potentials (A11L.UAS.76) outputs delivered in FY22

- Literature Review and Market Analysis: A detailed report outlining relevant research related to large UAS as well as identifying research related to transition (i.e., piloted to autonomous) and autonomous systems and operations. Delivered 1/10/2022
- Sponsor approved experiments and documentation of validated results. Delivered 3/30/2022
- Final Report. Expected Delivery FY23 Q2

Project: UAS Cyber Security and Safety (A11L.UAS.78)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.78	Identify and reduce cybersecurity risks agency wide and establish a UAS Cybersecurity Management process that will be practical and effective per area of responsibility aid in identifying, assessing, and mitigating UAS cybersecurity and safety gaps.	Paul Strande/ Nick Lento	FY22	FY22

Project Outputs: UAS Cyber Security and Safety (A11L.UAS.78) outputs delivered in FY22

- Create a guide or tool that will assist in delineating a practical process (utilizing the information specified in the Task 1 Literature Review above) to effectively manage UAS Cybersecurity and Safety holistically. The information in this guide or tool can be divided into operations, certification, and other subjects. Delivered 3/24/2022
- Considering the information learned in Task 1 and Task 2, create a UAS Cybersecurity and Safety Roadmap that will list as many vulnerabilities as possible that need to be addressed and rank highest risk accordingly. These can be categorized in areas related to such as FAA Cyber Infrastructure, UAS types or models, UAS supporting equipment like ground control stations and other devices utilizing plain language format. Delivered 3/24/2022

Project: Investigate and Identify the Key Differences Between Commercial Air Carrier Operations and Unmanned Transport Operations (A11L.UAS.83)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.83	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 likely large UAS operations in transporting passengers. The research will also assist the FAA in evaluating autonomous systems. In order to properly proceed, the research starts with an assessment of potential uses and identifying the FAA's immediate needs. This allows for the rapid technological advances that are occurring in the UAS community. Following that initial step, the necessary research will be prioritized. Based on funding and updated needs as the research is executed, the prioritized tasks will be complete.	Mike Lukacs/ Nick Lento	FY22	FY23

Project Outputs: Investigate and Identify the Key Differences Between Commercial Air Carrier Operations and Unmanned Transport Operations (A11L.UAS.83) outputs delivered in FY22

- Literature Review and Market Analysis: A detailed report outlining relevant research related to large UAS as well as identifying research related to transition (i.e., piloted to autonomous) and autonomous systems and operations. Delivered 1/10/2022
- Sponsor approved experiments and documentation of validated results. Delivered 3/30/2022

Project: From Manned Cargo to UAS Cargo Operations: Future Trends, Performance, Reliability, and Safety Characteristics towards integration into the NAS (A11L.UAS.84)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.84	This research will develop a framework for understanding and evaluating UAS commercial feasibility together with projected locational demand. Furthermore, an analytical framework detailing large UAS certification and explore the impact of autonomy on UAS with an emphasis on the cargo environment will be offered as well.	Mike Lukacs/ Nick Lento	FY22	FY23

Project Outputs: From Manned Cargo to UAS Cargo Operations: Future Trends, Performance, Reliability, and Safety Characteristics towards integration into the NAS (A11L.UAS.84) outputs delivered in FY22

- A detailed report outlining relevant research related to large UAS as well as identifying research related to autonomous systems and operations. Delivered 1/10/2022

Project: High-Bypass Turbofan UAS Engine Ingestion Test (A11L.UAS.85)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.85	Obtain a better understanding of the severity of a live engine ingestion event to estimate the extent of potential damage encountered in a typical incident/accident. Provide insight and recommendations to UAS Original Equipment Manufacturers (OEMs) on design and materials that most affect engine damage. Provide a clear understanding of potential interim engine component damage in a typical incident/accident. Inform prior engine ingestion modelling techniques, to aid in the longevity of the research findings. Inform FAA safety management system policies and the need to maintain safe separation between aircraft and small UAS. Create a verifiable and measurable risk assessment of a UAS ingestion by utilizing high-fidelity instrumentation and data collection processes.	Sabrina Saunders-Hodge/ Nick Lento	FY19	FY21

Project Outputs: High-Bypass Turbofan UAS Engine Ingestion Test (A11L.UAS.85) outputs delivered in FY22

- •UAS Launch Capability. Delivered 2/28/2022
- •Engine Controls and Interfaces, Engine Fabrication and Prep, Engine Interface Mechanical Design, Fan Blade Instrumentation, Test Execution, Test Setup. Expected FY22 Q4

Project: Mitigating Global Positioning Satellites (GPS) and Automatic Dependent Surveillance-Broadcast (ADS-B) risks for UAS (A11L.UAS.86)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.86	The results from this research will inform a variety of UAS standards. Some standards that may be informed by research outcomes to mitigate unvalidated GPS and ADS-B.	Sabrina Saunders-Hodge/ Nick Lento	FY20	FY22

Project Outputs: Mitigating Global Positioning Satellites (GPS) and Automatic Dependent Surveillance-Broadcast (ADS-B) risks for UAS (A11L.UAS.86) outputs delivered in FY22

- Literature Review and Risk Assessment: literature review and meta-analysis that identifies the potential safety and security risks of relying on GPS and ADS-B data used for UAS operations. Delivered 3/25/2022
- Identification of Potential Mitigations: Based on the risk assessment in Task 1, the performer will conduct a market survey of market solutions to mitigate loss of GPS and loss of ADS-B data. The performer will also conduct a market survey of market solutions to mitigate unvalidated GPS and unvalidated ADS-B In data. Expected FY22 Q4
- Planning the Testing and Demonstration of Mitigations: Prioritize the mitigations in Task 2 for further analysis based on those that show the most promise for reducing risks while remaining cost effective and implementable. Particular emphasis should be placed on prioritizing mitigations that support sUAS operations and could be tested in Task 4. Expected FY22 Q4

Project: Shielded UAS Operation - Detect and Avoid (DAA) (A11L.UAS.87)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.87	The results from this project will inform a variety of UAS standards. Some standards that may be informed by project outcomes and recommendations.	Sabrina Saunders-Hodge/ Nick Lento	FY20	FY22

Project Outputs: Shielded UAS Operations - Detect and Avoid (DAA) (A11L.UAS.87) outputs delivered in FY22

- A report that builds upon previous tasks to categorize different types of shielded operations. Delivered FY22 Q4

Project: Validation of Visual Operation Standards for sUAS (A11L.UAS.88)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.88	The sponsor intends to use the results of this research to support the development of visual observer and remote pilot training standards. The sponsor plans to share certain research findings with industry standards bodies. If appropriate, the research outcomes may also be used by other FAA offices to update Part 107 regulations. The research will provide the information necessary to make safety assessments on EVLOS operations and provide needed information to develop FAA UAS integration strategies, policies, and regulations.	Sabrina Saunders-Hodge/ Nick Lento	FY20	FY20

Project Outputs: Validation of Visual Operation Standards for sUAS (A11L.UAS.88) outputs delivered in FY22

- Test and Analysis Plan: development and execution of test plans that are guided by research findings from the literature review in Task 1. As part of this task, the research team will develop, review, and execute a test plan that seeks to answer key research questions. Delivered 6/13/2022
- Peer Reviewed Research Task Plan: The research team will update the Research Task Plan (RTP) based upon findings from the literature review in Task 1 and revise the project scope accordingly. The updated research task plan will reflect findings that steer goals/objectives of this research. Delivered 3/17/2022

Project: sUAS Mid-Air Collision (MAC) Likelihood (A11L.UAS.89)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.89	The research is intended to inform the FAA's understanding of MAC collision likelihoods risks. This information is intended to inform UAS safety case development and UAS standards. The research results may also be used to inform integration strategies, policies, and regulations. In order to properly proceed, the research starts with an assessment of potential uses of research results and identifies the FAA's immediate needs when developing simulation and analysis plans. A better understanding of the likelihood impacts is important for creating standards and understanding the limits UAS operations.	Sabrina Saunders-Hodge/ Nick Lento	FY20	FY23

Project Outputs: sUAS Mid-Air Collision (MAC) Likelihood (A11L.UAS.89) outputs delivered in FY22

- Unmitigated MAC Probability using MIT/LL datasets. Delivered 4/8/2022
- Unmitigated MAC Probability against different parts of manned aircraft. Delivered 6/17/2022
- Mitigated MAC Probability. Expected FY22 Q4
- sUAS Unmitigated Risk Assessment for GA and Commercial Aircraft. Expected FY22 Q4
- sUAS Mitigated MAC Risk Assessment. Expected FY22 Q4
- Comparative risk assessments with other aviation risks including bird strikes. Expected FY22 Q4

Project: sUAS Traffic Analysis (A11L.UAS.91)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.91	Reports, analysis findings, and recommendations useful for FAA UAS risk assessments, policy development, waiver guidance, and UAS standards development.	Michael Lukacs/ Dipasis Bhadra/ Nick Lento	FY19	FY24

Project Outputs: sUAS Traffic Analysis (A11L.UAS.91) outputs delivered in FY22

- Annotated Bibliography. Delivered 2/9/2022

Project: Design Guidance and Best Engineering Practices for Automated Systems (A11L.UAS.92)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.92	Information useful for refining FAA processes, UAS waiver assessments, UAS certification assessments, and information useful for UAS standards development.	Wes Ryan/ Jeremy Grogan/ Nick Lento	FY19	FY24

Project Outputs: Design Guidance and Best Engineering Practices for Automated Systems (A11L.UAS.92) outputs delivered in FY22

- Literature Review, Annotated Bibliography, and Identifying Risk. Expected FY22 Q4

Project: Advanced Materials Investigation - Composite Material Analysis for UAS (A11L.UAS.93)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.93	A comprehensive understanding of the materials in use, or proposed for future use, on UAS and AAM vehicles. Proposed updates (materials and material properties) to the composite materials handbook CMH-17 or other applicable guidance. An understanding of whether UAS and AAM vehicles use the same or different materials than traditional composites, whether they are used in unique ways (i.e., using a traditionally non-structural material in a structural application, or vice-versa), and an understanding of whether materials used in UAS and AAM applications require different characterization and property development that is different than traditional aircraft. Research findings shared with one or more applicable industry standards bodies.	Sabrina Saunders-Hodge/ Nick Lento	FY21	FY23

Project Outputs: Advanced Materials Investigation - Composite Material Analysis for UAS (A11L.UAS.93) outputs delivered in FY22

- Research Questions. Delivered 1/25/2022
- Literature Review. Delivered 4/1/2022
- Final Report. Expected FY22 Q4

Project: Evaluate UAS Electromagnetic Compatibility (EMC) (A11L.UAS.96)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.96	Briefings and proposed updates to industry standards. Criteria for FAA Decision Makers to use to assess risk when reviewing UAS waivers, developing UAS policy, and so forth.	Sabrina Saunders-Hodge/ Nick Lento	FY23	FY25

Project Outputs: Evaluate UAS Electromagnetic Compatibility (EMC) (A11L.UAS.96) outputs delivered in FY22

- Test Plans. Delivered 5/13/2022

Project Propose UAS Right-of-Way Rules for UAS Operations and Safety Recommendations (A11L.UAS.97)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.97	Useful criteria for FAA Decision Makers to use to assess UAS operations and their systems when reviewing waivers, creating certification criteria, creating policy, and working on proposed rulemaking. Briefings and proposed updates to industry standards.	Sabrina Saunders-Hodge/ Nick Lento	FY20	FY24

Project Outputs: Propose UAS Right-of-Way Rules for UAS Operations and Safety Recommendations (A11L.UAS.97) outputs delivered in FY22

- An approved report that provides a broad literature review on Right-of-Way Rules. Delivered 5/4/2022
- An approved and peer reviewed report containing a prioritized list of gaps in Right-of-Way Rules for UAS. Expected FY22 Q4

Project: Identify Flight Recorder Requirements for UAS Integration into the NAS (A11L.UAS.101)

CA#	Outcome	Project (Sponsor/ Performer)	First FY Funded	Last FY Funding
A11L.UAS.101	Reports and recommendations useful for FAA policy development, waiver guidance, and UAS standards development. It is expected that this information will be used to reassess and refine FAA policy with respect to shielded UAS operations.	Sabrina Saunders-Hodge/ Nick Lento	FY20	FY24

Project Outputs: Identify Flight Recorder Requirements for UAS Integration into the NAS (A11L.UAS.101) outputs delivered in FY22

- A comprehensive peer reviewed literature report that summarizes the current technologies, regulations, and industry standards for UAS. Expected FY22 Q3
- Peer reviewed report that assesses safety benefits, proposed data recorder requirements, and develops novel data recorder requirements that considers the variety of system constraints and operations for sUAS, medium sized UAS, large UAS, and UAM aircraft. Expected FY22 Q4

BLI Funding Profile: Unmanned Aircraft Systems Research (A11L)

Program Area Funding ($K unless noted) FAA Aviation Safety Research FY2022 REDAC Output Report	FY20 Total Actuals	FY20 Contract Actuals	FY21 Total Actuals	FY21 Contract Actuals	FY22 Total Actuals	FY22 Contract Actuals	FY23 Total Request	FY23 Contract Request	FY24 Contract Target
Aviation Performance & Planning									
Unmanned Aircraft Systems Research (A11L)	$24,035	$21,740	$24,035	$22,437	$22,077	$19,589	$15,000	$11,797	$17,657

Collaboration: Unmanned Aircraft Systems Research (A11L)

Collaboration/Partnerships	FAA William J, Hughes Technical Center, FAA Civil Aerospace Medical Institute, MITRE Center for Advanced Aviation System Development, DoT Volpe, Alliance for System Safety of UAS through Research Excellence: Center of Excellence, National Aeronautics and Space Administration, Interagency Partnerships (e.g., UAS Executive Committee), Industry Partnerships, International Partnerships, UAS Test Sites, Standards Organizations
Facilities	FAA Center of Excellence (COE) for UAS FAA Aviation Safety including: UAS Integration Office (AUS), Aviation Safety (AVS), Aircraft Certification (AIR), Small Airplane Directorate (ACE), Flight Standards (AFS)