Safety Enhancement SE 224.5 (R&D) Cargo – Hazardous Material Fires – Enhanced Fire Detection Systems	
Safety Enhancement Action:	Aviation community (government and industry) performs research, development, and certification of technologies that enhance flightcrew awareness of smoke, fire, fumes, and/or other fire effects within the cargo compartments.
Implementers: (Select all that apply)	☐ Air Carrier ☐ Industry Association ☐ Commercial Aviation Safety Team (CAST) ☐ Joint Implementation Measurement and Data Analysis Team (JIMDAT) ☒ Research Organization ☐ Labor Organization ☐ Manufacturer ☒ Regulator ☒ Other (specify) Standards Committee
Statement of Work:	To increase the time available for the flightcrew and/or fire mitigation systems to respond to a cargo fire involving hazardous materials, including lithium batteries, the aviation community (including manufacturers, operators, and regulatory agencies) should research, develop, and implement the following detection strategies: 1. Published standards and regulatory guidance regarding detection of smoke, fire, fumes, and other detrimental effects of a fire. 2. Fire detection systems that work in accordance with these published standards, including detection systems within unit load devices (ULD) or other containers as well as aircraft-based detection systems with capabilities exceeding those currently required by Title 14, Code of Federal Regulations (14 CFR) part 25. These detection systems should alert the flightcrew of the status and location of the fire within the cargo compartment. 3. Published research results for optimization of multi-criteria fire detection systems on aircraft that can detect fires (including lithium battery fires) in a more timely manner that is less prone to false alarms.
Total Financial Resources:	**Total: $12.6M** Output 1: $1.3M Output 2: $0.8M Output 3: $3.0M Output 4: $4.5M Output 5: $3.0M **FAA: $8.5M** **Industry: $4.1M**

<table>
<tr><td>Relation to Current Aviation Community Initiatives:</td><td></td></tr>
<tr><td>Performance Goal Indicators:</td><td>Not applicable – research and development (R&D).</td></tr>
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Output 1:		
Description:	Published documentation of the types and quantities of fire byproducts and associated hazards (such as noxious gas, burn rate, and explosive tendency) the flightcrew will need to be aware of to make educated decisions on the effectiveness of suppression actions and further safe flight of the aircraft.	
Lead Organization:	FAA Aircraft Certification Service (AIR)	
Supporting Organizations:	Industry standards committee	
Other Affected Organizations:		
Implementers: (Select all that apply)	☐ Air Carrier ☐ Industry Association ☐ Commercial Aviation Safety Team (CAST) ☐ Joint Implementation Measurement and Data Analysis Team (JIMDAT)	☐ Research Organization ☐ Labor Organization ☐ Manufacturer ☒ Regulator ☒ Other (specify) Standards Committee
Actions:	1. FAA AIR tasks a standards committee (such as SAE International; RTCA, Inc.; or ASTM International) to develop and publish material that defines the types and quantities of fire byproducts that the flightcrew will need to be aware of to make educated decisions on the effectiveness of suppression actions and further safe flight of the aircraft. This material should also define the manner in which fire information is relayed to the flightcrew. 2. FAA AIR tracks progress and reports status to JIMDAT and CAST.	
Financial Resources:	$1.3M (4 Full Time Equivalents (FTE) + $300K)	
Itemized Resources:	• Labor: 4 FTEs (2 FTEs per year for 2 years). • Overhead/Testing: $300K.	
Output Notes:		
Timeline:	24 months from CAST approval.	
Target Completion Date:	12/31/2018. Closed 02/06/2019 based on June 2016 publication of DOT/FAA/TC–16/37, Summary of FAA Studies Related to the Hazards Produced by Lithium Cells in Thermal Runaway in Aircraft Cargo Compartments.	

Output 2:		
Description:	Published research results on fire detection and alerting systems installed within cargo containers, including collapsible containers and containers with rain covers, that provide timely alerting to the flightcrew.	
Lead Organization:	FAA Aircraft Certification Service (AIR)	
Supporting Organizations:	FAA Technical Center Air carriers ULD manufacturers Air carriers	
Other Affected Organizations:		
Implementers: (Select all that apply)	☐ Air Carrier ☐ Industry Association ☐ Commercial Aviation Safety Team (CAST) ☐ Joint Implementation Measurement and Data Analysis Team (JIMDAT)	☒ Research Organization ☐ Labor Organization ☐ Manufacturer ☒ Regulator ☐ Other (specify)
Actions:	1. Using the information developed in Output 1, FAA AIR, in conjunction with the FAA Technical Center, manufacturers of cargo ULDs, and air carriers, sponsors research on fire detection systems contained within a ULD. This research should— a. Review systems that will provide real-time information to the flightcrew on the status and location of the fire inside the cargo compartment, which will allow the flightcrew to determine suppression effectiveness. b. Consider equipment/software that can be installed in current production, in-development, and out-of-production airplane programs. 2. FAA Technical Center performs research and publishes results of the studies in publicly available reports. 3. FAA AIR tracks progress and reports status to CAST.	
Financial Resources:	$825K (2.5 FTEs + $200K)	
Itemized Resources:	• Labor: 2.5 FTEs (1 FTE per year for 2.5 years). • Overhead/Testing: $200K.	

Output Notes:	1. Detection system to be at least as sensitive as current aircraft detection system. 2. Some development has already occurred, therefore development and standards generation (Output 1) will progress simultaneously. 3. Development of system does not include cost or time for aircraft certification.
Timeline:	30 months from end of Output 1.
Target Completion Date:	Due date extended from 6/30/2023 to 05/31/2024.

Output 3:		
Description:	Published research results on fire detection and alerting systems that can be installed within the aircraft and can detect fires within a container, on a pallet (with or without a fire containment cover (FCC)), or in a bulk load, and provide timely alerting to the flightcrew.	
Lead Organization:	FAA Aircraft Certification Service (AIR)	
Supporting Organizations:	FAA Technical Center Aircraft manufacturers Air carriers	
Other Affected Organizations:		
Implementers: (Select all that apply)	☐ Air Carrier ☐ Industry Association ☐ Commercial Aviation Safety Team (CAST) ☐ Joint Implementation Measurement and Data Analysis Team (JIMDAT)	☒ Research Organization ☐ Labor Organization ☐ Manufacturer ☒ Regulator ☐ Other (specify)
Actions:	1. Using the information developed in Output 1, FAA AIR, in conjunction with the FAA Technical Center, airplane manufacturers, parts suppliers, and air carriers, sponsors research on fire detection systems installed in airplane cargo compartments that are responsive to hazardous materials fires. This research should— a. Review systems that will provide real-time information to the flightcrew on the status and location of the fire inside the cargo compartment to determine suppression effectiveness. b. Consider equipment/software that can be installed in current production, in-development, and out-of-production airplane programs. 2. FAA Technical Center performs research and publishes results of the studies in publicly available reports. 3. FAA AIR tracks progress and reports status to CAST.	
Financial Resources:	$2.95M (10 FTEs + $450K)	
Itemized Resources:	• Labor: 10 FTEs (2 FTEs per year for 5 years). • Overhead/Testing: $450K.	

Output Notes:	1. Detection system to be at least as sensitive as current aircraft detection system. 2. Some development has already occurred, therefore development and standards generation will progress simultaneously. 3. Standards will be similar to those generated in Output 1 and Output 2. 4. Development of system does not include cost or time for aircraft certification.
Timeline:	60 months from end of Output 1. • 18 months to develop standards. • 42 months to research and develop system.
Target Completion Date:	Output 3a: 6/30/2020 to develop standards. Output 3b: 12/31/2023 to research and develop system. Due date extended from 12/31/2023 to 12/31/2026.

Output 4:		
Description:	Published research results on optimization of a multi-criteria fire detection system on aircraft that can detect fires (including lithium battery fires) in a more timely manner than existing state of the art and that are less (no more) prone to false alarms.	
Lead Organization:	FAA Aircraft Certification Service (AIR)	
Supporting Organizations:	FAA Technical Center Aircraft manufacturers Air carriers	
Implementers: (Select all that apply)	☐ Air Carrier ☐ Industry Association ☐ Commercial Aviation Safety Team (CAST) ☐ Joint Implementation Measurement and Data Analysis Team (JIMDAT)	☒ Research Organization ☐ Labor Organization ☐ Manufacturer ☒ Regulator ☐ Other (specify) _____
Actions:	1. FAA AIR, in conjunction with the FAA Technical Center, airplane manufacturers, parts suppliers, and air carriers, sponsors research to develop methods to optimize multi-criteria fire detection systems on aircraft that can detect fires (including lithium battery fires) in a more timely manner and are less prone to false alarms. The research should consider the effects of the following on the detection system's vulnerability to false alarms: a. Gases, b. Infrared, c. Heat, and d. Particles. 2. Air carriers provide research organizations access to operational expertise that can help improve effectiveness and feasibility of detection methods. 3. FAA Technical Center performs research and publishes results of the studies in publicly available reports. 4. FAA AIR tracks progress and reports status to CAST.	
Financial Resources:	$4.5M (14 FTEs + $1M)	
Itemized Resources:	• Labor: o 6 FTEs to develop standards (3 FTEs per year for 2 years). o 8 FTEs to develop systems (1 FTE per year for 2 years for 4 original equipment manufacturers (OEM)). • Overhead/Testing: $1M.	

Output Notes:	Development of system does not include cost or time for aircraft certification.
Timeline:	54 months from CAST approval. • 24 months for generating standard. • 30 months for developing detector system.
Target Completion Date:	Output 4a: 12/31/2018 for generating standard. Output 4b: 06/30/2021 for developing detector system. Due date extended from 06/30/2021 to 06/30/2026.

Output 5:		
Description:	Published research results characterizing the fire hazard associated with different battery chemistries (types), sizes, state of charge, and quantities, to include but not limited to temperature and flammable gas generation.	
Lead Organization:	FAA Aircraft Certification Service (AIR)	
Supporting Organizations:	FAA Technical Center	
Other Affected Organizations:		
Implementers: (Select all that apply)	☐ Air Carrier ☐ Industry Association ☐ Commercial Aviation Safety Team (CAST) ☐ Joint Implementation Measurement and Data Analysis Team (JIMDAT)	☒ Research Organization ☐ Labor Organization ☐ Manufacturer ☒ Regulator ☐ Other (specify) _____
Actions:	1. FAA AIR sponsors and conducts research to characterize the fire hazard associated with different battery chemistries (types), sizes, state of charge, and quantities to include but not limited to temperature and flammable gas generation. 2. FAA Technical Center (or other research facility) performs sponsored research and documents results in publicly available reports. 3. FAA AIR reports progress to CAST and JIMDAT.	
Financial Resources:	$3M (2.5 FTEs + $500K)	
Itemized Resources:	• Labor: 2.5 FTEs (0.5 FTE per year for 5 years). • Overhead/Testing: $500K ($100K per year for 5 years).	
Output Notes:	New battery types and chemistries are being introduced into the market on an annual basis.	
Timeline:	60 months from CAST approval.	
Target Completion Date:	12/31/2021. Closed 10/07/2021 based on completion of several FAA Technical Center reports, including TC–TN15/17, TC–15/40, TC–TN16/22, TC–16/37, TC–TN16/34, TC–15/59, TC–16/17, and TC–TT16/55.	

Reference Material	
Supporting CAST Intervention Strategies	IS1500: Manufacturers should develop and operators should implement a fire detection system within the container that can provide timely alerting to the flight crew. IS1501: Manufactures should develop and operators should implement fire detection systems on aircraft that can detect fires within a container and can provide timely alerting to the flight crew. IS1500B1: Manufacturers should develop and operators should implement a fire detection system capable of detecting fires within collapsible containers and containers with rain covers. IS1525: Manufacturers, operators, and regulators: Develop/implement an aircraft system that provides to the crew continuous real-time additional information on the environmental conditions (e.g., temperature and suppression effectiveness) inside the cargo compartment following the occurrence of a cargo-fire (e.g., trend monitoring and thermal imaging cameras). IS1502: Install state-of-the-art fire detection systems architecture (e.g., multi-criteria) in all aircraft cargo compartments. IS1500B2: Manufacturers should develop and operators should implement a fire detection system within the container that can provide timely alerting and position information to the flight crew.