Investigative Technologies

Aviation Rulemaking Committee

Interim Report

January 22, 2025

I. Background

The Federal Aviation Administration (FAA) established the Investigative Technologies Aviation Rulemaking Committee (ARC) on June 7, 2023, to facilitate collaboration and informed decision-making in the aviation industry concerning investigative technologies.[1] The ARC's principal focus was to develop recommendations to implement and effectively regulate investigative technology systems. The ARC was also charged with developing recommendations to support the FAA's response to numerous National Transportation Safety Board (NTSB) Safety Recommendations regarding cockpit image recorders (CIRs), safety management systems (SMS), and flight data monitoring (FDM). On September 21, 2023, the FAA amended the ARC's Charter to include cockpit alerting technologies for improved runway safety.[2] This amendment was based on recommendations from the Commercial Aviation Safety Team Approach and Landing Misalignment Joint Safety Analysis and Implementation Team.[3] The FAA amended the Charter again on Dec. 12, 2024,[4] to address several provisions in the FAA Reauthorization Act of 2024 (Pub. L. 118-63), including sections 333, 352, and 366.[5] The ARC prepared this interim report in response to the Charter's requirement that the ARC submit an interim recommendation report within 16 months of the first meeting of the ARC after the Charter's effective date.

II. ARC Charter – Tasks and Objectives

The FAA chartered the ARC to provide the agency with recommendations on various technologies to improve the collection and recovery of flight data, flightdeck voice and images, and more precise methods to track and locate aircraft in distress.

The ARC is in the process of developing recommendations on the following topics:

- International harmonization and International Civil Aviation Organization (ICAO) standards.
- Improvements to safety, impact on the flying public, and economic viability of recommendations regarding investigative technology systems.
- Maintenance, periodic testing, and validation of investigative technology systems.
- Pending minimum operational performance standards (MOPS) for additional mandatory flight data recorder (FDR) parameters.
- NTSB Safety Recommendations regarding recovery of flight data without underwater search, for example, automatic deployable flight recorders (ADFRs), CIRs, and cockpit voice recorder/flight data recorder (CVR/FDR) equipment on aircraft, or offloading data via communications systems prior to impact.
- Consideration of specific recording equipment installation for certain aircraft and for specified operations.
- Regulatory amendments, cost-benefit analyses, comprehensive guidance material, and advisory circulars for flight data recovery methods and related investigative technologies.

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[1] Investigative Technologies Aviation Rulemaking Committee Charter (June 7, 2023).
[2] Investigative Technologies Aviation Rulemaking Committee Amended Charter (Sept. 21, 2023).
[3] General Distribution ALM JSAIT Final Report.pdf (cast-safety.org).
[4] Investigative Technologies Aviation Rulemaking Committee Amended Charter (Dec. 12, 2024).
[5] Pub. L. 118-36.

Much of the ARC's work occurred prior to the December 12, 2024, amendments to the Charter. The ARC is considering the amended taskings as it continues to develop its analyses and recommendations and will address them in the final report.

III. Challenges

The ARC notes several challenges associated with the acquisition and implementation of recording systems.

A. Data Recording Accessibility

Many light aircraft types lack appropriate recording hardware options or a supplemental type certificate (STC) to install CIR/FDRs on aircraft. This also applies to other recorder technologies that either are in development or have limited options available.

B. Cost

Cost is a major factor for light aircraft operators, affecting both the acquisition of data recording hardware as well as the usability of the data. Hardware can range from $3,000 for a light data recording unit to $60,000 for an FDR. Additionally, adopting an FDM program can increase expenses, such as costs associated with software, data readout tools, analysis services, or a dedicated employee to manage the program. When considering the cost impact on larger aircraft and operators, consideration needs to be given to supply chain, availability of components, and installation/maintenance requirements, particularly for older aircraft. These costs can increase drastically for larger fleets.

C. Crash-Hardened/Crashworthy Technologies

EUROCAE ED-112 or ED-155 recorders have not typically been applicable to the U.S. light aircraft market. General research from the NTSB suggests that standards for accident survivability may not need to be a requirement for the light aircraft market. Numerous accident reports discuss post-accident data recovery and usability from devices that are not crash-hardened for high energy accidents.

D. Data Usability, Privacy, Misuse, Protection, and Reliability

Usability refers to the accessibility and usability of flight data. Reliability refers to the levels of data quality and accuracy a recording device provides. Across aircraft types, there are numerous variations of these data aspects. Optimally, data should be easy to download or transmit, made interpretable with the help of the original equipment manufacturer (OEM) or recorder hardware provider, and maintained to the highest degree of quality possible. Data obtained via any recording device must be private and protected from misuse by any company or governing authority. Previous incidents prove that this is a clear cybersecurity threat to investigational integrity.

E. Operator Necessity

Although requirements vary based on the scope of the operation on the need for data recorders associated with FDM programs in the U.S., recent trends have made more operators aware that flight data analysis is beneficial. Part 121 operators have incorporated this into their safety programs; however, few Part 135 operators are actively or continuously monitoring data. Aviation safety professionals generally agree that FDM programs are beneficial for safety, though overall adoption at smaller operators has been slow. At the operator level, challenges in administrative work and data analysis can sometimes stand in the way of FDM program adoption.

IV. ARC Progress on Charter Taskings

The table below shows the status of each tasking listed under Section 4 of the September 21, 2023, ARC Charter. As of November 15, 2024, the ARC's analysis is in progress and all topics are on schedule to meet the ARC deadline. The charter was amended with additional tasking on December 12, 2024. While some of these changes due to the FAA Reauthorization Act were anticipated and discussed, others will need to be further analyzed by the ARC.

Paragraph in Charter	Topic	Notes on Research and Draft Recommendations for Each Tasking
4.a	International harmonization and ICAO standards	Incorporated Into Other Topics
4.b	Recommendations based on improvements to safety, impact to the flying public, and economic vitality	Incorporated Into Other Topics
4.c	Recommendations for maintenance, periodic testing, and validation of investigative technology systems	Incorporated Into Other Topics
4.d	Pending minimum operational performance standards (MOPS) for additional mandatory FDR parameters	The ARC is considering recommendations: • regarding harmonization on EUROCAE ED-112, taking into account adoption by ICAO and state/national authorities, as well as time and cost considerations, and • addressing existing airplane model series if the FAA elects to adopt ICAO Standards and Recommended Practices (SARPs) requirements for newly manufactured airplanes.
4.e.i	Whether to require turbine-powered aircraft not equipped with an FDR or CVR to be equipped with a crash-resistant flight recorder system (NTSB A-13-12 and A-13-13)	The ARC is considering requirements for Part 135 operators to have CIR and flight data. However, the ARC believes crash-resistant requirements need to be reduced, as many light helicopters do not have STCed FDRs.
4.e.ii	Whether to require aircraft used in extended overwater operations to be equipped with a tamper-resistant method to broadcast information establishing the location of an aircraft within 6	Analysis and recommendations are in process.

Paragraph in Charter	Topic	Notes on Research and Draft Recommendations for Each Tasking
	nautical miles of point of impact (NTSB A-15-1)	
4.e.iii	Whether to require aircraft used in extended overwater operations to be equipped with a low-frequency underwater locating device (LF-ULD) that will function for at least 90 days (NTSB A-15-2)	The ARC supports the use of LF-ULD to enhance the ability to locate underwater aircraft wreckage in a timely manner and harmonize with existing international rules. Recommendations are being considered to suggest changes to 14 CFR Part 25, Subpart K, and 14 CFR Part 135, Subpart C, with language addressing: • Extended operation over water • Effectivity date • Applicable aircraft maximum takeoff weight (MTOW) • Applicable Technical Standard Order (TSO) standards
4.e.iv	Whether to require newly manufactured aircraft used in extended overwater operations to be equipped with a means to recover mandatory flight data parameters that does not require underwater retrieval (NTSB A-15-3)	Analysis on the ability of airframers, OEMs, operators, STC holders, and U.S. government implementation strategies is ongoing. The ARC will create a framework for recommendations based on further analysis.
4.e.v	How to coordinate with international regulatory authorities and ICAO to harmonize the implementation of requirements specified in A-15-1 and A-15-3 (NTSB A-15-4)	Analysis and recommendations are in process. The ARC believes ICAO harmonization will be addressed in alignment with recommendations for taskings in 4.e.ii, 4.e.iii, and 4.e.iv.
4.e.vi	Whether to require newly manufactured and existing aircraft to be equipped with a crash-protected CIR (NTSB A-15-7 and A-15-8)	The ARC considered the investigative value of CIRs when those recordings supplement several other available data sources for the investigation. The ARC is formulating recommendations that the FAA address: • Privacy and data misuse concerns prior to implementing requirements for any CIR technology. • How the CIR data would be handled for any events outside of the United States, particularly in states that may lack a Just Safety culture and respect for the privacy of the crew members. • The presence of laws, guidelines, and provisions to protect CIR data from being used in anything other than the investigation of an accident such as a criminal or disciplinary investigation.
4.e.vii	Whether to require Part 135 operators to install	The ARC is formulating recommendations that:

Paragraph in Charter	Topic	Notes on Research and Draft Recommendations for Each Tasking
	flight data recording devices capable of supporting a flight data monitoring program (NTSB A-16-34)	• Are based on a preference for performance-based rules over equipage mandates, with overall risk reduction the highest priority and design driver. • Consider installation complexity and ensure a low barrier to comply, taking into account that EUROCAE ED-155 compliant recorders already offer an essential balance of lightweight design and cost-effectiveness for smaller aircraft. • Weigh the benefits of enhanced crash survivability and investigation support with an ED-155 system against the proactive safety and operational advantages of an FDM-based solution. • Provide for easier acceptance to Flight Operational Quality Assurance (FOQA) programs. • Encourage manufacturers, owners, and operators to understand the benefits of industry-wide recovery of flight data to improve the economic viability of their own organizations, rather than another onerous hurdle to overcome.
4.e.viii	Whether to require Part 135 operators to establish a structured flight data monitoring program (NTSB A-16-35)	The ARC notes that, although FDM systems enhance safety and operational efficiency, they also impose substantial burdens on Part 135 operators. These burdens include significant financial costs, operational challenges related to data management and system integration, and complex administrative requirements for regulatory compliance and effective safety management. A potential FDM mandate should consider: • Operator fleet size, age, and aircraft commonality. • The extent of small operator management and IT systems. • The use of alternative technology to transmit data (cellular). • Giving operators additional time to design SMS with FDM in mind. • Voluntary participation with incentives. • Adding provisions for easier acceptance to FOQA programs.
4.e.ix	Whether to require the retrofitting of CVRs on all airplanes required to carry both a CVR and FDR with a 25-hour CVR (NTSB A-18-31)	The ARC has assessed the impact of the FAA reauthorization mandates and is formulating recommendations on achievable timeframes. The ARC is formulating recommendations regarding retrofitting that address the cost, aircraft useful life, harmonization with international standards, and impact on supply chain and equipment availability.
4.e.x	Whether to require manufacturers of newly manufactured turbine-powered helicopters without an FDR and CVR to install a crash-	The ARC is considering the adoption of flight recorders and CIRs on newly manufactured turbine helicopters. The ARC is formulating recommendations for a method that penetrates most of the market with a tiered approach to make the implementation more attractive to more manufacturers while recognizing that a more robust, comprehensive solution is necessary at the higher end of the market.

Paragraph in Charter	Topic	Notes on Research and Draft Recommendations for Each Tasking
	resistant flight recorder system (NTSB A-20-27)	
4.e.xi	Whether to require manufacturers of newly manufactured turbine-powered helicopters equipped with an FDR and CVR to install a crash-protected CIR system (NTSB A-20-28)	The ARC is formulating recommendations that take a nuanced approach to the certification requirements of this safety equipment to ensure industry maximizes benefits while acknowledging the potential significant cost and operational burdens associated with existing crash-resistant CIR technology. Crash-protected flight recorders should be consistently identified throughout the regulatory material in accordance with ICAO Annex 6: Operation of Aircraft, 6.3: Flight Recorders as follows: • a flight data recorder (FDR), • a cockpit voice recorder (CVR), • an airborne image recorder (AIR), • a data link recorder (DLR). Lightweight flight recorders should be defined in accordance with ED-155, which defines the minimum specification to be met for aircraft required to carry lightweight flight recording systems. Lightweight flight recorders should be consistently identified throughout the regulatory material in accordance with ICAO Annex 6: Operation of Aircraft, 6.3: Flight Recorders as follows: • an aircraft data recording system (ADRS), • a cockpit audio recording system (CARS), • an airborne image recording system (AIRS), • a data link recording system (DLRS). Detailed requirements for each flight recorder system should be consistent with ICAO Annex 6: Operation of Aircraft, Appendix 8: Flight Recorders. Applicability of aircraft affected by the tiered regulation should be determined by year of certification, certification category (transport, normal, utility, acrobatic, limited, restricted, or provisional), operational segment (14 CFR parts 91, 121, and 135), aircraft size, weight, and/or passenger capacity.
4.e.xii	Whether to require manufacturers of existing turbine-powered helicopters without an FDR or CVR to provide a means to install a crash-resistant flight recorder system (NTSB A-20-29)	The ARC is considering recommendations for requiring these owner/operators to install a crash-resistant flight recorder system while allowing flexibility and avoiding potential burdens of requiring OEM to provide means of installation.
4.e.xiii	Whether to require existing turbine-powered helicopters equipped with FDR and	The ARC is considering recommendations for requiring these owner/operators to install a crash-resistant flight recorder system while allowing flexibility and avoiding potential burdens of requiring OEM to provide means of installation.

Paragraph in Charter	Topic	Notes on Research and Draft Recommendations for Each Tasking
	CVR to install a crash-protected CIR system compliant with C176a or equivalent (NTSB A-20-30)	
4.e.xiv	Whether to require newly manufactured turbine-powered helicopters to be equipped with CIRs compliant with TSO-C176a (NTSB A-20-028)	The ARC found that recommendations should be revised, and amendments should be added in related advisory circulars and guides outlining proper installation, usage, and constraints of CIR systems. These updates must cover integration, compatibility, and maintenance concerns with helicopter operations. Manufacturers should be given two years from the rule's implementation to comply and equip new turbine helicopters with CIRs meeting TSO-C176a standards. The ARC is formulating recommendations for the FAA to revise regulations 14 CFR Part 27 and Part 29 to require CIR equipment for new turbine-powered helicopters, adhering to the minimum performance standard (MPS) of TSO-C176a.
4.f	Whether to allow the use of ADFRs that may currently be contrary to rule	Analysis and recommendations are in process
4.g	Alternate approaches for promoting voluntary installations of FDRs, CVRs, and CIRs for aircraft and operations where they may not be a mandatory installation requirement	Incorporated Into Other Topics
4.h	Draft advisory circular language and a strategy, process, and schedule for the implementation of new or revised criteria	Incorporated Into Other Topics
4.i	Updated guidance material, notices, handbooks, and other relevant material for investigative technologies	Incorporated Into Other Topics
4.j	Updated guidance material, notices, and handbooks and other relevant material on how FDRs, CVRs, and CIRs can be integrated	Incorporated Into Other Topics

Paragraph in Charter	Topic	Notes on Research and Draft Recommendations for Each Tasking
	into a voluntary or required SMS program	
4.k	How to require cockpit alerting technologies designed to reduce runway safety events	Concluded, report available at https://www.faa.gov/regulationspolicies/rulemaking/committees/documents/investigative-technologies-aviation-1
4.l	For any recommendation to change regulatory requirements, provide quantitative benefit and cost estimates, qualitative benefit-cost description, and compliance trade-offs	Incorporated Into Other Topics
Not in Charter	Privacy issues	The ARC is developing a set of additional recommendations to the FAA with the goal of improving the just and non-punitive safety culture on which investigations rely by strengthening protections for personally identifiable information.

V. Appendices

Appendix A – Acronyms

Acronyms	
ADFR	Automatic Deployable Flight Recorder
ADRS	Aircraft Data Recording System
AIR	Airborne Image Recorder
AIRS	Airborne Image Recording System
ARC	Aviation Rulemaking Committee
CARS	Cockpit Audio Recording System
CIR	Cockpit Image Recorder
CVR	Cockpit Voice Recorder
DFDR	Digital Flight Data Recorder
FAA	Federal Aviation Administration
DLR	Data Link Recorder
DLRS	Data Link Recording System
FDM	Flight Data Monitoring
FDR	Flight Data Recorder
FOQA	Flight Operational Quality Assurance
ICAO	International Civil Aviation Organization
LF-ULD	Low-Frequency Underwater Locating Device
MOPS	Minimum Operational Performance Standards
MPS	Minimum Performance Standard
MTOW	Maximum Takeoff Weight
NTSB	National Transportation Safety Board
OEM	Original Equipment Manufacturer
SARPs	Standards and Recommended Practices
SMS	Safety Management System
STC	Supplemental Type Certificate
TSO	Technical Standard Order

Appendix B – ARC Participants as of Nov. 15, 2024

FAA & Industry Co-Chairs	Organization
Charisse Green	FAA
Robert Ireland	Airlines for America
Jeff Mee	Air Line Pilots Association
Voting Members	**Organization**
Seth Buttner	Airbus
Lauren Beyer	Cargo Air
Doug Carr	National Business Aviation Association
Maryanne DeMarco	Coalition of Airline Pilots Associations
Jens Hennig	General Aviation Manufacturers Association
Chris Hill	Vertical Aviation International
Murray Huling	Aircraft Owners and Pilots Association
Chad Kirk	Aerospace Industries Association
Takeo Kuraishi	Boeing
George Paul	National Air Carrier Association
Ric Peri	Aircraft Electronics Association
Erik Strickland	Regional Airline Association
HRT Subgroup Members	**Organization**
Thomas Pack (Chair)	ACR Electronics
Andrew Averna	JetBlue Airways
Tanya Boisseranc	Boeing
Kara Charles	Boeing
Robert Fujimoto	Hawaiian Airlines
Russ Gossman	UPS Airlines
Hannes Griebel	EUROCAE
Mitch Hanson	Allied Pilots Association
Chris Heck	Air Line Pilots Association
Kevin Heffernan	Delta Air Lines
Kira Hein	Boeing
Craig Hildebrandt	Airbus
Jacob Hillery	JetBlue Airways
Jennifer Holder	Boeing
Chad Kirk	Aerospace Industries Association
Sven Knoop	Airbus
Takeo Kuraishi	Boeing
Matt Langridge	Gulfstream
Stuart Lau	Independent Pilots Association

Ted McFann	FedEx
Greg Moran	Boeing
Jeff Perin	Air Line Pilots Association
Justin Pinkerton	Air Line Pilots Association
Chris Sidor	Air Line Pilots Association
Erik Strickland	Regional Airline Association
Robert Swanson	FedEx
Luke Tschacher	Boeing
Blake Van den Heuvel	Leonardo DRS
Peter Walther	Airbus
Brighton Wang	Hawaiian Airlines
Mike Wickboldt	Air Line Pilots Association
Casey York	Boeing
Jacob Zeiger	Boeing
Rotorcraft Subgroup Members	**Organization**
Jeff Currin (Chair)	Truth Data
Seth Buttner	Airbus Helicopter
Brandon Carpenter	Metro Aviation
Jay Eller	Honeywell
Chris Hill	Vertical Aviation
Jose Jaramillo	Chevron
Alan Love	Bell Flight
Brody Paine	LifeFlight Network
Dan Shapiro	Sikorsky
David Shear	Robinson
Chad VerBerkmoes	Air Methods Corp.
Observers and Contractors	**Organization**
Joe Sedor	NTSB
Becca Fribush	FAA Contractor/The Regulatory Group
Puja Sardana	FAA Contractor/The Regulatory Group