International Civil Aviation Organization

MIDANPIRG/22 & RASG-MID/12 Meetings

(Doha, Qatar, 4 – 8 May 2025)

Agenda Item 4.2: Outcomes of the MENA ARCM / AIIG Meeting

CONTINUED OPERATIONAL SAFETY THROUGH EFFECTIVE ACCIDENT AND INCIDENT INVESTIGATION

(Presented by United States)

SUMMARY

This paper highlights the accident and incident investigation functions of the United States (U.S.) Federal Aviation Administration (FAA), which are focused on ensuring continued operational safety of products and describes how these functions relate to the investigations of the U.S. National Transportation Safety Board (NTSB). It outlines the FAA accident investigation process, how safety intelligence is shared, and how new technologies are utilized to investigate accident precursors and produce corrective actions to prevent undesirable events. The paper concludes by describing current and future global challenges for accident investigation.

Action by the meeting is at paragraph 3.1

REFERENCES

- Annex 13 – Aircraft Accident & Incident Investigation, Chapter 3 – General; Chapter 5 –Investigation.
- Annex 19 – Safety Management, Chapter 5 – Safety data and safety information collection, analysis, protection, sharing and exchange.
- The Independent Safety Board Act of 1974 – General Authority. (U.S. Law)

1. INTRODUCTION

1.1 Accident investigation is a crucial component of an effective safety management system. It facilitates identification of root causes to prevent future accidents, and improve aviation safety by analysing data, making recommendations, and promoting a culture of safety.

1.2 The FAA's Office of Accident Investigation and Prevention is delegated authority within the FAA's Aviation Safety (AVS) organization to be the primary liaison to the U.S. National Transportation Safety Board (NTSB) and maintains a team of accident investigators for this function. These investigators participate in accident investigations with the NTSB and share information with safety specialists at the FAA to prevent accidents by harnessing advanced safety data analytics. This is an important component of the U.S. State Safety Program (SSP) which uses safety management principles and active engagement with the aviation community to foster the adoption of voluntary safety enhancements.

2. DISCUSSION

2.1 Aviation remains the safest form of transportation in the United States. Nonetheless, aviation remains an industry of high consequence, so continuous improvement and learning are required to maintain that record. The FAA continuously explores new ways to uncover latent risk in the system before an incident or accident occurs by fostering a safety culture that prioritizes safety and creating an environment for the sharing of lessons learned.

2.2 Once an incident or accident occurs, the FAA is committed to learning what went wrong, why it went wrong, and how to prevent it from happening again. Understanding what went wrong requires the forensic expertise of accident investigators from the FAA, industry, and the NTSB, which is the U.S. independent accident investigation authority responsible for determining probable cause.

2.3 The FAA ensures continued operational safety by working alongside the NTSB in these investigations. This allows the FAA to have real-time insight to any findings uncovered during the course of an investigation, so that changes can be immediately implemented to protect the national airspace system. This allows the FAA to take steps to address risk before the final accident investigation report is released by the NTSB.

2.4 FAA investigators are hired for their aviation expertise, then are certificated by the U.S. Transportation Safety Institute after completing training in technical, human factors, and occupational safety courses. The FAA accident and incident investigation team includes specialists with backgrounds in investigation, air traffic control, turbine engines, drones, commercial space operations, flight data analysis, and event reconstruction.

2.5 To ensure the constant flow of information between the FAA and the NTSB, the FAA prepares a written responses to each NTSB safety recommendation within 90 days of receipt. In order to proactively manage safety, the FAA also acts upon safety recommendations received from within the FAA workforce, as well as those submitted by foreign civil aviation authorities.

2.6 The FAA receives notification of an incident or accident from the Washington Operations Center (WOC). The WOC provides 24-hour monitoring of the National Airspace System (NAS), collects and disseminates information, and serves as a central hub for emergency activities. The WOC becomes aware of accidents from numerous sources such as air traffic control facilities, first responders, and media sources. The FAA ensures that there is an employee on duty 24-hours a day to receive notification and initiate an investigation as needed. In addition to the full-time accident investigation team, the FAA leverages its aviation safety inspectors in field offices across the United States. These safety inspectors administer and enforce safety standards for operations and maintenance and receive training enabling them to also perform accident investigations. The additional workforce and geographic proximity afforded by the FAA's regional offices enables the FAA to investigate every single accident that occurs in the United States.

2.7 Every weekday morning, the FAA holds a meeting to share details of recent accidents and incidents and provides a forum for discussions between FAA leadership and accident investigators. This meeting allows the investigator on duty for the previous 24 hours to brief events that have occurred during their watch. The briefing covers aviation accidents, incidents, and events such as bird-strikes, turbulence encounters, off-airfield landings, ground collisions, commercial space transportation events; air traffic operational incidents such as losses-of-separation between aircraft; and other events of interest.

2.8 This meeting is attended by 30-50 members across FAA, including individuals

responsible for Aircraft Certification, Aerospace Medicine, Flight Standards, Rulemaking, Safety Management, Safety Assurance, Safety Promotion, Air Traffic Oversight and Air Navigation Services. Following the meeting, key personnel with investigative functions meet with a more targeted audience to discuss sensitive aspects of ongoing investigations, such as medical factors of aircrew involved in fatal accidents, as well as possible urgent actions that require an immediate response and may impact aerospace industry operations.

2.9 As noted earlier, each State organizes the roles and responsibilities of their accident investigation organizations differently. In the United States, the NTSB investigates to establish the facts, circumstances, and cause or probable cause of an aircraft accident.

2.10 The FAA has a dual role. In addition to participating as a permanent party member to NTSB investigations, the FAA performs a targeted investigation to ensure the continued operational safety of the NAS. The FAA has the statutory authority to enact immediate changes or take corrective actions to prevent recurrence of an accident/ incident.

2.11 The FAA has a statutory obligation to be involved in all NTSB investigations, but whereas the NTSB seeks probable causes to accidents, the FAA focuses on nine specific areas during investigations in order to ensure continued operational safety: (1) performance or functions of FAA facilities, (2) performance of non-FAA owned air traffic control facilities or navigational aids, (3) airworthiness of FAA certificated aircraft, (4) competency of FAA certificated airmen, air agencies or air operators, (5) adequacy of federal aviation regulations, (6) airport certification standards or operations, (7) security standards or operations including hazardous materials, (8) airmen medical qualifications, and (9) violation of the federal aviation regulations.

2.12 Most importantly, if during an investigation the FAA determines safety actions must be taken to ensure continued operational safety, the FAA may direct immediate action as necessary to prevent a recurrence. The United States advocates for all States to adopt this approach to dual investigation so that future accidents may be curtailed prior to the release of official reports.

2.13 The FAA engages with a myriad of stakeholders, as a part of the process to investigate accidents, analyse data, and develop and implement mitigations when appropriate. These stakeholders may include foreign civil aviation authorities, aircraft manufacturers, parts suppliers, operators, air navigation and other service providers or other government entities.

2.14 FAA accident and incident investigators have tools to accelerate the speed of forensic analyses to produce safety intelligence. The FAA is using a memory access and retrieval system and is developing a novel flight data recorder datamap library to greatly reduce the time needed to produce flight data plots, perform analyses, and reconstructive video animations. Additionally, the FAA is also using a new Flight Data Monitoring (FDM) software that will proactively monitor safety trends. This software is used to identify emerging safety trends in the national airspace by performing near real-time and retrospective analysis of Automatic Dependent Surveillance-Broadcast data using FDM methods. Investigative data queries can be made quite easily and quickly, taking mere minutes instead of several days. Looking to the future, FAA is researching how to use artificial intelligence and machine learning to aid in our data monitoring capabilities in an attempt find trends in data that indicate latent safety risks.

2.15 The memory access and retrieval system provides accident investigation authorities a way to download investigative data from flight recorders without reliance on the recorder manufacturer. The common download method used worldwide involves placing the accident flight's memory board into a non-damaged "surrogate" recorder. This introduces the risk of accidentally overwriting data and can often create situations in which data are not recoverable from damaged memory chips. The process does not allow for partial recovery when the memory chips are damaged. Instead, this new memory access and retrieval system has the capability of reading crash damaged

recorders by simply removing the crash-survivable memory unit from the chassis, if necessary, and connecting directly to the memory board's ribbon cable. The FAA will use this system, in conjunction with documentation provided by the original equipment manufacturers through EUROCAE ED-112 requirements, to ensure that all future certificated flight recorders can be downloaded and read out at the memory chip level. This will ensure that no investigation can be hampered by a flight recorder that is no longer supported by the manufacturer, or reliant on third-party software which may not be usable in the future.

2.16 The FAA datamap library enhances the use of flight data recorders as an investigative tool by removing the single biggest impediment to timely and accurate flight data analysis: the conversion of data from recorded binary format into meaningful engineering units. Such a conversion relies on the use of a datamap, and since thousands of datamaps exist, it takes time and effort to find and validate the best possible version for use in the conversion. The FAA is developing and will maintain an extensive datamap library for use by investigators worldwide through a secure access portal, greatly increasing the speed and accuracy of flight data analyses and, thus, vastly enhancing the ability to produce prompt insights into what occurred leading up to and during an accident sequence.

2.17 The FAA is also working to enhance how the results of investigations provide actionable intelligence for the FAA Safety Management System. This includes the detection of potential accident precursors with limited signatures, like software glitches that become evident only through the careful analysis of flight data, hazards produced by the unexpected consequences of new certification requirements, and undesirable actions by individuals that are hard to predict and control through existing industry safety systems.

2.18 Looking ahead, the critical need to scan the safety horizon for emerging threats cannot be overestimated, since finding the hazards of tomorrow, and the risks they pose, requires being 'in tune' with new advances in technology and science and how such advances interface with human operators. Over the next 10-20 years, the aerospace sector will likely adopt advanced materials for aircraft structures, new system designs, alternate fuels, airport technologies, innovative electric and hybrid propulsion methods, and novel uses of airspace. The aerospace sector will be significantly impacted by the widespread use of quantum computing and artificial intelligence, including machine learning, neural networks, and machine vision. These ground-breaking changes will pave the way for novel aerospace vehicles capable of supersonic speeds, suborbital and orbital profiles, and fully automated flight.

2.19 The regulatory landscape will also undergo continuous evolution as we incorporate advanced air mobility vehicles, commercial space and drones into the airspace. Such changes will require the continuous development of investigative techniques and skills to enable the detection and analysis of new hazards.

2.20 Aerospace accident and incident investigators in the FAA and other government agencies will have to increase the speed at which they enhance the skills of their workforce and the tools they use to stay ahead of the new technologies, procedures, and regulatory standards. In today's dynamic and ever-changing aviation landscape, investigators will need to adapt and constantly improve to ensure they are prepared to respond to the challenges future accidents may present

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) Note the information contained in this paper.

b) Promote continuous training for both proficiency and new skills as a priority for investigators to successfully determine root cause and for investigating

future accidents involving new technology, procedures, and regulations.

c) Share best practices amongst Civil Aviation Authorities (CAA's) for the accident investigation function to inform their safety decision-making processes.

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