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FUTURE FLIGHT DATA COLLECTION COMMITTEE FINAL REPORT

Prepared by:
Future Flight Data Collection Committee
December 4, 2001

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FOREWORD

This report was prepared by the Future Flight Data Collection Committee and approved by the RTCA Policy Board on December 4, 2001.

RTCA, Incorporated, is a not-for-profit corporation formed to advance the art and science of aviation and aviation electronic systems for the benefit of the public. The organization functions as a Federal Advisory Committee and develops consensus-based recommendations on contemporary aviation issues. RTCA's objectives include but are not limited to:

- coalescing aviation system user and provider technical requirements in a manner that helps government and industry meet their mutual objectives and responsibilities;
- analyzing and recommending solutions to the system technical issues that aviation faces as it continues to pursue increased safety, system capacity and efficiency;
- developing consensus on the application of pertinent technology to fulfill user and provider requirements, including development of minimum operational performance standards for electronic systems and equipment that support aviation; and
- assisting in developing the appropriate technical material upon which positions for the International Civil Aviation Organization and the International Telecommunication Union and other appropriate international organizations can be based.

The organization's recommendations are often used as the basis for government and private sector decisions as well as the foundation for many Federal Aviation Administration Technical Standard Orders.

Since RTCA is not an official agency of the United States Government, its recommendations may not be regarded as statements of official government policy unless so enunciated by the U.S. government organization or agency having statutory jurisdiction over any matters to which the recommendations relate.

EXECUTIVE SUMMARY

New communication, navigation, and surveillance technologies currently being developed, along with new cockpit-interface systems, give evidence that new and better concepts for flight data collection are possible. Concurrently, the operating environment of the National Airspace System is undergoing renovation made possible by these new technologies. It is an ideal time to take a step back and look to the future to see what is possible in the area of on-board flight data collection. Methods and concepts for flight data collection and analysis will need to keep pace with the advanced space-based technology for navigation and data-link communications.

Flight data information technology needs to focus on quickly and accurately determining the factors that cause accidents/incidents and, more importantly, providing a means to avoid those accidents/incidents. The continued use of programs similar to the Flight Operations Quality Assurance (FOQA) and Maintenance Operations Quality Assurance (MOQA) initiatives will permit daily data analysis to address flight operations and maintenance issues proactively.

To organize this effort, the RTCA was selected as the most appropriate venue and under their guidance the Future Flight Data Collection Committee (FFDCC) was established. The committee's objective was to define operational concepts for acquiring, storing, and managing data concerning the state of the aircraft, operation of the aircraft, and air/ground and air/air communications. The committee examined "out of the box" solutions and established a concept that would fit into an evolving operational environment and build on the principles established in current FOQA programs. This approach will serve to identify recorded data requirements to the industry in advance so the technology can be incorporated early in a new design, minimizing event-driven rulemaking.

In addition to the original chartered activities, the FAA requested that as part of the Committee work they evaluate the merits of the NTSB recommendations regarding the use of imagery in the cockpit.

Data and voice recording were first implemented as accident investigation tools designed to provide permanent account of the facts, conditions, and circumstances leading to an accident. Traditionally, information recorded on the aircraft was limited to the mandatory requirements recommended by investigative authorities and enforced by the regulatory authorities; the type and amount of data recorded were considerably restrained by cost and technological feasibility. As individual investigations highlighted deficiencies in the data and the need for more detailed information, additional parameter requirements were mandated. This reactive approach resulted in a piecemeal development, forcing air carriers to continually retrofit their aircraft to accommodate the rule changes. This process continues to be inefficient, time-consuming, and costly to the aviation industry.

The following five primary groups of data users were identified: accident investigation authorities, manufacturers, operators and labor, Air Traffic Control (ATC), and regulators. The Committee also identified three categories of data needs: Data Content; Data Design, Maintenance & Access; and Regulatory-Based. The needs under Data Content include the ability to: record "all available data;" record aircraft environment including cockpit, cabin, cargo hold, and external; and record all messages to and from the aircraft that affect the operation of the aircraft. The Data Design, Maintenance and Access needs include: a flexible, efficient, economic way to record both mandatory and voluntary data sets in a crash-protected system; a method to assure prompt deciphering of data and continued maintenance of data map; optimization of access to stored data; and minimizing and documenting data latency for mandatory parametric data. The Regulatory-Based needs include: an abbreviated means to certify modification of recorded flight data; a greater regulatory flexibility with respect to the MEL for the FDR; a means to compare and share recorded data and information among users for safety, FOQA, and trending; a method of validating recorded data and algorithms for use in design improvements, continued airworthiness, and operational decisions; and proactive periodic review of data needs.

Advances in recording technology have made it possible to easily record large amounts of data at a reduced cost. If identified and applied in the early stages of aircraft design, they can be implemented in the

development stage with minor impact on aircraft systems. More complex sensors can provide information relative to the environment surrounding the aircraft. In the future, most if not all, recorder systems will use digital recording techniques that essentially store the recorded data in an encoded form. A total recording system that may include ground, air and ancillary equipment and an integrated systems approach is appropriate.

Recording devices were originally placed on airplanes to aid and improve accident investigation and safety. Historically, air carriers and labor understood that resultant data/information would not be used for any other purpose. However, it is the view of labor and operators that numerous examples exist of abuse by the legal community, media, and regulatory authorities who gain access to supposedly protected recorded data. Labor and operators believe that the use of this information in criminal prosecution and civil litigation worldwide is inappropriate and a misuse. In a similar manner, misuse is perceived when CVR recordings are obtained by the media and played for the public, or dramatic reenactments are presented based on transcripts.

There were differing views on the value of imaging among members of the Committee. Image recording was identified as a technologically feasible method for collecting information not otherwise recorded. In the view of labor and operators, the advantages of image recording have not been shown to outweigh the disadvantages. Accident investigators strongly believe in the value of image recording for accident investigation purposes. Discussions focused on image recording security, privacy and confidentiality protections that must be in place prior to any regulatory action mandating image recording.

The final report contains seven recommendations that summarize the important issues and changes that need to be considered in the area of flight data collection over the next 15 years. Additionally the report contains a timeline of relevant airborne recorder legislation actions, both domestic and international, and recommendations concerning suggested recorder changes.

This report was drafted prior to the tragic events of September 11, 2001. It is noted that some of the issues currently being considered as a result of those tragic events, are similar to issues discussed within this report. The work of this committee did not focus on the collection of data related to intentional criminal acts, however the technical content of this report may be an aid in resolving some of these issues. Catastrophic criminal actions were considered beyond the Terms of Reference; if consideration were given to convening a group, a separate new charter would be appropriate. Action on some of the recommendations may be accelerated considering the events of September 11th.

RECOMMENDATIONS

1. Rather than continuing the historical practice of re-writing DFDR parameter requirements, the Committee recommends that current requirements and additional information, present on digital data buses and used in the operation of future aircraft and their systems, be recorded in a crash-survivable system.
2. Since 1992, U.S. laws protecting CVR recording release in the case of domestic accidents have been effective. Unfortunately, the same is not true internationally. The Committee recommends that effective international protections against misuse of CVR recordings from U.S. operators be developed.
3. Image recording was identified as a technologically feasible method for collecting information not otherwise recorded. The Committee recommends that issues regarding security, privacy and confidentiality be resolved, and acceptable protections be put in place prior to any action mandating image recording.
4. Several data design, maintenance, access, and validity issues have been identified that impact the ability to quickly and accurately use recorder information for accident investigation and prevention purposes. The Committee recommends that methods be developed to dynamically store data map information in the recorder, to cost effectively transfer data from the recorder media to analysis systems, and to reduce and document data latency for all systems.

5. The Committee identified several existing conditions that hamper the use of a single set of recorded data for both voluntary programs and accident investigation. Although policy exists that would allow an applicant to develop user modifiable software, this is not widely understood and/or applied in the community. Similarly, MEL repair windows as presently applied discourage frequent validation of the DFDR functionality. The Committee recommends that regulators and the aviation community address these issues, as appropriate, to develop guidance material and provide regulatory relief.
6. There is no standard to be used in exchanging recorded data and aggregate information (trends, events, Meta-Data, etc.) that have been collected. The Committee recommends that common naming conventions and standard definitions be developed for data exchange.
7. The Committee recommends that a group should convene periodically to determine if additional recording needs exist.

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1 BACKGROUND

Data and voice recording were first implemented on aircraft to provide investigators with a permanent account of the facts, conditions, and circumstances leading to an accident. The information recorded on the aircraft was limited to the mandatory requirements recommended by investigative authorities and enforced by the regulatory authorities; the type and amount of data recorded were considerably restrained by cost and technological feasibility. Since the data was used infrequently, problems with the recording system were not always identified until after an event, when the data had become essential. With more advanced aircraft, investigations became more complex and investigators relied heavily on the data. As individual investigations highlighted deficiencies in the data and the need for more detailed information, additional parameter requirements were mandated. This reactive approach resulted in a piecemeal development, forcing air carriers to continually retrofit their aircraft to accommodate the rule changes. This process continues to be inefficient, time-consuming, and costly to the aviation industry.

Over the years, the methods and uses of data recording on aircraft have changed dramatically. Advances in technology have made it possible to easily record large amounts of data at a reduced cost. These changes have made it feasible for operators and manufacturers to now use and benefit from the recorded data. Many new aircraft are currently recording hundreds of parameters more than the minimum required. These reasons made it important to determine the needs that would satisfy not only the accident investigation community but also other consumers of the data. By identifying the recording needs of all involved parties as early as possible, these needs can be met by future system designs to benefit the entire aviation community.

This report was drafted prior to the tragic events of September 11, 2001. It is noted that some of the issues currently being considered as a result of those tragic events, are similar to issues discussed within this report. The work of this committee did not focus on the collection of data related to intentional criminal acts, however the technical content of this report may be an aid in resolving some of these issues. Catastrophic criminal actions were considered beyond the Terms of Reference; if consideration were given to convening a group, a separate new charter would be appropriate. Action on some of the recommendations may be accelerated considering the events of September 11.

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2 ESTABLISHMENT OF FUTURE FLIGHT DATA COLLECTION COMMITTEE

On November 3, 1999, RTCA received a letter from Federal Aviation Administration (FAA) Administrator Jane Garvey and National Transportation Safety Board (NTSB) Chairman Jim Hall requesting the establishment of a committee to address future airborne data recording needs on commercial aircraft that would help prevent accidents (Appendix A). RTCA responded by developing the Future Flight Data Collection Committee (FFDCC). The purpose of the FFDCC was to explore future data collection methods that would better help determine the factors that cause accidents and incidents quickly and accurately, to provide a means to use data proactively to avoid accidents and incidents, and to support continued airworthiness. The committee was tasked with envisioning the recorded data needed to assist in accident investigations and to take into account future technologies and resources that would be available. This forethought would identify recording needs to the industry in advance so they could be incorporated early and minimize event-driven rulemaking.

The Terms of Reference (TOR) for the committee was produced on May 19, 2000 (Appendix B). The TOR describes the background, scope, leadership, membership, deliverables, and milestones of the group. The background describes the justification for more proactive airborne data recording. The scope discusses the objectives of the committee, work of similar organizations, Flight Operations Quality Assurance (FOQA) initiatives, and some subject areas that should be considered. The leadership section states that the groups will be headed by representation from the FAA, NTSB, and industry. The membership section explains that participation would be made up of government entities and other aviation organizations involved with accident investigation and safety including airlines, manufacturers, military, and unions. The deliverable and milestone sections dictated that an interim report would be due 6 months from the first meeting and a final report within 15 months.

From the TOR, three working groups were formed and their duties outlined in a proposal. The Data Needs Working Group (WG1), the Technology Working Group (WG2), and the Data Use and Protection Working Group (WG3) were all assigned different responsibilities. WG1 was charged with examining projected changes in the aviation industry and determining future recording requirements, extant in the year 2015 that would improve operational efficiency, aviation safety, and aircraft accident investigation. WG2 was responsible for determining the technological feasibility of the data needs presented by WG1 and examining existing and projected technologies, flight recording standardization, and data security methods. WG3 was responsible for focusing on the use of the collected flight data and for identifying privacy concerns and cost issues. Plenary sessions were held every 2 months. In January 2001 an interim report was submitted to the FAA Administrator and the NTSB Chairman.

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3 THE WORKING GROUPS

WG1, Data Needs, was tasked to focus on codifying and defining enhancements to the recorded data and emphasizing the use of recorded data to prevent future accidents and to improve operational efficiency. The working group was also tasked to evaluate a means to exploit existing and projected airborne and ground-based aviation information sources for improved safety and efficiency. The working group proposal suggested several sample topics that were to be discussed, such as standardization (recorders, data formats, etc.), "Dual Use" FOQA recording devices, image recording (cockpit, external, cargo, security, etc.), and access to recorded data.

WG2, Technology, was tasked with evaluating the means to exploit existing and projected airborne aviation information sources and ground-based playback capabilities, for improved safety and efficiency. The working group focused on in-flight recording, digital data link for telemetry, and recorder data. The group examined existing standards and identified the need for new standards while remaining cognizant of security and integrity issues associated with all recorded data. This workgroup focused on how to best utilize new technology that will be realized in the next 15 years.

WG3, Data Use and Protection, focused on the use of the collected flight data in the analysis of flight trends and prevention of future accidents. The group considered the recent ICAO Accident Investigation Group recommendation that states gradually mandate flight data analysis programs. WG3 also considered safety issues, privacy issues, misuse of data, and cost issues.

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4 SCHEDULE AND WORK

The Committee met for the first time in July 2000 and continued to meet through September 2001. Participation in the group was open to the public and encouraged throughout the industry. Representatives from aircraft, engine, flight data acquisition unit (FDAU) and flight recorder manufacturers, regulatory agencies, investigative agencies, air carriers, unions, military, general aviation, and various other organizations participated in these meetings.

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5 SCOPE, LIMITATIONS & FUTURE CONSIDERATIONS

While the Committee attempted to address all potential future data enhancements, the resulting list may not be complete and may change with time. It was not possible for the group to account for all future technologies that may exist by 2015. The Committee concluded that a group similar to the FFDCC, composed of government and industry representatives, should convene periodically to determine if additional recording needs exist. The development of new technologies or uses of recorded data may warrant additional recording requirements. It is best to review the recording requirements on a recurring basis and make recommendations that can be integrated proactively instead of reacting to urgent data needs. Only information sensed on the aircraft (regardless of source) was considered.

The Committee debated whether to examine recording issues for general aviation, helicopters, military, and powered-lift vehicles. The discussion revealed that many of the data enhancements that would improve safety and operational efficiency would be beneficial regardless of the type or operation of aircraft but it may not be feasible to implement them in all areas due to cost. The Committee decided that while the recording needs of users in all types of aviation were to be considered, the results would focus primarily on commercial air carrier aircraft.

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