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FAA (AIR-130) White Paper

Flight Recorder Rules and Activities
Related to Helicopter Emergency Medical Services

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AIR-130 White Paper

On

Flight Recorder Rules and Activities Related to Helicopter Emergency Medical Services

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SUMMARY

The Federal Aviation Administration's Office of Accident Investigation, Accident Investigation Division requests information from the Aircraft Certification Service, Aircraft Engineering Division, Avionics Systems Branch in support of the National Transportation Safety Board's public hearing on the safety of Helicopter Emergency Medical Services operations. This white paper is focused on flight data and cockpit voice recorder equipage requirements, associated regulations, and related flight recording activities for the subject helicopters operating under Title 14 Code of Federal Regulations parts 91 and 135.

1. Background

The National Transportation Safety Board (NTSB) is hosting a three day public hearing beginning on February 3, 2009. The intent of the public hearing is for the NTSB to learn more about the safety of Helicopter Emergency Medical Services (HEMS) operations. This public hearing is called due to the alarming rise of HEMS accidents.

2. Purpose

The Federal Aviation Administration's Office of Accident Investigation, Accident Investigation Division (AAI-100) requests information from the Aircraft Certification Service, Aircraft Engineering Division, Avionics Systems Branch (AIR-130) in support of this NTSB public hearing. The purpose of this white paper is to identify the HEMS rotorcraft applicability to the digital flight data recorder (DFDR) and cockpit voice recorder (CVR) regulations, the equipage requirements, and current HEMS related flight recording activities.

3. HEMS Regulatory Applicability

This section identifies and quotes the rules in Title 14 Code of Federal Regulations (14 CFR), specifically the DFDR and CVR equipage requirements applicable for HEMS rotorcraft.

3.1 General Operating and Flight Rules – 14 CFR Part 91

3.1.1 DFDR Equipage Requirements

3.1.1.1 Current Rule: 14 CFR § 91.609(c)(1)

*“No person may operate a U.S. civil registered, multiengine, turbine-powered airplane or **rotorcraft** having a passenger seating configuration, excluding any pilot seats of **10 or more** that has been **manufactured after October 11, 1991**, unless it is **equipped with one or more approved flight recorders** that utilize a digital method of recording and storing data and a method of readily retrieving that data from the storage medium, that are capable of recording the data specified in appendix E to this part, for an airplane, or **appendix F** to this part, for a rotorcraft, of this part within the range, accuracy, and recording interval specified, and that are capable of retaining no less than **8 hours** of aircraft operation.”*

3.1.1.2 Newly Manufactured: 14 CFR § 91.609(c)(3)

*“All airplanes and **rotorcraft** subject to paragraph (c)(1) of this section that are **manufactured on or after April 7, 2010**, must meet the flight data recorder requirements of §23.1459, §25.1459, **§27.1459, or §29.1459** of this chapter, as applicable, and retain at least the last **25 hours** of recorded information using a recorder that meets the standards of **TSO-C124a**, or later revision.*

3.1.1.3 Certification Rule: 14 CFR § 29.1459

Note that 14 CFR § 27.1459 reads identically the same except for the references to §§ 29.1323, 29.1325, and 29.1327 are references to §§ 27.1323, 27.1325, and 27.1327.

“(a) Each flight recorder required by the operating rules of Subchapter G of this chapter must be installed so that:

- (1) It is supplied with airspeed, altitude, and directional data obtained from sources that meet the accuracy requirements of §§29.1323, 29.1325, and 29.1327 of this part, as applicable;*
 - (2) The vertical acceleration sensor is rigidly attached, and located longitudinally within the approved center of gravity limits of the rotorcraft;*
 - (3) (i) It receives its electrical power from the bus that provides the maximum reliability for operation of the flight data recorder without jeopardizing service to essential or emergency loads.*
(ii) The cockpit voice recorder must remain powered for as long as possible without jeopardizing emergency operation of the rotorcraft;
 - (4) There is an aural or visual means for preflight checking of the recorder for proper recording of data in the storage medium;*
 - (5) Except for recorders powered solely by the engine-drive electrical generator system, there is an automatic means to simultaneously stop a recorder that has a data erasure feature and prevent each erasure feature from functioning, within 10 minutes after any crash impact; and*
 - (6) Whether the cockpit voice recorder and digital flight data recorder are installed in separate boxes or in a combination unit, no single electrical failure external to the recorder may disable both the cockpit voice recorder and the digital flight data recorder.*
- (b) Each nonejectable recorder container must be located and mounted so as to minimize the probability of container rupture resulting from crash impact and subsequent damage to the record from fire.*
- (c) A correlation must be established between the flight recorder readings of airspeed, altitude, and heading and the corresponding readings (taking into account correction factors) of the first pilot's instruments. This correlation must cover the airspeed range over which the aircraft is to be operated, the range of altitude to which the aircraft is limited, and 360 degrees of heading. Correlation may be established on the ground as appropriate.*
- (d) Each recorder container must:*
- (1) Be either bright orange or bright yellow;*

- (2) *Have a reflective tape affixed to its external surface to facilitate its location under water; and*
- (3) *Have an underwater locating device, when required by the operating rules of this chapter, on or adjacent to the container which is secured in such a manner that it is not likely to be separated during crash impact.*
- (e) *When both a cockpit voice recorder and a flight data recorder are required by the operating rules, one combination unit may be installed, provided that all other requirements of this section and the requirements for cockpit voice recorders under this part are met.”*

3.1.1.4 Summary

HEMS rotorcraft manufactured before October 11, 1991 are not subject to any DFDR equipage requirement.

HEMS rotorcraft manufactured after October 11, 1991 with 10 or more seats, excluding any pilots’ seats, must record 23 parameters for at least 8 hours.

HEMS rotorcraft manufactured on or after April 7, 2010 having the characteristics identified above, are subject to the 25 hour recording minimum duration, the most reliable electrical bus (§§ 27, 29.1459(a)(3)(ii)), the single electrical failure (§§ 27, 29.1459(a)(6)), and the combination unit (§§ 27, 29.1459(e)) requirements.

3.1.2 CVR Equipage Requirements

3.1.2.1 Current Rule: 14 CFR § 91.609(e)

*“Unless otherwise authorized by the Administrator, **after October 11, 1991, no person may operate** a U.S. civil registered multiengine, turbine-powered airplane or **rotorcraft** having a passenger seating configuration of **six passengers or more** and for which **two pilots are required** by type certification or operating rule unless it is equipped with an approved **cockpit voice recorder** that:*

*(1) Is installed in compliance with §23.1457(a) (1) and (2), (b), (c), (d), (e), (f), and (g); §25.1457(a) (1) and (2), (b), (c), (d), (e), (f), and (g); **§27.1457(a) (1) and (2), (b), (c), (d)(1)(i), (2), and (3), (e), (f), and (g); or §29.1457(a) (1) and (2), (b), (c), (d)(1)(i), (2), and (3), (e), (f), and (g)** of this chapter, as applicable; and*

*(2) Is **operated continuously** from the use of the **checklist before the flight** to completion of the **final checklist at the end of the flight**.”*

3.1.2.2 Newly Manufactured: 14 CFR § 91.609(i)

*“All airplanes or **rotorcraft required by this section to have a cockpit voice recorder and flight data recorder, that are manufactured on or after April 7, 2010**, must have a cockpit voice recorder installed that also—*

(1) Meets the requirements of §23.1457, §25.1457, §27.1457, or §29.1457 of this chapter, as applicable; and

(2) Retains at least the last **2 hours** of recorded information using a recorder that meets the standards of TSO-C123a, or later revision.”

3.1.2.3 Datalink: 14 CFR 91.609(j)

“All airplanes or rotorcraft required by this section to have a cockpit voice recorder and a flight data recorder, that install datalink communication equipment on or after April 7, 2010, must record all datalink messages as required by the certification rule applicable to the aircraft.”

3.1.2.4 Summary

HEMS rotorcraft with less than 6 passenger seats are not subject to any CVR equipage requirement.

HEMS rotorcraft with 6 or more passenger seats and require two pilots by type certification or operating rule must be equipped with a CVR in compliance with § 27.1457(a) (1) and (2), (b), (c), (d)(1)(i), (2), and (3), (e), (f), and (g) or § 29.1457(a) (1) and (2), (b), (c), (d)(1)(i), (2), and (3), (e), (f), and (g) and is operational from checklist to checklist for at least 15 minutes.

HEMS rotorcraft manufactured on or after April 7, 2010 and are required to carry a DFDR and CVR must have a 2 hour, TSO-C123a approved CVR with a backup independent power source that complies with the most reliable electrical bus (§§ 27, 29.1457(d)(1)(ii)), the single electrical failure (§§ 27, 29.1457(d)(4)), and the combination unit (§§ 27, 29.1457(h)) requirements.

For HEMS rotorcraft required to carry a DFDR and CVR that have installed datalink communication equipment on or after April 7, 2010 are subject to the datalink recording requirement in §§ 27, 29.1457(a)(6).

3.2 Operating Requirements: Commuter and On Demand Operations and Rules Governing Persons On Board Such Aircraft – 14 CFR Part 135

3.2.1 DFDR Equipage Requirements

3.2.1.1 Current Rule: 14 CFR § 135.152(a)

“Except as provided in paragraph (k) of this section, no person may operate under this part a multi-engine, turbine-engine powered airplane or rotorcraft having a passenger seating configuration, excluding any required crewmember seat, of 10 to 19 seats, that was either brought onto the U.S. register after, or was registered outside the United States and added to the operator's U.S. operations specifications after, October 11, 1991, unless it is equipped with one or more approved flight recorders that use a digital method of recording and storing data and a method of readily retrieving that

*data from the storage medium. The parameters specified in either **Appendix B** or **C** of this part, as applicable must be recorded within the range, accuracy, resolution, and recording intervals as specified. The recorder shall retain no less than **25 hours** of aircraft operation.*

3.2.1.2 Retrofit: 14 CFR § 135.152(l)

*“By **April 7, 2012**, all **aircraft manufactured before April 7, 2010**, must also meet the requirements in §23.1459(a)(7), §25.1459(a)(8), **§27.1459(e), or §29.1459(e)** of this chapter, as applicable.”*

3.2.1.3 Newly Manufactured: 14 CFR § 135.152(m)

*“All **aircraft manufactured on or after April 7, 2010**, must have a **flight data recorder** installed that also—*

*(1) Meets the requirements of §23.1459(a)(3), (a)(6), and (a)(7), §25.1459(a)(3), (a)(7), and (a)(8), **§27.1459(a)(3)(ii), (a)(6), and (e), or §29.1459(a)(3)(ii), (a)(6), and (e)** of this chapter, as applicable; and*

*(2) Retains the **25 hours** of recorded information required in paragraph (d) of this section using a recorder that meets the standards of **TSO-C124a**, or later revision.”*

3.2.1.4 Summary

HEMS rotorcraft operating under part 135 with less than 10 passenger seats are not subject to carrying a DFDR.

If HEMS rotorcraft has 10-19 passenger seats and either manufactured after, brought onto the U.S. register after, or was registered outside the United States and added to the operator's U.S. operations specifications after, October 11, 1991, must have a 25 hour DFDR that records the 23 parameters of Appendix C.

By April 7, 2012 all HEMS rotorcraft manufactured before April 7, 2010 and are required to carry a DFDR must comply with the combination unit requirements in § 27.1459(e) or § 29.1459(e).

HEMS rotorcraft manufactured after April 7, 2010 and are required to carry a DFDR must have a 25 hour TSO-C124a approved DFDR that also complies with the most reliable electrical bus (§§ 27, 29.1459(a)(3)(ii)), the single electrical failure (§§ 27, 29.1459(a)(6)), and the combination unit (§§ 27, 29.1459(e)) requirements.

3.2.2 CVR Equipage Requirements

3.2.2.1 Current Rule: 14 CFR § 135.151(a)

*“(a) **No person may operate a** multiengine, turbine-powered airplane or **rotorcraft** having a **passenger seating configuration of six or more and for which two pilots***

are required by certification or operating rules unless it is equipped with an approved cockpit voice recorder that:

(1) Is installed in compliance with §23.1457(a) (1) and (2), (b), (c), (d), (e), (f), and (g); §25.1457(a) (1) and (2), (b), (c), (d), (e), (f), and (g); §27.1457(a) (1) and (2), (b), (c), (d)(1)(i), (2), and (3), (e), (f), and (g); or §29.1457(a) (1) and (2), (b), (c), (d)(1)(i), (2), and (3), (e), (f), and (g) of this chapter, as applicable; and

(2) Is operated continuously from the use of the check list before the flight to completion of the final check list at the end of the flight.”

3.2.2.2 Newly Manufactured: 14 CFR § 135.151(g)(1)

“(g)(1) No person may operate a multiengine, turbine-powered airplane or rotorcraft that is manufactured on or after April 7, 2010, that has a passenger seating configuration of six or more seats, for which two pilots are required by certification or operating rules, and that is required to have a flight data recorder under §135.152, unless it is equipped with an approved cockpit voice recorder that also—

(i) Is installed in accordance with the requirements of §23.1457, §25.1457, §27.1457(a)(6), (d)(1), (d)(4), (d)(5), and (h), or §29.1457(a)(6), (d)(1), (d)(4), (d)(5), and (h) of this chapter, as applicable;

(ii) Is operated continuously from the use of the check list before the flight, to completion of the final check list at the end of the flight; and

(iii) Retains at least the last 2 hours of recorded information using a recorder that meets the standards of TSO-C123a, or later revision.

3.2.2.3 Datalink: 14 CFR § 135.151(h)

“(h) All airplanes or rotorcraft required by this part to have a cockpit voice recorder and a flight data recorder, that install datalink communication equipment on or after April 7, 2010, must record all datalink messages as required by the certification rule applicable to the aircraft.”

3.2.2.4 Summary

HEMS rotorcraft with less than 6 passenger seats are not subject to any CVR equipment requirement.

HEMS rotorcraft with 6 or more passenger seats and require two pilots by type certification or operating rule must be equipped with a CVR in compliance with § 27.1457(a) (1) and (2), (b), (c), (d)(1)(i), (2), and (3), (e), (f), and (g) or § 29.1457(a) (1) and (2), (b), (c), (d)(1)(i), (2), and (3), (e), (f), and (g) and is operational from checklist to checklist for at least 15 minutes.

HEMS rotorcraft manufactured after April 7, 2010 and are required to carry a DFDR and CVR must have a 2 hour, TSO-C123a approved CVR with an backup independent power source that complies with the most reliable electrical bus (§§ 27, 29.1457(d)(1)(ii)), the single electrical failure (§§ 27, 29.1457(d)(4)), and the combination unit (§§ 27, 29.1457(h)) requirements.

For HEMS rotorcraft required to carry a DFDR and CVR that have installed datalink communication equipment on or after April 7,2010 are subject to the datalink recording requirement in §§ 27, 29.1457(a)(6).

4. HEMS Related Flight Recording Activities

Although the FAA plans no rulemaking activities that require FDR systems to be installed on general aviation (GA) aircraft, the FAA has been in communication with manufacturers who are developing lightweight, low cost recording systems that could meet the needs of commercially operated airplanes and rotorcraft within the GA community.

4.1 S-76 Supplemental Type Certification

An FAA Organization Delegation Authorization (ODA), is in the process of certifying a cockpit image recording system installation design via Supplemental Type Certification (STC). The STC was approved on December 29, 2008 by the ODA through the New York Aircraft Certification Office. The STC is applicable to S-76B models operating in European airspace. Additional European Aviation Safety Agency (EASA) certification validation effort is expected to be complete in early February 2009.

This non-hazardous, non-essential, cockpit image recording system STC is the first of its kind. Based on this recent experience, the FAA plans to streamline the certification process to enable installations of non-required, low cost, and light weight recording technologies.

4.2 EUROCAE Working Group 77

The FAA has been in attendance at the EUROCAE WG-77 activity which was established to develop a Minimum Operational Performance Specification (MOPS) for lightweight, low cost data recording systems. Subcommittees within the working group are establishing requirements for new aircraft data recorders, cockpit audio recorders, cockpit image recorders, and datalink recorders. WG-77 will complete its work and publish the MOPS, ED-155, in 2009.

4.3 U.S. Rotorcraft Manufacturer Data Recording Initiatives

Eurocopter USA has partnered with Appareo and is developing an image recording system that they hope to install on all new helicopters being delivered in 2010.

Bell Helicopter has developed and tested a cockpit information recording system that they hope to have approval on in 2009.

5. Conclusion

The FAA does not require any equipage of a recording device, whether CVR or FDR, on rotorcraft operating under 14 CFR parts 91 and 135 with a passenger seating configuration of

five or less seats. Additionally, there is no equipage requirement for rotorcraft required to operate with one pilot, unless the rotorcraft has a passenger seating configuration of 20 or more seats.

The following bullets summarize the current (pre April 7, 2010) rotorcraft equipage requirements:

- The FDR equipage requirement (23 parameters for 25 hours) is invoked on rotorcraft with a passenger seating configuration of 10-19 seats that are
 - 1) manufactured after October 11, 1991,
 - 2) added to the U.S. register after October 11, 1991, or
 - 3) registered outside the United States and added to the operator's U.S. operations specifications after October 11, 1991.

- The CVR equipage requirement (radio voice communications to and from the rotorcraft and flightcrew voice communications on the flightdeck for 15 minutes) is invoked on rotorcraft with a passenger seating configuration of six or more seats and required to operate with two pilots by type certification or operating rule.