Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada

# REASSESSMENT OF THE RESPONSE TO TSB RECOMMENDATION A16-03

## Emergency locator transmitter system crash survivability standards – Federal Aviation Administration (on behalf of the Radio Technical Commission for Aeronautics)

### Background

On 31 May 2013, at approximately 0011 Eastern Daylight Time, the Sikorsky S-76A helicopter (registration C-GIMY, serial number 760055), operated as Lifeflight 8, departed at night from Runway 06 at the Moosonee Airport, Ontario, on a visual flight rules flight to the Attawapiskat Airport, Ontario, with 2 pilots and 2 paramedics on board. As the helicopter climbed through 300 feet above the ground toward its planned cruising altitude of 1000 feet above sea level, the pilot flying commenced a left-hand turn toward the Attawapiskat Airport, approximately 119 nautical miles to the northwest of the Moosonee Airport. Twenty-three seconds later, the helicopter impacted trees and then struck the ground in an area of dense bush and swampy terrain. The aircraft was destroyed by impact forces and the ensuing post-crash fire. The helicopter's satellite tracking system reported a takeoff message and then went inactive. The search-and-rescue satellite system did not detect a signal from the emergency locator transmitter. At approximately 0543, a search-and-rescue aircraft located the crash site approximately 1 nautical mile northeast of Runway 06, and deployed search-and-rescue technicians. However, there were no survivors.

The Board concluded its investigation and released report A13H0001 on 15 June 2016.

### TSB Recommendation A16-03 (June 2016)

In this occurrence, as in numerous others investigated by the TSB,[1] the Emergency Locator Transmitter (ELT) system was rendered inoperative nearly immediately or within seconds following impact by damage sustained during the crash sequence. As a result, the ELT was unable to transmit a distress signal to the Cospas-Sarsat SAR satellite system. In many instances, ELT signals have not reached the Cospas-Sarsat system due to a broken antenna or a break in the wire connecting the ELT unit to the antenna. In this occurrence, it was determined that although the ELT unit was operable, a broken ELT antenna prevented the signal from being

[1] TSB aviation occurrences A09Q0111, A09Q0190, A10A0041, A10A0122, A10O0125, A10O0145, A10O0240, A10P0142, A10Q0098, A10Q0111, A10Q0132, A11C0047, A11P0117, A11W0151, A12C0005, A12O0170, A12P0070, A13C0150, A13P0127, and A13W0009.

transmitted. The crashworthiness design specifications are robust for the actual ELT unit; however, the specifications are significantly less stringent for the other key components (i.e., the wiring and antenna) of the ELT system.

One of the inherent limitations of a 121.5 MHz ELT is its requirement for a whip-style antenna, which extends outward from the aircraft fuselage, significantly increasing the likelihood that it will be damaged or broken by impact with terrain, trees, or other parts from the aircraft during a crash sequence. Modern 406 MHz ELTs permit the use of low-profile (i.e., flush-mounted) antenna installations, which are significantly less susceptible to such damage. Transport Canada (TC) has recently issued a Notice of Proposed Amendment (NPA) that would mandate 406 MHz ELTs; however, the NPA also states that the regulation will mandate the carriage of dual 121.5/406 MHz ELTs. According to TC, retaining the 121.5 MHz requirement for new 406 MHz ELT installations, in accordance with Technical Standard Order (TSO) C126b, is to allow for homing. If these dual-frequency units are designed to use a single antenna, that antenna would need to be whip-style to accommodate the 121.5 MHz frequency. Some 406 MHz ELT units now come equipped with a backup, internal global positioning system (GPS) receiver and antenna that meet the specifications of Radio Technical Commission for Aeronautics (RTCA) RTCA DO-204A and European Organisation for Civil Aviation Equipment (EUROCAE) document ED62A. However, the internal antenna has not been tested and approved by Cospas-Sarsat, whose standard does not include details on the design's radiation and power output. Finally, depending on the location of the ELT unit, the signal from an ELT using an internal antenna may be emitted at a reduced effectiveness due to shielding from aircraft components or terrain. TC has indicated that it will not stipulate a dual-antenna requirement for new dual 121.5/406 MHz ELTs. As a result, if the design standards allow for a single antenna, versus separate 121.5 MHz and 406 MHz antennas, to be used on dual-frequency units, the risks associated with the use of a whip-style antenna will persist.

The International Civil Aviation Organization (ICAO) establishes International Standards and Recommended Practices for member states. However, it has not established any ELT system design standards; these are currently determined by national regulatory bodies such as TC, the Federal Aviation Administration (FAA), and the European Aviation Safety Agency (EASA). In Canada, Canadian Aviation Regulations (CARs) Part V—Airworthiness Manual (Chapter 551: Aircraft Equipment and Installation) states that ELTs must meet the performance standards for 121.5 MHz and 406 MHz ELTs set out by the RTCA. In the United States, although there is no regulatory requirement for 406 MHz ELTs, the FAA only accepts requests for new ELT technical standard order authorizations for 406 MHz ELTs. As in Canada, the FAA relies on the performance specifications set out by the RTCA. In Europe, EASA has taken a similar approach, requiring that ELTs meet the design specifications set out by EUROCAE. A considerable body of research now indicates that current ELT design standards do not ensure a reasonable degree of crash survivability.

As a result, it is highly likely that aircraft equipped with ELT systems that meet the current design standards will continue to be involved in occurrences in which potentially life-saving

SAR services will be delayed as a result of damage to the ELT system, decreasing the survivability of an accident.

Therefore, the Board recommends that:

> The Radio Technical Commission for Aeronautics establish rigorous emergency locator transmitter (ELT) system crash survivability specifications that reduce the likelihood that an ELT system will be rendered inoperative as a result of impact forces sustained during an aviation occurrence.
>
> **TSB Recommendation A16-03**

## The Federal Aviation Administration's response to Recommendation A16-03 (January 2017)

In December 2013, the RTCA Program Management Committee established Special Committee SC-229, 406 MHz Emergency Locator Transmitters (ELTs), to develop a Minimum Operational Performance Standard (MOPS) for second generation ELTs. As part of the Terms of Reference, the committee is developing cabling, antenna, and crash safety specifications for first and second generation ELTs. Special Committee SC-229 is expected to publish the revised MOPS in March 2018. The FAA will provide an updated response 60 days after the MOPS is published.

We expect to provide an updated response to Safety Recommendation A16-03 (FAA file number 16.133) by June 1, 2018.

## TSB assessment of the Federal Aviation Administration's response to Recommendation A16-03 (March 2017)

The Board is pleased to hear that the committee is developing cabling, antenna, and crash safety specifications for first and second generation ELTs, and that a specific deadline has been set for the completion of this work.

However, until the new specifications are available for review, the Board is unable to determine if the new standards, once fully implemented, will substantially reduce or eliminate the safety deficiency associated with Recommendation A16-03.

Therefore, the response to Recommendation A16-03 is assessed as **Satisfactory Intent**.

## The Federal Aviation Administration's response to Recommendation A16-03 (July 2019)

RTCA Special Committee SC-229, 406 MHz Emergency Locator Transmitters (ELTs), completed its tasks in August 2018 and the Minimum Operational Performance Standard (MOPS) for first and second generation 406 MHz ELTs was published on December 13, 2018.

To reduce the likelihood of an ELT system not performing its intended function upon a crash, the committee worked to develop more robust antenna cabling and crash survivability specifications, as well as installation guidance within the MOPS.

Section 3.4 of the document discussed external antenna cable specification. The committee developed specifications which require the antenna cable materials be of a more robust quality equivalent to military standard, MIL-DTL-17, Detail Specification: Cables, Radio Frequency, Flexible and Semi-Rigid. In Section 4 the ELT system, the antenna and antenna cabling is subjected to certain environmental tests to determine that its overall laboratory performance is representative of its normal operation.

The committee made enhancements to the crash safety tests in Section 4.5.9.4. The purpose of the enhancements to the testing are to ensure the ELT system will survive the crash environment and will function properly during and after a crash. Additionally, the testing ensures during a crash sequence, the ELT system components will remain safely in their mounting and, if appropriate, be activated by a crash sensor. TABLE 4-4: Crash Safety Test Environment Definitions, increases the number of orientations the ELT unit must be tested in, including testing in ELT directions at 45 degree angles. A cross-axis inputs test was added for those ELT units not tested at the 45 degree angle as specified in TABLE 4-4 to confirm the crash sensor performance. The MOPS also added a curve, FIGURE 5-5, to show the expected crash sensor response for helicopters when exposed to shock tests.

The committee developed Section 6 of the MOPS that discusses the importance of installed equipment performance. The purpose of the chapter is to provide installation instructions which can be incorporated into ELT installation manuals, for use by ELT installers. These uniform instructions will better enable the ELT to perform properly following a crash. Two key topics of discussion in the chapter are ELT antenna location and antenna cabling.

Section 6.2.11 discusses the importance of antenna mounting location for both external and internal antennas, whether it be to specify the static load of the mounting structure the externally mounted antenna can withstand or to ensure the internally mounted antenna location does not reduce the Equivalent Isotropically Radiated Power transmitted by the antenna below the stated decibel level. Additionally, the chapter provides details of the antenna proximity to the ELT to reduce the risk of the antenna cable breaking.

Section 6.2.12 of the MOPS focuses on ELT antenna cables to ensure the cable does not come disconnected from the ELT antenna. It discusses the appropriate cable strain relief expected, the importance of avoiding installing the cable across break points, the appropriate cable mounting methods, the antenna cable bend limitations, as well as recommendation of a fire sleeve for added fire protection.

With RTCA/DO-204B now published, Technical Standard Order (TSO)-C126c, 406 MHz Emergency Locator Transmitters, which incorporates RTCA/DO-204B, will publish in March 2019. In the new version of the TSO, in order to obtain TSO approval, applicants must submit installation manuals which include the installation instructions discussed in section 6.2 of the

MOPS. This action is taken to ensure uniformity among all ELT manufacturers manuals, as well as to convey explicit instructions to ELT installers.

We believe we have effectively addressed FAA safety recommendation 16.133 and consider our actions complete.

## TSB reassessment of the Federal Aviation Administration's response to Recommendation A16-03 (December 2019)

The Board is pleased that the Radio Technical Commission for Aeronautics (RTCA) Special Committee (SC)-229, working in conjunction with the European Organisation for Civil Aviation Equipment (EUROCAE) Working Group (WG) 98, has completed its tasks and that the following actions to address Recommendation A16-03 have been taken:

- in December 2018, the RTCA published DO-204B, a new Minimum Operational Performance Standard (MOPS) for first- and second-generation 406 MHz emergency locator transmitters (ELTs) that includes:
  - more robust antenna cabling specifications;
  - crash survivability specifications; and
  - installation guidance, including mounting location for both external and internal antennas and additional information regarding antenna cables.
- in December 2018, EUROCAE published ED-62B, a technically equivalent document to RTCA/DO-204B.
- in March 2019, the Federal Aviation Administration (FAA) issued a revised Technical Standard Order (TSO)-C126c, *406 MHz Emergency Locator Transmitters*, which incorporates RTCA/DO-204B.

The Board considers that the actions taken by the FAA and the RTCA will significantly reduce the risks associated with the safety deficiency identified in Recommendation A16-03.

Therefore, the Board considers the response to the recommendation to be **Fully Satisfactory**.

## Next TSB action

This deficiency file is **Closed**.