2nd Generation ELT Performance Specification Development

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NASA SAR is supporting RTCA with the goal of making “significant improvement to ELT performance” through a multi-faceted research, analysis and test effort.

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<td>Historic and current failure rates and modes</td>
<td>Nonlinear dynamics analysis of severe but survivable airplane crash scenarios</td>
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<tr>
<td>• Crash data from NTSB and other international sources</td>
<td>• Validate models through test correlation</td>
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<td>• Compare current to historic trends</td>
<td>• Investigate various installation plans</td>
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<td>• Identify previous improvements to avoid duplication of effort</td>
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<td>• Identify primary failure modes</td>
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<td>Ground-based unit testing and installed system crash testing</td>
<td>Recommendations to RTCA/EUROCAE regarding Minimum Operational Performance Standards (MOPS) for 2nd Generation ELTs</td>
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<tr>
<td>• Crash safety testing</td>
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<td>• Helicopter crash test</td>
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<td>• Vibration testing</td>
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<td>• 3 GA airplane crash tests</td>
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Research Summary

• Historical Performance
  – ELT success rate estimated to be 25% with TSO C-91 and earlier beacons [1]

• Current Performance
  – ATSB estimated success rate at 40-60% with high degree of uncertainty in fitment (69%) [2]
  – Canada DR&D estimated success rate at 74% with high degree of uncertainty due to sufficient ELT data provided in only 13% of cases [3]
  – German BFU summarized 6 cases involving beacon mount failures and cited the antenna connection as the weak link in the system [4]
  – Cospas-Sarsat proceedings discuss the reliability of ELT performance statistics as information is recorded in only 10% of accidents resulting in substantial damage to the aircraft [5]
  – NASA/NTSB special study revealed 58% success rate in TSO-C91a and later ELTs involved in injurious accidents over the period Jan 2009-Mar 2014 and no correlation between performance and aircraft [6]

• Enhanced Data Collection
  – NTSB Form 6120.1 has been updated to include additional fields for ELT information

ELT failure is responsible for the loss of more than 1 life per week on average [1]
Findings & Action Plan

- Research revealed similar themes to those reported historically by NASA as well as more contemporary studies by international stakeholders

- Current MOPS falls short of defining requirements that ensure robust systems in a number of areas, including:
  - Vibration
  - Fire/Flame Survivability
  - Automatic Activation
  - Crash Safety
  - System Installation

- NASA will provide research and test data to support improved MOPS in each of the above areas

- A representative sample of GA AF-type ELTs from each vendor represented on RTCA SC-229 will be evaluated
Laboratory Testing

• Crash Safety & Automatic Activation
  – Previously qualified systems have exhibited structural deficiencies in the field, resulting in disconnected antenna due to beacon ejection from its mounting
  – NASA tests have reproduced the behavior by modifying the test parameters to be more representative of actual crash environments and include confirmation of functionality during the crash event

• Vibration
  – Crash sensors have exhibited sensitivity to vibration exposure
  – NASA will evaluate the performance of current systems after exposure to robust vibration environments

• Antenna Cable System
  – No strength requirements exist for the cabling system
  – NASA has performed static and dynamic strength testing and will compare results to cable loads recorded during full-scale crash testing

• Fire
  – Current test duration is shorter than the time required for satellite transmission
  – NASA will test antenna systems for functional performance during fire exposure with and without additional COTS thermal protection
Full-scale Crash Testing

- Series of tests at NASA Langley Research Center’s (LaRC) Landing and Impact Research Facility (LandIR)
  - 1 CH-46E Helicopter Fuselage
  - 3 Cessna 172 Airplanes
- “Severe but survivable” crash conditions
- Live testing of SARSAT system with multiple full ELT systems onboard each test
- Data used to calibrate and validate simulations of additional crash scenarios

Objective: Identify enhanced installation guidance for functionality and crashworthiness of the entire system
Summary

• Several failure modes have been identified that stem, in part, from inadequate performance specifications.

• NASA will provide performance-based recommendations to RTCA that will result in significant improvements in 2\textsuperscript{nd} Generation ELTs.

Questions?
Backup Charts
References


