RTCA-229/EUROCAE WG-98: Wash, DC; 13-15 Jan 15
Rough Notes

Chair: Tom Pack

Attendance: 45 attending plus two on phone at start

SC-229 Working Groups:

1) **In-flight Flight ELT Activation** (EUROCAE only) intends to have a minimum aircraft system performance specifications (MASPS) published by February 2016 and to be referenced in Annex 6 (Aircraft Operations) of the ICAO Convention by November 2016
2) **Crash Safety** will prepare input for DO-204b by the end of 2015
3) **Homing**: This Group had met six times and would be providing input for SGB specifications, DO-204b and ED-62b (both ELT MOPS)
4) **GNSS/Return Link/Power Source** would also be providing input for SGB specifications, DO-204b and ED-62b

ICAO Activities

ICAO mentioned a number of relevant **meetings**. IATA (International Air Transport Association) WG (AT-TF) and ICAO Ad-Hoc WG (AH-WG) had met three times to discuss in-flight triggering. The ICAO FLIRECP (flight data recorder panel) had met in September 2014 to work on flight recorders and on use of ELTs flight for accident site locations. The High Level Safety Conference (HLSC) would be meeting in 2015 to deal with normal flight tracking. An Aircraft Tracking Task Force (AT-TF) would address near-term flight tracking needs. The AH-WG was working on a concept of ops for normal tracking to prepare amendments for ICAO Annexes. The Air Navigation Commission (ANC) reviews recommendations applicable to aircraft over 27,000kg from these groups and sends Annex amendments to States for comment.

From 2021, aircraft would be subjected to **new requirements** to send their position to ground once every minute. In-flight activation would occur within five seconds of an emergency indication; the transmission would be able to be deactivated automatically if the triggers cease, or alternatively from the ground. Aircraft would be required to have one fixed ELT and two flight data recorders; a means of activation from the ground would also be provided. Transmission of a distress code from the aircraft would also activate the ELT along with other triggers. ICAO expects to adopt RTCA DO-204b (a minimum operational performance standard (MOPS)) by reference in its requirements. An activated fixed ELT would also activate a second device, either a distress tracking system, automatic deployable flight recorder (ADFR) or second ELT. The requirement for a second ELT could be replaced by a distress tracking system.

George Theodorakas pointed out the need for **ICAO and Cospas-Sarsat** to coordinate their work: Cospas-Sarsat specifications for SGBs would need to be conveyed to ICAO so they could be taken into account, and that Cospas-Sarsat would also need to understand in detail any ICAO requirements that would apply to the ELT. By the time the C-S TG on beacons would meet in February, the ANC would have proposals finalized; Miguel Marin (ICAO) would report to the C-S TG. An ICAO definition of 'distress' is needed for triggering criteria to be determined. ICAO's performance-based standards would not mention ELTs; nevertheless, ICAO had apparently been viewing ELTs as the preferred solution.

Cospas-Sarsat

Dany St-Pierre reported that 27,211 persons had been rescued since 1982 using Cospas-Sarsat alerting, with about 20% of the rescues having been aviation related. A preliminary SGB specification

had been developed, but not completed. 2015 would include a lot of work on MEOSAR and SGBs. The Task Group on SGBs that would meet in February would work on a test plan that would account for tests for in-flight activation. ICAO had not yet specified the duration of the transmission of an in-flight activated ELT. Dany emphasized that SAR authorities need positions from ELTs ASAP. While Cospas-Sarsat specifications are driven mainly by SAR requirements, ICAO requirements would also be met to as practicable. MASPS provisions are in addition to DO-204 requirements.

Helicopter Accident Analysis

Airbus had analyzed 42 reports of Airbus helicopter crashes involving fixed ELTs. 67% of accidents had ELT transmissions with 29 % fatalities (12% non-survivable accidents and 17% survivable); 33% of accidents had no ELT activations (19% of these had fatalities (17% non-survivable and 2% survivable) and 14% had no fatalities or injuries). The ELTs seemed to be operable in 84% of the accidents analyzed. Transmissions were not received from ELTs when the antenna cable broke and the ELT did not have its own ELT.

A substantial percentage of U.S. flag commercial aircraft do not, and are not required to, carry fixed-ELTs on domestic and international flights.

Greg Smith (NTSB) reported that NTSB was now collecting more complete data on ELTs than it had been before 2014.

ELTs within helicopter tails

New Zealand had tested ELTs within helicopter tails without external antennas. The tests were to see if an ELT with its own antenna inside the tail boom would enable the ELT signal to be received by Cospas-Sarsat. The concern was that cables to antennas outside the tail typically break in a crash.

About 80% of the radiated 406 MHz signal passed through the aluminum or carbon fiber tails on average compared to ELTs with external antennas…more (84%) near the tail and less (78%) as the ELT was moved forward within the tail. ELTs were mounted both vertically and horizontally and were detected well by LEO satellites in both orientations. 406 MHz signals did not propagate well from helicopter cabins without external antennas, and the 121.5 MHz signals did not propagate well from within the cabin or tail.

New Zealand recommended that the requirement that ELTs be installed vertically near a window be changed from *shall* to *should* in 3.1.10.4 of DO-204a so the engineers can put the ELT where it can be better protected in a crash. The main concern is crash-worthiness.

Working Group 1 (In-flight Activation)

Philippe Plantin de Hugues (**chair**) had identified what he thought needed to be decided so the MASPS provisions could be completed, particularly which criteria would be needed for activation. Not all criteria would apply to all aircraft, and criteria that would apply might not be the same for every aircraft. Chris Parfitt (FAA) **co-chaired** the WG with Philippe.

Do the criteria apply to an imminent crash or also to trigger flight data for other reasons? Philippe said the **MASPS criteria relate to an imminent crash** so the accident can be found…not to flight tracking. ICAO said it might have additional triggers. The FAA said that most nuisance messages received by the FAA were related to engine fire alerts or other smoke detections, so the FAA thought the distress activation should be based on loss of all engine functions. Crews that detect an actual fire will shut down the engine which would activate the ELT. An engine fire, by itself, should not trigger ELT activation. Actual fires that progress would trigger other criteria, and the pilot could also activate the ELT.

While detections based on triggers are problematic, activating mechanisms are generally reliable.

The MASPS might identify who will receive messages from in-flight activations and cover verification of performance of activation criteria.

The WG walked through the draft **MASPS** to identify **additions and changes**, such as:

- The MASPS would apply to activation criteria for imminent crashes.
- The MASPS purpose would be to define the minimum specification to be met for all aircraft required to carry a system that can be used to activate on-board equipment in flight for the purpose of locating an accident site
- The key concern of the MASPS is to help ensure people are rescued.
- Change *flight data* (too inclusive) to *information from which a decision can be made*
- Define 'nuisance trigger'
- Include a diagram example of the aircraft triggering functional system interfaces
- Ability to identify which trigger activated the ELT
- Possible provisions for ELT resetting or deactivating…undecided
- Table 3.1 lists the criteria to maximize the detection of potential accidents as early as possible: so far included bank, pitch, stall, excess vertical speed, unusual load factors…decided to remove the criteria table
- Eliminate antenna specifications, as they are outside the scope of the MASPS

George inquired about ELT activation from the ground that ICAO had recommended. Philippe said that only on-board systems would be addressed by the MASPS. Miguel noted that **ICAO had recommended that the ELT be able to be activated from the cockpit or the ground, and deactivated by the same source that activated it**, except that the ground could over-ride other controls to de-activate the beacon. How will ground control be communicated to the aircraft and trigger the ELT? Greg Smith (NTSB) said **ground activation** was **outside** the scope of the **MASPS** because ground activation would not be based on an imminent accident. The requirement is for the aircraft system, not for the ELT.

George pointed out that regardless of why or how the ELT is activated, the alert would be viewed as a distress alert and the response would be the same unless the alert can somehow be associated with some non-distress scenario. Dany pointed out that an alert might be processed differently if the ELT is triggered on the ground, which would require that the message to identify the means of activation. Whether the ELT is **activated manually or automatically** might need to be known as well.

A **scenario** is a condition or situation (of set of such) that could result in loss of controlled flight (and a likely accident if uncorrected) and that would cause an in-flight activation of data transmission that would enable location of the accident. Philippe will include a sample Scenario table based on a combination of robust (detailed) criteria.

In-flight criteria identified as relevant were unusual attitude or speed, loss of power by all engines, and ground proximity (except during take-off or approach). Deceleration would not be considered relevant. The MASPS will not include 'robust' triggering criteria (specific quantifications and time limits). The aircraft must be designed to meet the criteria. Some in the WG felt that the criteria should be specific, since the MASPS will be a guideline with examples, not a mandate for all aircraft.

The **triggering function** would be an aircraft rather than an ELT function.

Boeing had some data indicating that about nine **nuisance alerts** happen worldwide each day, and was concerned about degrading the SAR system. Mark Smith (Boeing) said there had been about one

worldwide underwater accident per year since 1980 among all jet-powered commercial aircraft (22,732 aircraft with about 26 million flights per day and about 55 million flight hours…a great potential nuisance risk), and about once in ten years a downed aircraft had taken more than a year to locate. (Philippe had data that indicated two per year on average.) There were roughly 15 accidents per year on the ground. Boeing thought the focus of in-flight alerting should be to find downed aircraft with survivors in less than a day for SAR, and less than about 30 days for other purposes. Mark's main point was that the criteria must be such as to make the number of nuisance alerts manageable.

To control costs, aircraft use VHF communications within VHF range of the airport, and then switch to SATCOMMs or HF. Most accidents have happened within the VHF range. ICAO refers to the comms system as **ACARS** (aircraft communications addressing and reporting system). Boeing has started including lat/longs in ACARS transmissions with its 787s and other recent models.

Connectivity is often compromised during aircraft descents, which makes the in-flight ELT function of greater value. **Boeing** uses these **triggers**: pitch, roll, yaw, low airspeed, over-speed, both engines inoperable inflight, abnormal acceleration, vertical rate and low few. Boeing had many nuisance alerts due to sensor problems, especially for low fuel. ACARS transmits once per minute post-trigger, and reports which trigger was exceeded, the time/location/altitude/speed/heading/track, Euler angles (three angles to describe the aircraft orientation) and change rates, vertical speed, engine info, total fuel, total air temperature (TAT), etc.

Airlines must resolve nuisance triggers from ACARS, but the ELT alerts would likely prompt a SAR response. About 60 bank angles and 30 stalls trigger ACARS alerts each day world-wide, indicative of potentially more in-flight ELT alerts than should have to be dealt with. Boeing argued that the potential nuisance problem should be evaluated. However, Philippe thought this would be unnecessary since the MASPS would not include mandatory criteria. Chris Parfitt felt that some target should be set for the maximum number of **nuisance alerts** (e.g., alerts per million hours based on historical data) and a way to demonstrate that this would likely be met. Philippe wanted the document to specify an objective of zero nuisance alerts.

The tolerance of Cospas-Sarsat and SAR should account for all potential sources of nuisance alerts, e.g., commercial, helicopters and potential general aviation. Dave Fuhrmann commented that the AFRCC could accommodate a maximum increase of about 700 more false alerts per year. Many transponders are triggered during maintenance and testing, and this problem will be exacerbated with the addition of MASPS. Such activations could also put time on the ELT that would necessitate a battery change. For FAA certification, manufacturers would have to show compliance with a standard for nuisance rate limits…some way. For Cospas-Sarsat, the nuisance rate for an aircraft (mainly affected by the software algorithm) is more relevant than the rate for each triggering criteria. The **nuisance rate** should be agreed with Cospas-Sarsat.

Other systems besides ELTs might be used to send MASPS alerts; the MASPS is not being written solely for ELTs.

To reduce nuisance alerts, the WG considered providing for **disabling the MASPS** capability during times when radar or ADS-B would provide tracking and passive alerting.

Persistence time (duration) would be applied before triggering to help limit nuisance alerts while still ensuring transmission of alerts for any actual distress situations.

The **SGB** has **advantages** over ACARS due to global coverage and better chance of rescue. Chris O'Connors pointed out that SARSAT would need to establish procedures for handling in-flight alerts; whether in-flight alerts will go to SAR or elsewhere is to be determined.

The **triggering outputs** need to be identified for automatic activation, manual activation, de-activation and perhaps other desired ELT responses.

Specifications will be drafted on a parameter for **automatic cancelation**.

Chapter 4 of the MASPS will deal with triggering **performance verification**.

ELT messages could indicate whether the ELT was activated in-flight, on the ground, or canceled and whether the activation was manual or automatic. However, the transmitter might not be an ELT. The MASPS trigger would only tell the transmitter when to **transmit or stop** transmitting. DO-204 can provide a standard way for the MASPS to tell an ELT to turn on or off.

Working Group 2 (Crash Safety)

WG-2 recommendations on how to install ELTs would be presented to RTCA and EUROCAE by early 2016.

Chad Stimson (NASA) commented on NASA's research, called **ELTSAR** (ELT survivability and reliability), was being supported by tests and by the FAA and NTSB. A helicopter had been crashed. Vibration tests were conducted. Preparations were underway for three severe but survivable general aviation crashes; NASA agreed to announce the test dates so observers could attend. NASA will develop computer models to predict results and then use the tests to calibrate and improve the models. ELTs from various manufacturers were being used in crash tests. Chad reviewed topics that he anticipated would be addressed in MOPS based on multi-axis loading, crash pulses and functionality tests. Multi-axis g-switches had been performing much better so far than single axis switches. Activations are checked at 3, 6, 9 and 12 Gs. Some crash-tested ELTs did not activate even with excessive Gs applied. There had apparently been some g-switch failures over time due to in-flight vibrations. WG-2's vibration tests might be based on RTCA DO-160G.

Eric Hiner (Astronics) had provided input to WG-2 on **fire and flame** research related to ELT crash performance. DO-204A requirements are severe for 15 seconds, but FGB first bursts occur at 50 seconds, which is an obvious concern. Both battery cells and oscillators need to be protected from overheating in a fire for proper ELT operation. ELTs had failed to operate in prominent crashes involving fire. WG-2 was reviewing a proposed fire test method.

Working Group 3 (Homing)

Al Knox commented on the SGB homing signal work for the C/S CWG. He spoke to the importance of homing to SAR, work on signal characteristics, and the desire to accommodate existing DF equipment. Interleaved homing signals (406 MHz, 121.5 MHz, and AIS) were being studied as a transition until use of 121.5 MHz homing signals can end. 121.5 MHz apparently can interfere with receipt of GPS signals.

FRAC (final review and comment/RTCA consensus building process)

RTCA has 496 members. Consensus is not always 100% agreement, but all opinions are heard and all members 'can live with' the results. Dissenters can have their view documented and presented to the Program Management Committee (PMC) with a special committee's report. All committee plenary sessions are open to the public.

RTCM documents are reviewed for 30-60 days during which comments can be submitted to the 'workspace.' Then the Committee approves the document and sends it to the PMC, again with dissenting views, if any. A Federal Register announcement provides details of a PMC meeting where the document will receive final review for approval. The MOPS is expected to be approved and published by around April 2017.

The PMC Chair is Chris Hegarty from Mitre Corporation. Committees like SC-229 are 'sunset' when their MOPS or other product is finished.

The FAA estimates that the Technical Standard Order (TSO) will be published by August 2017 assuming PMC approval by March 2017. The FAA does not plan to phase out first generation beacons when the new TSO is effective; however, they might eventually be phased out.

FGBs are not expected to have in-flight triggering other by pilot activation. However, FGB locations would not be reliable or useful. SGBs will have guaranteed detection and performance with MEOSAR, which is expected to be operational by early 2018…DASS satellites might enable earlier deployment if the ground system is sufficient.

Action Items

Action items 1 and 3 from the Toulouse meeting (refer to Toulouse minutes) were closed; other Toulouse actions were to be completed before or at the Hamburg, Germany meeting.

2015 SC-229 Meetings

21-23 April in Hamburg

1-3 September in the USA (possibly outside of Washington, maybe at Boeing in Seattle/draft MOPS would need to be agreed)

15-17 December in Paris (MOPS finalized)