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**MEETING MINUTES
 MEETING OF SPECIAL COMMITTEE 231**

TAWS – Plenary Session

Date: March 24, 2015
Time: 0900 EDT to 1100 EDT
Place: RTCA Office, Washington DC
Co-Chairmen: Yasuo Ishihara Rick Ridenour
Designated Federal Official: Charisse Green

Attendees:

Name	Company/Agency
Baker, Kirk	FAA
Becerikli, Eylem	STM A.S.
Bykov, Vladimir	IANS, Inc
Bousquet, Sophie	RTCA
Fleury, Stephane	Thales
Green, Charisse	FAA
Ishihara, Yasuo	Honeywell
Johnson, Steve	Honeywell
Kapytov, Vasily	IANS Inc.
Kirtz, John	Rockwell Collins
Labay, Marcus	FAA
Le Cann, Alexandre	Airbus
Mulkins, Jim	Honeywell
Resnik, Boris	IANS Inc.
Reynolds, Zach	ACSS
Ridenour, Rick	ACSS
Teel, Brandi	RTCA
Tubb, Nicholas	Boeing
Vafiades, Monica	U.S. Air Force
Zapoluch, Steven	Garmin

Plenary Discussion:

Rick Ridenour and Yasuo Ishihara (co-chair) led this meeting.

Meeting called to order with a brief self introduction of each of the 14 attendees.

A request was made for any changes or comments to the current group charter. None were noted.

NEXT STEPS

The next plenary meetings are as follows: 9-11 June 2015 in Washington DC. The following meeting is then planned for 22-24 September 2015, also in Washington DC.

The next planned meeting is the telecon planned for 16 April at 1000 AM EDT. The regular scheduling of each telecon is on the third Thursday of each of the following months:

- May, July, August, October, and November, at 10:00 AM Eastern Time for a 2 hour duration.

Plenary section closed with this remark.

Working Group Discussion:

Tuesday, 24 March:

Rick Ridenour and Yasuo Ishihara (co-chair) led this meeting.

A walkthrough of actions stemming from DO-161 comparisons took place first, using the **Exhibit 2** Comparison to DO-161A Power Point slides.

Slide 4 – definition of Equipment was discussed and the omitted sentence of “The equipment need not include other sensor systems for which separate standards are applicable, e.g. Radio Altimeter.”

The e-mail recommendation of Hugues Meunier has been analyzed and determined to be applicable, where external sensors are not accounted for the in the equipment definition:

The word “equipment” as used herein includes all the functional components necessary to properly performed the intended function. However all external components to the function which are cockpit or system specific, though necessary for a proper operation of the function at a system level, are out of the scope of the “equipment requirements” (e.g. cockpit controls, cockpit indicators, cockpit display, aural systems, inputs sensors).

The Strawman was then updated within the meeting for these items.

We have also noted that the Equipment definition is not present in the Definition section. Other definitions may also be missing.

Action (Z. Reynolds TBD) – a review of the definition section of the Strawman should take place.

Slide 7 – existing Strawman paragraph 2.1.7 was considered the correct reference and no further action is required for this item.

Slide 13 – A shall requirement has been drafted by R. Ridenour. The group then modified the wording to include a shall requirement per below:

“The equipment shall be designed such that the appropriate alert modes are automatically enabled throughout the flight without requiring any dedicated action by the flight crew.”

A clarification of the note associated with this requirement was made. This was then added to the upfront section 2.1.X, as “Automatic Mode Selection”.

The group felt this requirement could be met either by test or by inspection of no other mode selection buttons or switches in the cockpit.

Slide 17 – Self-test discussion. We brought up the potential of in-air self test. We agreed that this would not be precluded; if a given system could perform an initiated self-test, we would not stop them. Then we clarified that self-test would be better defined as initiated self-test. The use of initiated self-test rather than self-test was then implemented in the Strawman.

A side discussion of Class A vs. Class B section arrangement occurred. We are stating that each section should be standalone, so that a viewer of Class C requirements would not need to view Class A sections for their requirements. In keeping with this, common requirements will be set up in section 2.1.X. We then moved the failure monitor and initiated self-test in section 2.1.X.

A review of *Exhibit 1*, comparison to TSO-151C, has taken place. More than 10 real time updates were made of the Straw Man during this discussion. Several sections’ comments remain from the Class B sections. One action remained from this review.

Within this discussion, Kirk Baker commented that the use of the term “hazardous” or “hazardously” implies to some readers a safety category consistent with a 1E-07 criticality level. Therefore, the following was generated.

Action (Z. Reynolds TBD): Remove the word hazard from the SC-231 Strawman and replace with appropriate phrasing.

Action (Z. Reynolds TBD): Replace the word “must” with “shall” or “should” in all instances. The term must is ambiguous and often has no test case.



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Action (Honeywell, ACSS, Garmin): By 3 April, suppliers to provide Phase of Flight limitations (enroute, terminal and final) to Charisse Green. We will then plan on a discussion by the May telecon.

Past actions were covered. Charisse indicates that the below action should remain open:

Action – C. Green to check with other manufacturers to determine if they are providing this Mode 4 Too Low Terrain function. If the supplier response is 100 % or nearly so, this could be included as a formal description in the new DO document.

In regard to the below action, Charisse feels she has the information now for Modes 1-5 needed to create a consolidated requirements for the below. PDA alert information has not yet been provided.

Action (C. Green) –C. Green to provide the remaining consolidated envelope containing net result of inputs provided to her on Modes 1-5 GPWS. Within this set of meetings, Mode 1 Normal, Mode 1 Steep, Mode 3 and Mode 5 have been presented.

Action (C. Green) – While all PDA alert envelopes have been provided to C. Green, she will consolidate these. Therefore, an action remains for Charisse to present the consolidated PDA curve information.

Rick Ridenour presented **Exhibit 3**, a spreadsheet showing a discontinuity of the vertical speed descent cases of Tables B, D, and F compared to the level flight case. For one example, the extrapolation of the -1000 fpm case shows a zero vertical speed crossover at 500 feet and yet the level flight case has a minimum alerting threshold of 600 feet. It is proposed that the minimum alerting threshold for the level flight case would be lowered to match the descending case. In one example, the 5700 (+0/-100 ft) example would be changed to 5600 (+0/-100 ft).

Steve Johnson presented a study (**Exhibit 4**) of 6 past CFIT cases which might yield one moderate turning FLTA case to determine one of more case to add to Table J to cover the turning case. One line of thinking is to capture the Cali, Columbia case to insert as an additional Table J case.

Action (C. Green)– Charisse to work with the Accident liaison (TBC) to the NTSB to determine if the aircraft telemetry can be obtained for the Cali Columbia case. At the same time, we would wish to obtain the telemetry from the Birmingham UPS crash from the NTSB.

As much as possible, the test report should include as many of the following parameters as possible used to recreate the events per a listing accumulated during the meeting (reference **Exhibit 7**) for at least 2 minutes leading up to the crash.

A discussion then took place over what bank angle recovery rate one might expect to apply to the Table J case we are proposing. The number of 5 degrees per second (after the 1 second pilot response) to a wings level orientation is a going in position.

Action (A. Le Cann) – Alexandre Le Cann to investigate maximum recovery modes which may be available through Airbus channels.

Wednesday, 25 March:

Z. Reynolds brought up a missing requirement in section 2.2.1.1.5.1, FLTA Arming/Disarming. This led to a discussion took place over definitions of arming/disarming vs. inhibition. It seems that in general, arming or disarming is an automatic action by the system. Inhibition is a silencing or overriding of an alerting function from an external input or manual action.

Action – Rick Ridenour to develop a definition for arming/disarming and inhibition to clarify these definitions.

Charisse Green presented a spreadsheet, *Exhibit 5*, showing each of the GPWS Mode curves for the collective suppliers. Mode 1 was presented first, showing (a) current alert thresholds via 161A, (b) Suppliers' minimum alert thresholds. Rick Ridenour moved that the (a) current thresholds would be acceptable if at least a Caution alert "Sink Rate" is present at this (a) level.

Charisse then provided a consolidated Caution and Warning set of Mode 1 curves. In this presentation, we considered the tradeoff between (a) including a Maximum and Minimum Caution alert AND Maximum and Minimum Warning alert. Or (b) a Maximum Caution and Minimum Warning as has been done in the FLTA alerting?

Decision: For the non-steep (later combined) Mode 1 alerting, include (a) Maximum and Minimum Caution alert AND (b) Maximum and Minimum Warning alert. With the information from suppliers now gathered, it makes sense that we can now define these respective limits. During the document review process, we may learn of other non-attending suppliers who can not meet these respective limits and at that point we may decide to return to (b) Max Caution and Minimum Warning.

Mode 5 was then presented. A lower limit of 30 feet is beyond the 161A limits. Honeywell has noted that the lower limit is a heritage value and is not present in the industry.

Airbus higher low altitude cutoff (150 feet) is also not presented and should be part of the Mode 5 curve.

Action (closed) – ACSS and Thales to provide information back to Charisse requesting a new lower limit for Mode. ACSS/Thales confirms a 30 foot lower limit.

Action (closed) – Charisse Green to add Caution levels to the Mode 1 and Mode 2 curves also to allow the comparison of the Supplier's caution curves to (a), the regulation limit.

Zach Reynolds presented a series of illustrations showing the GPWS modes and FLTA mode. Several comments were recorded and the presentation updated per *Exhibit 6*.

Steve Zapoluch presented alternate wording for the FLTA concept of having caution alerting before warning alerting. This was then adopted within the meeting.

The topic of Mode 2 degraded modes was brought up. A discussion took place to propose a statement such as “When FLTA function is operating and database is reliable, then it is permissible to reduce or eliminate Mode 2 envelope.” Charisse remarked that the safety benefit is not apparent in this statement. The new applicant would still need to go through an approval process. Alternate wording to allow for this would be “the above substitution of FLTA functions is allowable provided written justification is provided.” A generic argument exists for why Mode 2 is not needed.

At the least, we feel that Mode 2 needs to be compatible with radio vectoring altitudes which would prescribe not having alerts above 1,000 feet. In order to attempt to converge on this topic,

The next topic was the filtering or time guard topic. Each supplier has provided the FAA with its static Mode curves. These lower limits are not the actual test lower limit. So an approach to account for this dynamic effect is to establish the lower limit and subtract from this the Honeywell provided filter and time lag effect at each vertical speed of the Mode 1, 2, 4 and 5 lower limit.

Action (Honeywell): Upon establishment of the static based GPWS curve lower limits, Honeywell to provide the lower dynamic limit. After this step, other suppliers will be invited to verify that their system meets these lower limits.

Thursday, 26 March:

Mode 3B alerting was presented. While there is a maximum shown at 1500 feet, the desire is to show a maximum of 1600 feet as the Mode 3 alerting maximum, allowing for some tolerance. Then, for the eventual curve, we would plan on having (a) a Maximum and Minimum upper threshold and (b) a Maximum and Minimum lower threshold. We would also propose (c) having an arming level of 100 feet, to allow for current suppliers to enable/disable.

Decision: for all of GPWS Caution-only modes, the combination of (a) a Maximum and Minimum upper threshold and (b) a Maximum and Minimum lower threshold would be applied.

Action (Garmin remains): All suppliers to check for their Mode 3 arming level. At takeoff, low level fluctuations may be allowable until certain levels at which time the Mode 3 alerting can take place. This is distinguished from the lower limit which determines down to which levels the Mode 3 alert will continue. Honeywell has responded that the re-arming occurs at 100 feet. ACSS/Thales indicates no altitude based re-arming and therefore they are able to comply with re-arming at 100 feet.

For the Mode 2 deactivation, Honeywell has provided a generic wording which could potentially address all implementations and thus eliminate the need for a deviation.

- FLTA is enabled
- FLTA is not INOP

- FLTA is not inhibited
- Horizontal position accuracy is sufficient
- Altitude accuracy is sufficient
- Surrounding terrain database is high quality

ACSS and Thales expressed a concern that GPS should not be required if adequate safety can be shown with the less accuracy lateral sources.

R. Ridenour suggested including test cases of specific 3 sigma offsets from a correct position. There was a discussion of a GPS signal being jammed and having an undetected significant position error. However, this is considered a 1E-06 event and not worthy of addressing. K. Baker has asked what we are trying to solve here – are we developing a GPS error detector (beyond the HFOM/HIL) or are we trying to set requirements for a backup to FLTA? This leads to the suggestion that a test can set up to simply shut down FLTA and ensuring that Mode 2 protection is available.

We intend to word requirements to indicate:

- Modifications or deactivation of Mode 2 can take place when FLTA is active.
- When FLTA is Inoperative, Mode 2 alert levels must be maintained.

The committee recommends an Appendix providing rationale for this decision. This can include specific Mode 2 alerting scenarios from the past and a demonstration that the FLTA alerting occurs in a timely manner in these same scenarios. Another means could be a Monte Carlo analysis showing the effectiveness of FLTA compared to FLTA plus Mode 2 alerting. Then, qualitatively, we can describe the greater proliferation of GPS, the improved accuracy of GPS and the increased accuracy and resolution of the terrain database.

Another thrust is made towards requiring suppliers to provide their justification for modification/deactivation of Mode 2. Perhaps requiring the continued submittal of justification, but without the burden of a deviation could be sufficient.

The committee recognizes that it may not have the final say on this issue. While we have some rationale for simply choosing the FLTA Inop case as the only test condition for Mode 2, this may ultimately lead to further discussion.

Action (R. Ridenour): Rick to propose Strawman wording for the rationale for the Mode 2 deactivation or modification.

The consolidated Mode 1 steep approach curves were then presented. Because the respective minimum alerting altitudes are very similar, one thrust is to have a single Mode 1 curve rather than break into Non-Steep and Steep curves. In theory, we could propose a single Mode 1 curve that would then include the most extreme (max of the maximums, min of the minimums) limits in a single curve.



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Decision: The Mode 1 curve will include both Non-steep and Steep approach limits. The resulting curve will then have limits for:

- (a) Maximum (from normal approach) and Minimum (from steep approach) Caution alert
- (b) Maximum (from normal approach) and Minimum (from steep approach) Warning alert
- (c) Maximum and Minimum lower cutoff for all alerts

For both warning and caution lower limits, Honeywell has noted that the FAA interpreted lower limits are in fact lower at many points than the actual curve. Because the Honeywell Mode 1 limits are in the public domain, Honeywell has asked for the lower limits which Charisse has presented to be replaced by the Honeywell limit.

We are aware of the arming minimum at 100 feet that is found in the DO-161A. For all suppliers, the lower limit is the defacto arming altitude with no safety impact. We would also propose (d) having an arming level of 100 feet, to allow for other current suppliers to enable/disable.

Action: C. Green to propose the combined Mode 1 curves, consolidating the (a), (b), (c) and (d) limits above.

NEXT STEPS

The next telecon to be held on Thursday, 16 April at 10:00 AM EST.