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WORKING GROUP MEETING MINUTES MEETING OF SPECIAL COMMITTEE 231

TAWS - GPWS

Date: June 9, 2015 to June 11, 2015
Time: 0900 EDT to 1700 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.
Bosquet, Sophie	RTCA
Fleury, Stephane	Thales
Green, Charisse	FAA
Ishihara, Yasuo	Honeywell
Johnson, Steve	Honeywell
Le Cann, Alexandre	Airbus
McKeon, Sean	Universal Avionics
Mulkins, Jim	Honeywell
Reynolds, Zach	ACSS
Ridenour, Rick	ACSS
Sadilov, Seva #	IANS Inc.
Tubb, Nicholas *	Boeing
Vafiades, Monica	U.S. Air Force



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Zapoluch, Steve #	Garmin
# attended by Phone *-attended by Phone Tuesday only	



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June 9:

A review of action items from the March meeting and April telecon took place while using the Exhibit 1 Strawman to accumulate Redline changes. If a given action was closed within this meeting, the action is shown in standard characters. Action remaining from this meeting are shown in bold.

Action (Z. Reynolds / June 10) – a review of the definition section of the Strawman should take place. Zach had not completed this for the word equipment or other definitions found within the document. He asked for an additional month.

CLOSED within meeting. During the presentation, most comments were resulting from a comparison to AC 25.1322. The initial analysis did not include AC 25.1322. Zach took the action to review this Tuesday evening and develop a better definition package, inclusive of the AC 25.1322. These were then incorporated into the Strawman.

Action (C. Green / June 15): Charisse to pull together a consolidated summary of Phase of Flight into a single graph of the respective limits by Mon, June 15.

Action (S. McKeon / July 16): Sean McKeon of Universal, having joined the group, has been asked to provide the following to Charisse to consolidate within the consensus curves:

- Phase of Flight
- Modes 1 – 5 curves

Other actions accumulated within these meetings:

- Handling of obstacles in the same manner (sensor, clearance) as FLTA
- Check to ensure that Mode 4 alerting is independent of FLTA, as the current Strawman reads in this manner at the moment.

Sean will check with his Universal counterparts to decide on what further information Universal can provide.

Action (C. Green/ July 16) - Charisse to update all of the below modes to show the correct minimum and maximum envelope limits. Changes will need to be made based on Tuesday June 9 discussions to provide the Mode 2B envelope. In general then, the below shows the status of the consolidated Graphs. Within these meetings, the suppliers decided on a static set of curves rather than dynamic, as had been suggested in earlier meetings.

Alert Type	Status of Consolidated Graph, where a Universal exception may exist when they provide curve
Mode 1	Please Provide, based on Static
Mode 2A	Please Provide, where separate

	caution and warning are needed
Mode 2B	Please Provide, based on Static
Mode 3	Please Provide, should be same but to be provided
Mode 4	Generic curve to be used, existing action for Suppliers on Envelope 3
Mode 5	Please Provide, should be same but to be provided
PDA	Suppliers to Provide

Action (R. Ridenour / June meeting): Define a set of requirements for a Mode 4 Too Low Terrain alert within the June meeting.

ACTION closed – the discussion below supersedes, with a spawning of 2 new actions below.

Mode 4 discussion took place. Several manufacturers meet the existing 161A Mode 4 Envelope 1 with Radio Altitude and Baro Altitude Rate. This Envelope 1 will be ported over unchanged. No suppliers are using Envelope 2. Some manufacturers are using something resembling Envelope 3, but Baro Altitude Rate is unused.

For the suppliers using Envelope 3, a single threshold is shown in the y-axis with CAS on the x-axis and some cutoff for a transition from Too Low Gear to Too Low Terrain. We would then have words like “above some aircraft dependent Airspeed, the manufacturer may transition this alert from Too Low Gear to a Too Low Terrain.”

The same type of behavior would be applied to Too Low Flaps, with a range of levels (245 feet).

Then, Too Low Terrain would be the complement of the Too Low Flaps/Gear, where word could be applied such as “below some aircraft dependent Airspeed, the manufacturer may transition this alert from Too Low Terrain to a Too Low Gear or a Too Low Flaps.”

As an option, the radio altitude threshold should also be expressed as height above field. This would apply to either Envelope 1 or Envelope 3.

Action (Z. Reynolds/ TBD) – develop requirements for the Mode 4 thresholds without graph.

This was then presented on Thursday as Exhibit 5, with modifications made within the meeting to the text, but no changes yet made in the Strawman. It was then decided to include a graph for Envelope 3 if the above requirements are placed in the eventual Strawman.

ACTION closed within this meeting.



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Action (R. Ridenour/ TBD) – Rick to develop graph and requirements for the Option 2 {Envelope 3 Mode 4 thresholds (2 of them – one for Too Low Flaps transitions to Too Low Terrain, another for Too Low Gear transitioning to Too Low Terrain)}.

Action (Z. Reynolds/ TBD) – Zach to develop graph and requirements for the Option 1 Mode 4 thresholds based on the original GPWS Envelope 1.

Action (C. Green/ 21 May) –C. Green to provide the remaining consolidated envelope containing net result of inputs provided to her on Mode 2B, Mode 4 and PDA.

ACTION closed within this meeting.

PDA discussion then took place (using Exhibit 8), where the Charisse provided curves which gave suppliers the insight that the minimum radio altitude levels compared to distance from runway are the key elements for this alert. This caused the realization that suppliers' alerting is dependent on two different factors: distance from runway and vertical speed. In the context of typical PDA scenarios, the group decided that the best definition should be based on distance to runway vs. height above terrain where Vertical speed and ground speed are considered irrelevant for the curve being generated.

Action (Y. Ishihara, S. Fleury, S. Zapoluch, S. McKeon/ 23 June) –Suppliers are asked to respond with a PDA table showing the alert heights at 0.25 Nm increments and down to 0.25 Nm away and up to 20 Nm away at the Runway Threshold with no displaced threshold, providing this to Charisse. The vertical speed is considered as close to level as possible, in order to still get alerting.

Action (C. Green / 9 June) – 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, each of the 6 turning cases and every current Table J case from the NTSB.

A week ago, Charisse learned that a formal letter is required by the NTSB. It can be as simple as taking the E-mail words and applying these to an RTCA letterhead.

ACTION superceded within this meeting.

Action (R. Ridenour/S. Bosquet / TBD) – Submit a formal RTCA letter describing the request for flight test data for key crash cases which are desirable for the new release DO document.

The RTCA letter created from Margaret Jenny to Chairman Hart of the NTSB, but this has not yet been posted.

Action (Rick / 9 June) – Rick Ridenour to update the strawman in regards to the use of arm, disarm, inhibit and related words.

While reviewing these inputs, the term “system” was raised as not being defined. The HTAWS MOPS DO-309 includes a definition of the entire system. The suggestion was made that the SC-231 DO document should include the System definition.

ACTION closed within this meeting.

Action (R. Ridenour / 21 May); Rick to propose Strawman wording for the rationale for the Mode 2 deactivation or modification. This can include the widely perceived view that Mode 2 alerts are so alert prone that they provide marginal alerting value.

ACTION closed within this meeting. See Exhibit 6 – Mode 2 Disarming.

Question raised in this June meeting on whether to indicate static vs. dynamic limits for alerting on the curves shown in the new DO document. The group consensus now is that the Mode 1-5 limits are more easily described with static limits.

With the static limits decided, a maximum latency is requested from each supplier which would be an addition. We will look out for a case where there are suppliers who are heavily weighted (low limits but short time delays vs. high limits but long time delays).

Action (Y. Ishihara, S. Fleury/Z. Reynolds, S. Zapoluch, S. McKeon/ 23 June) –Suppliers to provide the time delays to Charisse for the alerting for the below cases. This time delay is to include filtering effects, confirmation time, hysteresis, or time guards. As part of this response’s consolidation, there will be 2 x Mode 2 warning numbers developed (a minimum and maximum).

Alert Type	Caution Time Delay	Warning Time Delay
Mode 1	Please Provide	Please Provide
Mode 2A	Please Provide	Please Provide
Mode 2B	Please Provide	Please Provide
Mode 3	Please Provide	N/A

Mode 4	Please Provide	N/A
Mode 5	Please Provide	N/A
FLTA	Please Provide	Please Provide
PDA	Please Provide	N/A

Action (Z. Reynolds / 21 May): Develop a 500 foot Altitude Callout figure.

ACTION closed within this meeting. See Exhibit 2.

Action (R. Ridenour / 21 May): Within the FLTA – Option 1, better illustrate the changing search volumes with a series of depictions. The addition of a level flight example is also suggested. But this is already presented in the Imminent Terrain Impact example shown on slide 9.

The WORD document of Exhibit 7 shows the intended figure for depicting this alerting condition. This we briefly reviewed, with a change suggested within the Warning Alert (which still says caution). No other changes noted within this meeting, though questions may arise after this meeting.

ACTION closed within this meeting and Strawman updated accordingly.

A general review of the document's Editorial comments (Ed:) then took place. Several notes were taken for future editing.

The FLTA figures are currently labeled to be dropped into the FLTA section 2.2.1.1.2. In fact, we have included these figures into the section 2.2.1.1.5.

Notes were added for the disarming of FLTA during a takeoff / landing.

June 10:

A review of definitions was conducted and added to the Strawman per Exhibit 3 notes and a creation of a Class A, B and C summary shown in Exhibit 4. These were both added to the Strawman.

This set of definitions then included recommendations to change the AC 25-23.

Action (Z. Reynolds/ July 16) – E-mail Charisse Green a summary of these changes for the AC. He will be sure to include the modified definition of Class A and B to not include RTC and ITI which are test cases, not functions.

Action (Z. Reynolds/ TBD) – E-mail co-chairs a section 1.2.1 and 1.2.2 replacement drawn from the AC 23-25 requirement.

ACTION closed within this meeting.

Within the definition of Terrain Database, a further discussion of the handling of obstacle alerting function. We weighed out adding the obstacle alerting to the TSO vs. allowing obstacles as an added feature. It appears that significant number of installations (~10 %) will not have obstacle capability and therefore it is prohibitive to mandate the obstacle alerting in the TSO.

In favor of including obstacles in our new DO document:

- Operator approach procedures will take credit for a TAWS having obstacle procedures, though we can not find this on the spot.
- AC 90-101A reads: “Class A Terrain Awareness Warning System (TAWS). An operable TAWS is required for all RNP AR procedures. The TAWS should use altitude that is compensated for local pressure and temperature effects (e.g., corrected barometric and Global Navigation Satellite System (GNSS) altitude), and include significant terrain and obstacle data.”

Because all suppliers handle sensor constructions and clearance allowances for obstacles identically as terrain, a decision was made to include obstacle references throughout the requirements. However, obstacles are not required.

Action (S. Fleury/ July 16) – Added a dotted line obstacle database box to the System Overview figure. Then, continue by replacing where appropriate, references to “terrain” with “terrain/obstacles”.

A discussion was held revealing that the AC 90-101A also discusses using the TAWS as an independent cross check for the Low RNP route. As the TAWS will very likely have a common GPS source with the navigation system and the TAWS is not meant to be used for navigation purposes, the below paragraph from AC 90-101A is being raised for further investigation:

g. System Crosscheck. For approaches with RNP values less than 0.3, the flightcrew must crosscheck the lateral and vertical guidance provided by the navigation system with other available data and displays provided by an independent means (e.g., TAWS, weather radar, etc.).

This is contrasted with the AC 25-23 TAWS regulation which shows:

21. AIRPLANE FLIGHT MANUAL (AFM)/AIRPLANE FLIGHT MANUAL SUPPLEMENT (AFMS). The applicant should make an evaluation to determine if there are any limitations of the system and, if so, how they will affect aircraft operations. Any limitations affecting operations must be included in the AFM/AFMS. As a minimum, the applicant should provide instructions in the Limitations Section of the AFM/AFMS that include the following:

a. **Limitations.** The following instructions should be included in the Limitations section of all AFM/AFMS:

- (1) Navigation must not be predicated upon the use of the TAWS.

NOTE: The Terrain Display is intended to serve as a situational awareness tool only. It may not provide the accuracy and/or fidelity on which to solely base decisions and plan maneuvers to avoid terrain or obstacles.

Action (S. Bosquet / C. Green/K. Baker / TBD): Contact Barry Miller for discussion on how applicable the above advice is for the System Crosscheck requirement found in AC 90-101A. This can be initiated within SC-227 Standards of Navigation Performance (RNP) committee meeting next week at RTCA.

Upcoming meetings were discussed:

The next planned meeting is the telecon planned for 16 July at 1000 AM EST. Then, 22-24 September 2015 is the next planned Plenary meeting. The regular scheduling of each telecon is on the third Thursday of each of the following months:

- Other upcoming telecons include August, October, and November, at 10:00 AM Eastern Time for a 2 hour duration.

Planning of upcoming meetings has been discussed:

- 8-10 December 2015 is then planned for a Plenary meeting. As an option, ACSS could host this meeting in Phoenix to accommodate the better weather conditions. Charisse will let us know if she can also attend. Chip Bulger may also attend and Charisse can notify of his availability also.
- 9-11 February 2016 next at RTCA in Washington.

We are aware that the review takes 3 months. Thus, we must complete the Strawman by September 2016. In the past, the HTAWS took 2 full meetings for test cases. Therefore, we plan on getting into test cases well before 2016 to avoid any crunch.

A general review of the document's Editorial comments (Ed:) then continued.

Action (Z. Reynolds/ 18 June) – Paste pictorial figures for Mode 1 to 5, callout and FLTA cases into the Strawman from Power Point.

A general discussion of curve presentation was then made. Dashed lines are now being shown for Maximum points. Dotted lines are being shown for minimum alert points. Shading of must alert areas, numeric callouts of vertices and three distinct label (Shall, Shall Not, May), grayscale compatible plots. These will become the standard for the graph presentation.

Action (Y. Ishihara/ 20 August) – Create graphs for Modes 1 to 5 into the Strawman, based on the Mode 1 Caution example provided during committee meeting of June.

Action (R. Ridenour/ 16 July) – Rewrite intro section of 2.2.1.1.8, which currently has incorrect information such as “Mode 2 is always active...”. Provide as an Exhibit, for later pasting into the Strawman.

Most suppliers have a time dwell for transitioning from a Mode 2 Caution to a Mode 2 Warning. But at least one supplier has separate curves for Mode 2 Caution and Mode 2 Warning. Therefore, 2 sets of curves are needed for Mode 2 Implementation 1 and Implementation 2.

Monica suggested that a “shall not” series of requirements for the Modes 1-5 be applied in order to ensure that complete test coverage is applied for these cases. Having only shall requirements for the respective curves does not indicate strong enough to the supplier that there are 2 criteria for each of their test points.

Because there are 2 separate implementations for the Mode 2 warning, there are separate latency concerns for each. The Garmin implementation is based on a Warning envelope while the other suppliers’ implementation is based on the use of a single envelope. For the latter, a discussion on Mode 2 timelines then occurred. In the context of Mode 2 Caution and Mode 2 Warning, we defined:

- YYY seconds: maximum latency from raw signal entering the Mode 2 curve and the time the caution visual and aural for the alert occurs.
- WWW seconds: minimum from raw signal entering the Mode 2 curve and the time the warning visual and aural alert occurs.
- UUU seconds: maximum latency from raw signal entering the Mode 2 curve and the time the warning visual and aural for the alert occurs.

Action (R. Ridenour/ TBD) – Propose a rewrite that includes (a) an introduction to the Mode 2 warning containing 2 implementations, (b) a treatment of implementation 1 latency and (c) a treatment of the time bounds for the implementation 2 latency (minimum to hear the caution and maximum at which a warning must occur). Also, add the consideration of the condition where landing gear being down causes no Mode 2 warning to occur for implementation 2.

ACTION closed - The above action was reviewed within the 11 June meeting and incorporated into the Strawman.

Action (R. Ridenour/ 16 July) - Expand this above language in such a way that the alerting requirements cover 2 separate graphs for 2A and 2B.



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We noted that the Garmin submittal for Mode 2 envelopes was the warning curve only. A caution envelope also exists, which may be overlapping with the Do Not Alert region. Garmin is asked to re-submit this.

Action (S. Zapoluch/ TBD) – Provide Mode 2 Caution limit to Charisse Green for creation of a higher Must Not Alert limit.

ACTION closed

During the Mode 2 discussion, the exit behavior of the Mode 2 alerting situation was discussed. In Honeywell's implementation, a lamp persists even after the alert region has been exited, where the lamp stays on until either a timeout or altitude clearance has been achieved. To avoid confusion on this point, the below action has been created to better allow for this situation.

Action (S. Johnson/ 16 July) – Provide a substitution for the current phrasing of “The Equipment shall remove the visual and aural alert once the situation has been resolved”, where the word ‘resolved’ has been considered unclear.

NEXT STEPS

The next planned meeting is the phone call planned for Thursday, 16 July 2015 at 10:00 EDT.

The next planned Plenary meeting is set for 22-24 September 2015 in the RTCA office in DC.