RTCA Papar Number: 304-16/SC231-023
November 9, 2016

PLENARY MEETING MINUTES
MEETING OF SPECIAL COMMITTEE 231

TAWS

Date: 7 – 9 November

Time: 0900 EST to 1700 EST,
Wednesday adjourned at 11:30 AM

Place: RTCA Office, Washington DC

Co-Chairmen: Yasuo Ishihara Rick Ridenour

Designated Federal Official: Charisse Green

Attendees:

Name	Company/Agency
Bulger, Chip	FAA
Chaudhari, Claudia #	RTCA
Fleury, Stephane	Thales
Green, Charisse	FAA
Hogestad, Marie #	FAA Transport Directorate
Ishihara, Yasuo	Honeywell
Johnson, Steve	Honeywell
Kirtz, Jon #	Rockwell Collins
Licata, Bill #	Universal Avionics
Morrison, Rebecca	RTCA
Ostrom, Gary	Honeywell
Reynolds, Zach	ACSS
Ridenour, Rick	ACSS
Rossi, Angelo #	MITRE
Vafiades, Monica	U.S. Air Force
Zapoluch, Steve #	Garmin
# - on phone	

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November 7:

A review of action items took place. All remaining actions have been completed from the previous meeting. The SC-231 action log is included as Exhibit 1.

A review of each FRAC comment then took place. As there were only 2 non-concurs, we addressed the entire set of comments in the sequence of the document, without sorting by priority.

In general, changes made in real time within the meeting are not recorded here but are instead recorded in the All Comments SC-231 FRAC log, attached as Exhibit 2. When a point had a further discussion or spawned an action item(s), it was recorded here.

Some actions implied RTCA involvement for editorial comments. These are shown below.

- There is a miniscule "DRAFT" text found after line 18. The committee chairs could not find a means to remove this.
- The Figure 1-1 was not centered. It could not be centered unless the raw image was replaced by a JPEG. This reinforced the need to include all jpeg representations of the various figures found in the document in a Power Point artwork section that can be maintained by RTCA, although not part of the released document. These will be useful in the future for any updates or adaptations.
- For support of lexical sorting of requirement tags, it would be appreciated if leading zeros were used on tag numbers less than 100 (i.e. 090).
- Remove MAC OS "." tags on the Data Supplement file, as these have apparently been zipped using the MAC computer.

Chip desired further addressing of the comment shown below:

> Add a new subsection to section 2.1 to create a requirement for databases to comply with RTCA/DO-200B. Add a new subsection to appropriate test section requiring verification the DO-200B requirement

Chip is suggesting that the TAWS supplier doesn't need to follow the LOA or to audit a supplier to meet DO-200B. However, the FAA database group felt that at a minimum, some level of DQR is needed in the MOPS requirements.

Rick expressed that the DQRs are already a part of the certification package. This is in the same class as the Installation Manual, Operating Manual and other data packages that are part of the certification package.

Chip agrees that the TAWS computer doesn't itself verify that the real-time database being accessed is of sufficient quality. However, there is a need to acquire or prove that a database is compliant to DO-200A or 200B.

From a manufacturer standpoint, the database requirement is not an equipment requirement. When running box testing, this DO-200 process can not be proven. In fact, the TSO testing includes non-DO-200 approved databases.

What appears to be at issue is that there is a single process requirement, analogous to Installation Manual and Operating Manual requirements, that is showing up as a performance requirement.

Chip feels that the FAA position is that the DO-200B requirement needs to be in section 2 of the Strawman. There is precedent in industry for Flight Management Systems which list their DO-200 navigation databases in section 2 of those MOPS. In this case, maintaining precedence is critical.

The proposed Section 2 wording is shown below:

2.1.5 Database 2.1.5.1 Database Data Quality Requirements. You shall [TAWS_MOPS_xxx] define the data quality requirements for the TAWS database necessary to support intended function in accordance with RTCA/DO-200B. You may use RTCA/DO-200B, Appendix B, RTCA/DO-276C, *User Requirements for Terrain and Obstacle Data*, dated September 22, 2015, and RTCA/DO-272D, *User Requirements for Aerodrome Mapping Information*, dated September 22, 2015, for guidance to define data quality requirements.	2.4.7 Database 2.4.7.1 Database Data Quality Requirements Verify the TAWS database data quality requirements are properly defined in accordance with RTCA/DO-200B. [TAWS_MOPS_xxx]

The committee agrees to move this wording into a new dedicated section 2.1.5 of the DO document. In addition, the information regarding terrain cell resolution contained in section 3.3 will be moved into this new section 2.1.5 and thus section 3.3 will be vacated.

Rebecca Morrison noted that the PMC recently agreed upon a new release of the "Minimum Operational Performance Standards (MOPS) Drafting Guide, RTCA Paper No. 255-16/PMC-1530. Included in this document, there is a "shall" definition, as opposed to "must" and "will" statements in an effort to standardize DO documentation. Some groups have bypassed these instructions here in 2016, where they have moved beyond FRAC and these groups are feeling that they will be "grandfathered". However, SC-231 still has this week and will make efforts to include 2 aspects of this document:

- While we will make use of shall and must, we have defined these in our Strawman section 1.1.1 and are consistent in the usage of must throughout the document.
- Also included in this drafting guide is a section 1.10 which defines the "Aircraft Equipment Information Vulnerabilities". The SC-231 committee intends to drop this into the Strawman

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directly. All committee members are asked to review this section 1.10 and express any concerns on Tuesday.

A discussion around the Mode 1 graph showing a lower limit representing the Steep Approach minimum. Chip felt that the years of experience around the separation of Steep vs. Normal approach mode is being lost in this current version of the MOPS.

A counter argument of a rather low difference between the curves was made. However, the difference between Mode 1 Standard minimum and Steep minimum is approximately 100 feet, which appears to be significant to most participants. Another counterargument is that if the Steep minimum is considered "safe" and if we are defining the minimum standards, why can't the minimum safe value be applied. However, this view does not consider the enhancement of having two different modes that has been developed historically.

Another argument in favor of splitting the Mode 1 into standard and steep is that we were representing an alert methodology based on the minority case, where most approaches are not steep. In effect, the history again has been lost on what constitutes a reasonable vertical speed during a normal approach.

The group felt that developing additional requirements around Mode 1 would be optimum, even if late in the process. Only the "must alert" caution and warning curve need be developed separately. The "must not" levels of caution and warning need not be changed.

Action: Charisse to provide a Mode 1 minimum curve for the standard case.
Closed within meeting.

Action: Chip to provide a Mode 1 section markup, including the conditional steps around determining either automatically or manually that a steep approach is underway. Then, additional requirements pointing to the new curve will be developed.
Closed within meeting.

Action: For the turboprop case, Honeywell to provide a minimum curve for the non-steep case.
Closed within meeting.

For the expansion of Mode 5 alerting, there has been resolution within the FAA to reinstate the LPV and GLS Mode 5 alerting. There is concern that VNAV based guidance is too inconsistent in scaling to apply.

November 8:

A review of action items took place. All parties agree with the Aircraft Equipment Information Vulnerabilities section to be added to the introduction of the document. This still needs to be then added to the MOPS.

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The Mode 5 non-concur was then discussed.

Mode 5 Envelope	Some currently certified installations have a lower cutoff altitude of 130 ft, based on OEM requirements. The Must Alert envelope in Figure 2-27 is in conflict with these installations.	Change the vertices of the lower boundary of the Must Alert Mode 5 curve for Class A equipment from (1.5,150)(2.1,110)(4,110) to (1.5,150)(4,150).	N S

At least 2 suppliers have historically implemented an OEM requested steep allowance for Mode 5 in which the last 150 feet are freed up for flare operations. The suppliers indicate that roughly 90 % of the Mode 5 nuisance alerting occurs in the last 150 feet. Many or the original systems with alerting down to 30 feet produced an inordinate amount of nuisance alerting as a result of steep approach and flare operations. The aircraft is going to be visual (below DH) at this point and likely to have situational awareness. In addition, protection of the Mode 1 alert is applicable here. The committee felt that a combining of Mode 5 curves, both steep and normal, was acceptable here.

The 500 foot callout had some additional comments regarding the use of 400 foot or Minimums as acceptable options, via the Flight Standards group. The UPS 1354 case showed that a TAWS box with 500 foot capability had this function disabled with no equivalent function enabled on the aircraft. This situation needs to be prevented and if it would help any suppliers, the other two callouts could be used in its place. But as the UPS 1354 case shows, the problem is at a level where the STC was approved without this feature. TAWS suppliers see no benefit from the flexibility of the additional callouts.

To respond to commentary requesting that Class A and Class B sources make use of a requirement similar to the below Class C, the committee discussed several options. However, the committee is concerned that suppliers can not show how a given system is "immune" to a given input's errors. Instead, we wish to show that reasonable efforts have been made to avoid these errors – either through the use of GPS for altitude or some temperature compensation for the baro source.

> Class C Equipment **shall (TAWS_MOPS_285)** be capable of computing an actual MSL aircraft altitude value that is immune to temperature errors and manual correction mis-sets that would otherwise prevent the TAWS from performing its intended function.
>
> ***Note 3:*** *This type of altitude is derived primarily from geometric sources such as GPS, and referenced to MSL typically via a database correction.*

The Canadian C600-003 regulation for defining enhanced altitude accuracy has been invoked as a good example. This wording has been drawn upon to help formulate the Strawman definition:

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(a) **EAA**: Enhanced Altitude Accuracy requires TAWS to give priority to sources of altitude which are not affected by:

(i) any pilot action or input;

(ii) altimeter setting; and

(iii) temperature and pressure deviations from the International Standard Atmosphere (ISA).

The resulting language developed within the meeting is then shown below:

Class A Equipment **shall (TAWS_MOPS_xxx)** contain or support an interface to an aircraft altitude source that is not affected by temperature and pressure deviations from the International Standard Atmosphere (ISA), and manual correction mis-sets that would otherwise prevent the TAWS from performing its intended function.

A separate comment caused a discussion of what defines an acceptable source.

Vertical Rate Source	TAWS_MOPS_131 limits vertical rate source to Vertical Velocity Instrument or Air Data Computer. GNSS could be a source. Perhaps other souces could be used.	Modify last part of Shall to ".. Or other approved Vertical Velocity Source with a current TSO." Allow for newer technology in future.	Not Started	...	William Licata	

Suppliers quickly recognized that multiple sources are possible for vertical rate – GPS, Baro or IRS. This introduced the concept that each of a TAWS LRU's source data could be subject to TAWS manufacturer discretion which makes this source sufficient for each supplier. The interest of the FAA would be met if the FAA could be assured that the source is certified by that equipment's TSO. This generic "certified" term was applied to the vertical rate source as no direct TSO exists for IRS. For all other sources, phrasing such as the below was placed into the Strawman:

Class A Equipment **shall (TAWS_MOPS_128)** contain or support an interface to a position source(s) that meet the requirements of one of the TSOs for a GNSS source.

The following comment caused a request for the substantiation for this initial statement of "The majority of past CFIT accidents…".

Potentially misleading	The statement "The majority of past CFIT accidents occurred because flight crews did not have adequate situational information regarding the terrain/obstacle in the vicinity of the airplane and its projected flight path." can be misconstrued as suggesting cause of accidents which is not RTCA responsibility. Reword or remove.	Reword to say "The conditions that contributed to past CFIT accidents could possibly have been lessened by providing pilots better situational awareness regarding the terrain/obstacle in the vicinity of the airplane and the aircrafts projected flight path."	Not Started	...	William Licata	

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The NTSB's CFIT Training Program contains the following which is a reasonable citation:

SECTION 4-C
CFIT Safety Briefing

There are two basic causes for CFIT accidents; both involve flight crew situational awareness. (One definition of situational awareness is an accurate perception by pilots of the factors and conditions currently affecting the safe operation of the aircraft and the crew).

The causes of CFIT are the flight crews' lack of vertical position awareness or their lack of horizontal position awareness in relation to the ground, water, or an obstacle. More than two-thirds of all CFIT accidents are the result of altitude error or lack of vertical situational awareness.

Simply stated, flight crews need to know where they are and the safe altitude to fly. It follows then that CFIT accidents occur during reduced visibility associated with instrument meteorological conditions (IMC), darkness, or a combination of both conditions.

The environmental section has had a separate discussion preceding this meeting, in which the categories of "survival" and "performance" are thought to be overlapping with DO-160G current definitions. Rather than re-introducing these concepts in the MOPS requirements, we have instead limited the environmental table to what is commonly performed per the below introductory table. We then discussed again how performance testing for the TAWS function is more software related and therefore insisting on specific performance tests for hardware validation seems mismatched. We have instead sustained the language of allowing Acceptance Testing commonly used to validate hardware functionality.

> Table 2-16 shows the environmental tests that are recommended to meet this standard.
> There is a 'Recommended Environmental Test' column showing what is commonly performed for a typical TAWS environmental exposure. However, if a TAWS LRU is installed in a more benign environment, some of these categories could be omitted (category X applied). In the opposite sense, a harsher environment may demand the running of tests categorized as 'As Necessary' below.

A series of comments attempting to specify further test limits or specific tests cases for the GPWS modes were discussed. Suppliers indicated that the heritage testing is necessarily limited to specific locations (nuisance, CFIT), where theoretically every other location could have inconsistent results. However, compared to most MOPS, the TAWS Strawman does include these specific cases and in that sense the Strawman addresses emerging (i.e., Birmingham) as well as historical behavior issues. While the heritage tests may not address further robustness, suppliers frequently have their own robustness test regimes which provide some additional assurance beyond the MOPS required testing. With this rationale, the committee felt that maintaining the current set of testing is sufficient.

An aspect of testing has been brought out from the comment on the nuisance alerting section of the former Table I. In fact, the circling procedure need not be run because the test description

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indicates that the MDA point is the terminating point of the test, as has always been the case from the first TSO-151. At least 2 suppliers are currently running these approaches up to the MDA only and not performing the circling portion of the approach. No change has been made to this requirement or test, as the existing standard has proven to be robust using the existing test cases and field experience, where field experience tends to be the more thorough flushing out of potential nuisance locations. Real world cases will quickly number into the hundreds and thousands with fielded equipment as opposed to the 7-9 cases found in the MOPS.

Nuisance Alert Test Cases	Two of the nuisance test cases in Table 2-3 (Calvi, France and Teguciagalpa, Honduras) are identified as circle to land approaches. However, the instructions of how to run the test (line 5356) appear to suggest the test terminates at the missed approach point. It seems contradictory to say the test terminates at the missed approach point when the approach is identified as a circle to land. The same issue exists with Table 2-8 for Class B and the Class B explanation at line 5954.	Either remove the indication that Calvi and Tegucigalpa should be performed as circling approaches or specify how the circling maneuver should be performed. (Is it a circle to the opposite runway? A 360 overhead to the straight in runway? Is any flight technical error to be assumed during the circling maneuver? Does the aircraft descend to the runway or stay at circling minimums? Etc.) Note that if the circling maneuver is removed from the test, these two approaches are not particularly challenging. The Calvi approach is over the ocean and the missed approach point is well offshore. The MDA of the Tegucigalpa approach is 2300ft above the runway. Does it make sense to keep these approaches in the list of Nuisance Alert test cases without the circling maneuver? Could they be removed from the list?	Not Started	...	Rick Ridenour	L-3 Communications	2

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Chip quizzed the group when discussing the addition of the CFIT case for Birmingham and with the comment below with the question, "did you go beyond simply adding the Birmingham case?"

Numbering	(TAWS_MOPS_001 instead of TAWS_MOPS_1)				
NTSB A-14-82	I'm unclear how the proposed MOPS addresses the TOR Item G for the NTSB Safety Recommendation A-14-82 which states: Revise the minimum operational performance standards to improve the effectiveness of terrain awareness and warning systems when an airplane is configured for landing and near the airport, including when the airplane is descending at a high rate and there is rising terrain near the airport. (A-14-82). Adding the Birmingham accident scenerio goes part way in meeting this, but its a single scenerio, not necessarily a broad solution.	Clarify MOPS improvements which address A-14-82 or have committee work to implement improvements to comply with A-14-82. I believe one solution is to modify the Mode 1 envelope below typical MDA levels (400-500 ft AGL) or to modify the PDA envelope.	Not Started	...	Chip Bulger

The committee responded with examples of the PDA alerting that have now been put into place and extended into the 1.0 Nm range where the implied previous limit (test case only) had the closest approach PDA occurring at 2 Nm. Additionally, the Imminent Terrain Impact alerting is now tied to a Warning alert, where previously a Caution alert was sufficient for this particular set of testing. The committee felt that due diligence had been done in converting from existing standards to address improvements to TAWS systems consistent with the NTSB recommendation.

November 9:

A review of action items then took place, as shown below. Initial Mode 1 curves were distributed before the meeting. Several suppliers had concerns with either (a) the lower left inflection point or (b) the lower cutoff limit for the Steep Approach case. These adjustments were made in real-time at the meeting and corresponding curves created.

The phrasing of the multiple Mode 1 alerting requirements was then reviewed. This was applied in 6 places in Class A – Standard Caution Mode 1, Steep Caution Mode 1, Standard Warning Mode 1, Steep Warning Mode 1, Turboprop Standard Warning Mode 1, Turboprop Steep Warning Mode 1.

Class B and C Mode 1 sets of curves need to have the same requirement treatment. Four such graphs exist and have been completed within this meeting. The phrasing of these requirements have not been completed within this meeting but will take place afterwards as a remaining action before providing the Strawman to RTCA.

Exhibit 3 shows the resulting Strawman that was produced within the meeting, complete except for the Class B and Class C requirement and test sections. A separate transmission will occur for the post-FRAC Strawman.

Rebecca advised the group on what typical steps are available for closing the FRAC process.

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One option is that in order to establish consensus on these last items, the RTCA workspace can be used to "poll" suppliers using a ballot. This gives every committee member a chance to achieve consensus. Another alternative is to have a phone call, "virtual plenary", to review these last changes and ensure consensus on the changes that are understood to be occurring.

The committee felt that the preferred option is the "virtual plenary". Rick asked that this "virtual plenary" be limited to the specific sections that are changed, rather than opening up further sections once again for what would amount to be grammatical changes. The virtual plenary would then be conducted in December.

As there was no further work needed for the committee to complete within this meeting, the Plenary was dismissed early on 9 November in the public's interest.

NEXT STEPS

All committee members to review the Mode 1 graphs, posted in the FRAC meeting folder at 940 AM (Mode 1 Envelopes_Basic&Steep_Class A-B-C_20161109AM.docx), by Tuesday, 15 November. The document, complete with Mode 1 Class B and Class C sections, will be provided to Yasuo by Rick on 16 November. Yasuo to perform an internal review of this added wording by 18 November. The document is then provided by Yasuo to the RTCA by Monday, 21 November.

The RTCA will then be asked to do the following:

- Renumbering requirements that have been added, in order to create a sequential list of tagged requirements.
- There is a miniscule watermark "DRAFT" text found after line 18. The committee chairs could not find a means to remove this.
- The Figure 1-1 was not centered. It could not be centered unless the raw image was replaced by a JPEG. This reinforced the need to include all jpeg representations of the various figures found in the document in a Power Point artwork section that can be maintained by RTCA, although not part of the released document. These will be useful in the future for any updates or adaptations.
- For support of lexical sorting of requirement tags, it would be appreciated if leading zeros were used on tag numbers less than 100 (i.e. 090).
- Remove MAC OS "." tags on the Data Supplement file, as these have apparently been zipped using the MAC computer. A specific name may be needed, where Perla with advise what the RTCA naming convention is.

RTCA will assemble the document including the above steps by Thursday, 1 December.

The virtual plenary will then be held via a telecon on Thursday, 8 December at 1000 AM EST which will be set up by Rebecca. From there, the document will go to the PMC for review in December with approval cycle occurring in March 2017.

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Given the above, today's face-to-face meeting will be concluded with an opinion of "Consensus pending the virtual plenary." Assuming no further changes, we will propose to the PMC that the SC-231 committee will be sunset in March 2017.