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Summary of the EUROCAE Working Group 110/ RTCA SC 237 (Meeting 6) Helicopter Terrain Awareness Warning Systems (TAWS) for Offshore Operations

DATE: March 31st – April 2nd 2020

PLACE: Webex

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1 Introductions

Yasuo Ishihara opened the webex by welcoming everyone to the call. He noted that the working conditions would be difficult, but hoped that good progress would be made.

Rebecca Morrison then showed the mandatory slides which explain the obligations of members and covered administrative aspects of the meeting. Adrian Cioranu explained the additional requirements of EUROCAE.

2 Previous Meeting Minutes

Actions arising from the previous meetings were discussed and open items identified.

Meeting 5

Action Reference	Action	By Whom	By Date
5.1	Draft test section of the MOPS.	Co-Chair, Y Ishihara	Closed
5.2	Check MOPS wording for consistency.	Co-Chair, Y Ishihara	Closed
5.3	OEMs to assess the Mode 1 Caution envelope and report any conflicts with current and future offshore steep approach profiles.	Airbus, D Kleinitz Bell, E Oltheten Leonardo, F Ricciardi Sikorsky, B Endrizzi	Open
5.4	Share Mode 7 presentation.	Sikorsky, B Endrizzi	Closed
5.5	Provide detailed proposals for Mode 7B MOPS.	Bell, E Oltheten/M Deer	Closed
5.6	Plot Rate of Descent v IAS for accident and incident cases where FDR data is available.	UK CAA, D Howson	Closed
5.7	Review if issuing a Mode 1 alert during offshore OEI conditions is compatible with FAR/CS 27/29.1309(c).	EASA, R Di Caprio	Open
5.8	Send updated MOPS document to all WG/SC members.	Co-Chair, Y Ishihara	Closed

Open items from previous meetings

Action Reference	Action	By Whom	By Date
4.7	Confirm the maximum rate of descent which will be required when conducting certified flight profiles.	All airframe OEMs	Open

The minutes from the previous meeting were accepted.

3 Work Schedule

The future workload and publication date for the MOPS were discussed and it was agreed that the work is still on track to achieve the deadlines below:

3.1.1 Following meeting 7 in May/June 2020, the draft MOPS will be subject to internal review and comment.

3.1.2 An agreed draft will be delivered to the RTCA/EUROCAE in September 2020 for external review and comment.

3.1.3 The final meeting of the WG/SC will take place in December 2020 where external comments will be reviewed and processed.

3.1.4 The MOPS will be published in March 2021.

Secretary's Note: The following minutes group the discussions by topic rather than chronologically, as some items were discussed during more than 1 session.

4 Mode 1

4.1 Analysis linked to action 5.3 (OEMs to assess the Mode 1 Caution envelope and report any conflicts with current and future offshore steep approach profiles.)

4.1.1 Sikorsky (Bob Endrizzi) showed an analysis of Mode 1 nuisance alerts derived from HUMS/FDM data. It showed that using barometric rate of descent there was a high nuisance alert rate at low altitude/height above the ground/helideck. In the discussions which followed it was agreed that this might be partially due to ground cushion effects. It was noted that CAP 1538 and 1519 used inertial altitude rate (Alt Rate) to minimise this issue. Sikorsky undertook to do a quick analysis to investigate if using inertial rate of descent and raising the alert floor would reduce the nuisance alert rate.

On day 2 an update was provided by Sikorsky which showed that by using inertial altitude rate and raising the alert floor to 30ft would reduce the nuisance alert rate significantly to between 1.5% and 7%. It was noted that the data set used by Sikorsky included onshore approaches, which if removed, would show a further reduction in nuisance alerts. Raffaele Di Caprio stated that the group should not get too concerned over the exact nuisance alert rate shown as the overall impression was satisfactory. Furthermore, it was noted that with the introduction of helicopter FCOMs and improved SOPs the nuisance alert rate would decline anyway.

Action 6.1
Sikorsky (Bob Endrizzi) to share the slides used in the presentation. By 30th April 2020

4.1.2 Airbus (Dietmar Kleinitz) stated that Airbus had difficulty in separating offshore and onshore approaches to conduct an analysis of Offshore Mode 1. He said that the proposed Mode 1 caution and warning envelopes were appropriate for current operations.

4.1.3 Leonardo (Francesco Ricciardi) said that the MOPS should cover any need to switch between the Must Not Alert (maximum) and Must Alert (minimum) envelopes, for example when supressing the nuisance alert rate during high speed offshore automated approaches.

4.1.4 Bell (Erik Oltheten) stated that Bell had no comments on Mode 1.

4.2 Accident & incident data cases plotted on the proposed Mode 1 envelopes

The UK CAA (Dave Howson) had plotted the four relevant occurrences for which data was available on the Mode 1 envelopes proposed at the 5th meeting and the modified caution envelope subsequently proposed by EASA - see email of 25 March 2020. He explained the content of the plots, highlighting the associated caution and warning times for two approach accidents and two serious take-off incidents. He also produced a table of alert times for the four occurrences noted that, with Mode 7A available, Mode 1 was dominant in only one of the four cases.

It was noted that the modified Mode 1 caution envelope proposed by EASA (Eric Bennett – email 13th January 2020) cut into the warning envelope, which was generally agreed to be undesirable.

It was observed that the caution and warning envelopes have different requirements. The size of the caution envelope is restricted by the requirement to reduce the nuisance alert rate to an acceptable level. The size of the warning envelope must provide sufficient warning to avoid CFIT. These conflicting requirements may result in the caution envelope being close to the warning envelope and so a rapidly accelerating descent (as seen in three of the four examples plotted) may enter the warning envelope before the caution message is complete. This was deemed acceptable by the group as the caution message should initiate the crew taking corrective action.

During the meeting, Dave Howson produced an updated caution envelope (see email of 31 March) reflecting the outcome of the discussions. He proposed an additional adjustment so that the main slope of the must caution envelope coincided with the maximum warning envelope, the rationale being to have the caution start where the warning ends (and vice-versa). This was agreed and Dave forwarded the coordinates of the corner points of the envelope to Y Ishihara.

4.3 Action 5.7 EASA to review if issuing a Mode 1 alert during offshore OEI conditions is compatible with FAR/CS 27/29.1309(c).

EASA (Raffaele Di Caprio) stated that discussions were ongoing within EASA and that he hoped to present an official statement in the near future.

4.4 Mode 1 Arming

It was agreed that the MOPS should state that Mode 1:

- Shall be armed for all phases of flight except take-off and go-around;

- May be armed for take-off and go-around;
- May be inhibited during OEI states, if Mode 1 alerts would contradict the RFM flight profiles.

5 Mode 7

Modes 1-6 are designed to protect against CFIT. Mode 7 in general terms aims to provide envelope protection, as it is acknowledged that neither Modes 1-6, nor a DO 309 system can provide comprehensive warnings for all foreseeable offshore incidents.

Mode 7 is optional. At present 3 elements of envelope protection have been proposed for Mode 7, but as it is optional, other technologies or algorithms may be used to provide an equivalent or enhanced level of protection under the aegis of Mode 7 in the form of a non-TSO function. The proposed 3 elements of Mode 7 could be viewed as complementary and use of any element should not exclude another.

5.1 Mode 7A

Mode 7A aims to warn of a combination of reducing airspeed and low power, i.e. a condition which if uncorrected will lead to a further loss of airspeed. The Mode 7A envelopes are type specific.

The type specific envelopes may be derived from operational (FDM) data, or where this does not exist, may be calculated using flight test data as discussed during the 5th meeting (see section 10.3 of the minutes).

It was agreed that the MOPS should include an appendix explaining how a Mode 7A envelope could be calculated. This would be helpful for new helicopter types where FDM data is not yet available.

Action 6.2
Sikorsky (Bob Endrizzi) to provide a draft on the methodology to calculate a Mode 7A envelope. By 30th April 2020.

5.2 Action 5.6 Plot Rate of Descent v IAS for accident and incident cases where FDR data is available

The UK CAA (Dave Howson) had emailed a set of slides with plots of accident data plotted with the vortex envelopes proposed by Bell at the 5th meeting and the CAP 1538 99% boundary (see email of 03 February 2020).

He noted that, overall, the Bell Vortex envelopes did not appear to be optimised for the types of scenario represented in the flight data available; alert times were either inadequate or shorter than those provided by other modes. He added that the Bell Vortex envelopes extend into the CAP 1538 99% boundary so may generate excessive nuisance alerts. There are caveats to the analysis but the nuisance alert rates for each type the need to be investigated.

5.3 Mode 7B

Bell presented an update on their proposal for Mode 7B, which provides a caution if the steepness of an approach exceeds a set threshold. It was agreed that the proposed Mode 7B envelope should be assessed against flight data to confirm that the nuisance alert rate was acceptable.

At a previous meeting a presentation by Sikorsky identified that most cases of the S92 entering into the Mode 7A envelope occurred from the top of the envelope, i.e. a loss of airspeed occurred before a steep rate of descent developed. For this reason, Mode 7B could be viewed as complementary to Mode 7A, as they will alert at different times, with Mode 7A occurring first, and Mode 7B following if no corrective action was taken.

5.4 Mode 7C

Bell presented their proposal for Mode 7C which warned of approaching Vortex Ring State. This envelope will be type specific and applies the VRS model developed by Newman *et al*. The group is aware that Airbus has submitted a patent for a VRS warning function.

Action 6.3
Airframe OEMs to validate the proposed Mode 7B and 7C envelopes against their flight data to assess the timeliness of alerts. By next meeting

Action 6.4
Airframe OEMS to assess the proposed Mode 7B and 7C envelope against flight data to assess the potential nuisance alert rate. By next meeting

Action 6.5
Airbus (Dietmar Kleinitz) to confirm if the proposed Mode 7C method infringes the Airbus VRS patent application. By 30th April 2020

Action 6.6
Bell (Erik Oltheten) to provide a draft on the methodology to calculate a Mode 7C envelope. By next meeting.

6 Review of Draft MOPS

6.1 Introduction Text – Action 2.8

The introduction text provided by Sikorsky (Steve Schellberg) was reviewed and accepted.

6.2 MOPS Chapter 3

Chapter 3 was reviewed and accepted.

6.3 MOPS Chapters 4 and 5

All members were requested to review Chapters 4 and 5 and provide comment.

Action 6.7
All parties to review the MOPS Chapters 4 and 5. A nil return will show acceptance of these sections. By 30th April 2020

Action 6.8
HTAWS equipment manufacturers to cross check the MOPS against the DO 309 environmental testing requirements and revert with comments. By 30th April 2020.

6.4 MOPS Chapter 6
Chapter 6 was reviewed and modified where necessary.

7 General Discussions

7.1 Consistent Terminology
It was agreed that the MOPS should be reviewed to ensure that consistent terminology was used throughout. In particular, use of arm/disarm/, activate/deactivate, inhibit/enable needed to be checked for consistency with the definitions shown in paragraph 1.7.
Action 6.9
All to check for consistent terminology when reviewing the MOPS. By 30th April 2020.

7.2 Inhibiting Alerts
Previous TAWS MOPS have allowed alerts to be inhibited, although no one present could provide a rationale for this requirement. As Offshore HTAWS can be inhibited by deselecting the Offshore Mode, and so reverting to the current Modes 1-6, it was agreed that this was sufficient and no further inhibits were necessary.

7.3 Aural and Visual Alerts
An Appendix will be added to the MOPS which includes guidance on aural and visual alerts in helicopters, provided by Dr Greaves [email 16th September 2019]. This guidance is a summary of the research reported in CAP 1747.

7.4 Updated MOPS
Co-Chair (Yasuo Ishihara) agreed to provide an updated set of MOPS for all to review in accordance with their actions.

Action 6.10
Yasuo Ishihara to provide an updated set of MOPS to the group. By as soon as possible.

8 Future Meetings
Due to the Covid 19 virus it was decided to rearrange meeting 7 from May into June in the expectation that travel restrictions will have been removed by June. The RTCA (Rebecca Morrison) agreed to send out a poll asking for preferred meeting dates in June **[secretary**

note: the poll was sent out electronically on Friday 3rd April and currently awaiting the results]. Saab (Mikaela Lokatt) agreed to host a rearranged meeting in June.
A face-to-face meeting in May was converted to WebEx meeting on 26 – 28, May.

The following 2 meetings are planned:

- Meeting 7 – WebEx, 26th – 28th May 2020 or Hosted by Saab, Stockholm date to be agreed.
- Meeting 9 – Hosted by Bell, Dallas w/o 14th or 21st September 2020.

9 Any Other Business

There was no other business

10 Close

The Chair closed the meeting on the 2nd April at 16.00 UTC and thanked all the attendees for their input.

11 Decisions and Actions

Action Reference	Action	By Whom	By Date
6.1	Share the Mode 1 slides used in the presentation	Sikorsky (Bob Endrizzi)	30th April 2020
6.2	Provide a draft on the methodology to calculate a Mode 7A envelope.	Sikorsky (Bob Endrizzi)	30th April 2020
6.3	Validate the proposed Mode 7B and 7C envelopes against their flight data to assess the timeliness of alerts.	Airframe OEMs	By next meeting
6.4	Assess the proposed Mode 7B envelope against flight data to assess the potential nuisance alert rate.	Airframe OEMs	By next meeting
6.5	Confirm if the proposed Mode 7C envelope infringes the Airbus VRS patent application.	Airbus (Dietmar Kleinitz)	30th April 2020
6.6	Provide a draft on the methodology to calculate a Mode 7C envelope.	Bell (Erik Oltheten)	30th April 2020
6.7	Review the MOPS Chapters 4 and 5. A nil return will show acceptance of these sections.	All	30th April 2020
6.8	Cross check the MOPS against the DO 309 environmental testing requirements and revert with comments.	HTAWS equipment manufacturers	30th April 2020
6.9	Check for consistent terminology when reviewing the MOPS.	All	30th April 2020
6.10	Provide an updated set of MOPS to the group.	Co-Chair (Yasuo Ishihara)	As soon as possible

11.1 Outstanding Actions

Action Reference	Action	By Whom	By Date
5.3	OEMs to assess the Mode 1 Caution envelope and report any conflicts with current and future offshore steep approach profiles.	Airbus, D Kleinitz Bell, E Oltheten Leonardo, F Ricciardi Sikorsky, B Endrizzi	Open
5.7	Review if issuing a Mode 1 alert during offshore OEI conditions is compatible with FAR/CS 27/29.1309(c).	EASA, R Di Caprio	Open
4.7	Confirm the maximum rate of descent which will be required when conducting certified flight profiles.	All airframe OEMs	Open

Mark Prior
Secretary, SC 237/WG-110