EASA European Union Aviation Safety Agency	**Consultation paper** **Deviation**	Doc. No.: CPTS-0000362 Issue : 1 Date : 29 May 2024 Proposed ☐ Final ☒ Deadline for comments: 21 Feb 2024

SUBJECT	:	Flight Crew Alerting
REQUIREMENTS incl. Amdt.	:	CS 25.1322 at Amdt. 21
ASSOCIATED IM/MoC	:	Yes☐ / No ☒
ADVISORY MATERIAL	:	AMC 25.1322

Table of Contents

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INTRODUCTORY NOTE:

The following Deviation (DEV) shall be subject to public consultation in accordance with EASA Management Board decision 12/2007 dated 11 September 2007, Article 3 (2.) which states:

"*2. Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means of compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least 3 weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency.*"

ABBREVIATIONS:

EFVS	Enhanced Flight Vision System
EVS	Enhanced Vision System
HUD	Head-Up Display
PDU	Primary Display Unit
SVS	Synthetic Vision System

IDENTIFICATION OF ISSUE:

CS 25.1322 at amdt. 21 (unchanged since CS25 Amdt.11) specifies the following:

"(a) Flight crew alerts must:
(2) be readily and easily detectable and intelligible by the flight crew under all foreseeable operating conditions, including conditions where multiple alerts are provided;

(b) Alerts must conform to the following prioritisation hierarchy based on the urgency of flight crew awareness and response:
(1) Warning: For conditions that require immediate flight crew awareness and immediate flight crew response.

(c) Warning and Caution alerts must:
(2) provide timely attention-getting cues through at least two different senses by a combination of aural, visual, or tactile indications.

(e)Visual alert indications must:
(1) conform to the following colour convention:

i. Red for Warning alert indications.
ii. Amber or yellow for Caution alert indications.
iii. Any colour except red or green for Advisory alert indications.

(2) use visual coding techniques, together with other alerting function elements on the flight deck, to distinguish between Warning, Caution and Advisory alert indications, if they are presented on monochromatic displays that are incapable of conforming to the colour convention in paragraph (e)(1).”

During compliance finding activities for the certification of an Enhanced flight vision system (EFVS) with both single and dual Head-Up Displays (HUD) configurations, the design of the HUD and EFVS installation was identified as not compliant with the above CS 25.1322 sub-paragraphs for some specific alerting conditions.

The identified non-compliances result from the following:

- The design proposed by the applicant maintains the consistency with the full cockpit philosophy and flight crew alerts in head-down displays. However, the subject design change is made to a configuration based on an existing avionics suite originally designed according to CS25.1322 pre-Amdt.11.
- The HUD being a monochromatic display, visual coding techniques to distinguish between Warning, Caution and Advisory are expected to be used. However, the same visual display features for HUD and EFVS-specific flags have been used regardless of the level of urgency for flight crew awareness and response that depends on the flight phase.
- Not all alerts related to the HUD and EFVS have been associated with a visual indication head down, which is an issue when only one HUD is used.
- Not all alerts related to the HUD and EFVS have been associated with dual modality attention-getting cues based on at least two different senses.

Therefore, a deviation has been requested by the applicant to record the non-compliances reported in the below table along with the details on the flight phases in which those non compliances are identified.

ID	Flight Phase	Abnormal condition	Non-Compliance (description)	Non-Compliance (req. para)
1	Take-Off (until TO mode is deactivated)	**LOSS** of SVS or EVS image	For this scenario the design is not compliant since: • The applicant has declared this alert as an Advisory whereas the SVS & EVS Flags have been designed as a Warning in the HUD. This misclassification results in a non-compliance to CS25.1322(b)(1). • The same Visual flags consistent with a Warning alert is used in HUD for conditions requiring an advisory alert. Displays do not conform with visual coding techniques as requested by CS25.1322(e)(2).	CS25.1322(b)(1) CS25.1322(e)(2)
2	Climb Cruise Descent	**LOSS** of SVS or EVS image	For this scenario the design is not compliant since: • The applicant has declared this alert as an Advisory whereas the SVS & EVS Flags have been designed as a Warning in the HUD. This misclassification results in a non-compliance to CS25.1322(b)(1). • The same Visual flags consistent with a Warning alert is used in HUD for conditions requiring an advisory alert. Displays do not conform with visual coding techniques as requested by CS25.1322(e)(2).	CS25.1322(b)(1) CS25.1322(e)(2)

ID	Flight Phase	Abnormal condition	Non-Compliance (description)	Non-Compliance (req. para)
3	Approach (starting from approach mode armed or SF1 or Gear down, until published minima)	**LOSS** of SVS, EVS, conformal runway during operations with ops credits	For this scenario the design is not compliant since: • The applicant has declared this alert a CAUTION whereas the SVS & EVS Flags have been designed as a Warning in the HUD. This misclassification results in a non-compliance to CS25.1322(b)(1). • The same Visual flags consistent with a Warning alert is used in HUD for conditions requiring a Caution alert. Displays do not conform with visual coding techniques as requested by CS25.1322(e)(2). • The alerts are classified Caution but there is no attention getting through a second sense or is delayed (only the visual cue is available). This design is not compliant with 25.1322(c)(2). • Single HUD configuration: The loss of the synthetic runway conformal is not displayed in the PDU. The lack of visual alert information located so that both pilots can readily identify the alert condition is not compliant with 25.1322(a)(2).	CS25.1322 (a)(2) CS25.1322(b)(1) CS25.1322(c)(2) CS25.1322(e)(2)
4	Approach (starting from published minima and until 100ft above touch down zone elevation)	**LOSS** of SVS, EVS, conformal runway during operations with ops credits	For this scenario the design is not compliant since: • The alerts are classified Warning but there is no attention getting through a second sense (only the visual cue is available) or is delayed and associated with Cautions alerts. This design is not compliant with 25.1322(c)(2). • The loss of SVS image and EVS image are also enunciated in PDU. However, the visual alerts are Amber. Warning situations require a red visual indication as imposed by CS25.1322(e)(1)(i). Single HUD configuration: • The loss of the synthetic runway conformal is not displayed in the PDU. The lack of visual alert information located so that both pilots can readily identify the alert condition is not compliant with 25.1322(a)(2).	CS25.1322 (a)(2) CS25.1322(c)(2) CS25.1322(e)(1)(i)

The applicant has proposed that, per point 21.B.80(a)3(i) of Part 21, the following mitigating factors:

- Addition to the AFM of the necessary Pilot Flying and Pilot monitoring instructions to ensure adequate situational awareness, correct and timely crew decision-making.
- The AFM will require the use of automation as described in the following Deviation (Ref: §4. Mitigations ID#4); this reduces Pilot Flying's workload allowing a continuous monitoring of consistency between EVS image, conformal runway symbol, Flight Path Vector and Flight Path Angle Reference Cue symbols and a prompt detection of the loss of EVS image or conformal runway.

as detailed in appendix A to this paper, provide alternative means to ensure compliance with the applicable essential requirements for airworthiness (as defined in appendix A) laid down in Annex II of the regulation (EU) 2018/1139.

EASA has accepted this request for Deviation due to the limited number of CS 25.1322 non-compliances that can be well covered by adequate flight crew instructions and that are supported by in-service experience with no safety issue being reported..
Note: A similar deviation DEV-F25.1322-01 was granted to the applicant for other alerting display in the cockpit. As part of a separate certification process, the applicant is engaged to address and correct all CS 25.1322 Amdt 21 non-compliances.

Considering all the above, the following Deviation is proposed.

CPTS-0000362

Deviation

Flight Crew Alerting

1. APPLICABILITY

This DEV is applicable to CS-25 large aeroplanes featuring Enhanced flight vision system (EFVS) with both single and dual Head-Up Displays (HUD) configurations not fully compliant to CS 25.1322.

1.1 AFFECTED CS

The following paragraphs of CS-25 at amendment 21 are affected to which compliance cannot be demonstrated for the alerts and messages as detailed below:

CS 25.1322 "Flight Crew Alerting"

a) Flight crew alerts must:
   (1) provide the flight crew with the information needed to:
      (i) identify non-normal operation or aeroplane system conditions, and
      (ii) determine the appropriate actions, if any;
   (2) be readily and easily detectable and intelligible by the flight crew under all foreseeable operating conditions, including conditions where multiple alerts are provided;

b) Alerts must conform to the following prioritization hierarchy based on the urgency of flight crew awareness and response:
   (1) Warning: For conditions that require immediate flight crew awareness and immediate flight crew response.
   (2) Caution: For conditions that require immediate flight crew awareness and subsequent flight crew response.
   (3) Advisory: For conditions that require flight crew awareness and may require subsequent flight crew response.

c) Warning and Caution alerts must:
   (2) provide timely attention-getting cues through at least two different senses by a combination of aural, visual, or tactile indications;

d) …

e) Visual alert indications must:
   (1) conform to the following colour convention:
      i. Red for Warning alert indications.
      ii. Amber or yellow for Caution alert indications.
      iii. Any colour except red or green for Advisory alert indications.
   (2) use visual coding techniques, together with other alerting function elements on the flight deck, to distinguish between Warning, Caution and Advisory alert indications, if they are presented on monochromatic displays that are incapable of conforming to the colour convention in paragraph (e)(1).

f) …

1.2 PRE-CONDITIONS FOR APPLICATION OF THE DEVIATION

A limited number of CS 25.1322 non-compliances that can be well covered by adequate mitigations.

2. APPLICABLE ESSENTIAL REQUIREMENTS FOR AIRWORTHINESS OF REGULATION (EU) 2018/1139 (ANNEX II)

The following paragraphs of the "*Essential Requirements for Airworthiness*" as defined in Annexes II of Regulation (EU) 2018/1139 are related to the CS identified in 1.1 for which a non-compliance exists:

Paragraph 1.3.4:
"Information needed for the safe conduct of the flight and information concerning unsafe conditions must be provided to the crew or maintenance personnel, as appropriate, in a clear, consistent and unambiguous manner. Systems, equipment and controls, including signs and announcements must be designed and located to minimise errors which could contribute to the creation of hazards."

And

paragraph 2.3(c):
"Crew compartments, as appropriate to the type of operations, must be arranged in order to facilitate flight operations, including means providing situational awareness, and management of any expected situation and emergencies. The environment of crew compartments must not jeopardise the crew's ability to perform their tasks and its design must be such as to avoid interference during operation and misuse of the controls."

3. STATEMENT OF DEVIATION

To address the non-compliance with CS 25.1322, the mitigating factors in chapter 4 shall be met. Compliance with the mitigating factors ensures compliance with the applicable essential requirements of Regulation (EU) 2018/1139.

4. MITIGATING FACTORS

ID	Flight Phase	Abnormal condition	Mitigating factors
1	Take-Off	**LOSS** of SVS or EVS image	Addition to the AFM of the necessary Pilot Flying and Pilot monitoring instructions to ensure adequate situational awareness, correct and timely crew decision-making. SVS or EVS image is not required to fly the aircraft during these phases. In case of SVS or EVS failure, SVS or EVS Flags do not interfere with primary information used to fly the aircraft and SVS and/or EVS image are automatically removed. CAS messages related to navigation sensor failure (causing loss of SVS) or EVS camera failure (causing loss of EVS) are inhibited during take-off phase.
2	Climb Cruise Descent		
3	Approach (starting from approach mode armed or SF1 or Gear down, until published minima)	**LOSS** of SVS, EVS, conformal runway during operations with operational credits	Addition to the AFM of the necessary Pilot Flying and Pilot monitoring instructions to ensure adequate situational awareness, correct and timely crew decision-making. When approaching published minima, EVS cues need to be detected and consistency with conformal runway checked to continue the approach. If SVS, EVS or conformal runway have been lost before minima, this will be detected by the Flight crew and will execute a go around if visual references are not acquired with natural vision.
4	Approach (starting from published minima and until 100ft above touch down zone elevation)	**LOSS** of SVS, EVS, conformal runway during operations with operational credits	Addition to the AFM of the necessary Pilot Flying and Pilot monitoring instructions to ensure adequate situational awareness, correct and timely crew decision-making. All approaches until visual references are acquired with natural vision, will have to be conducted with: • Autothrottle, • Autopilot (except when a visual maneuver is required to align with runway centerline due to an offset between final approach axis and runway centerline). For single HUD configuration (in addition to visual alerts in PDU alerting about the loss of EVS or SVS), the Pilot flying will detect and announce the loss of EVS image or conformal runway. The Pilot

ID	Flight Phase	Abnormal condition	Mitigating factors
			Monitoring will confirm it through the MDU repeater which is mandatorily displayed during operations with operational credits.

Note: Following changes to HUD/EFVS and Avionics load upgrades will have the complete CS 25.1322 Amdt. 21 or higher Amdt as the applicable adequate certification basis.