New CS-AWO for SVGS, HUD, EFVS and SA CAT I

3rd EASA Flight Test & Human Factors Conference
21-22 June 2017

Carl Garvie
CT.7.1
Regulations Officer-Initial Airworthiness

Vincenzo Pennetta
CT.1.3
Flight Test Engineer

Your safety is our mission.

An agency of the European Union

TE.GEN.00409-001

Contents

- Evolution of CS-AWO
- Strategy for updating CS-AWO
- Proposed structure for CS-AWO
- Proposed additional contents for CS-AWO
- Next Steps for CS-AWO
- EFVS consideration

Evolution of CS-AWO

Joint Aviation Requirements

JAR–AWO

All Weather Operations

Joint Aviation Authorities

+

NPA JAR:

- AWO-08
- AWO-09
- AWO-10
- AWO-12

=

EASA Certification Specifications

for

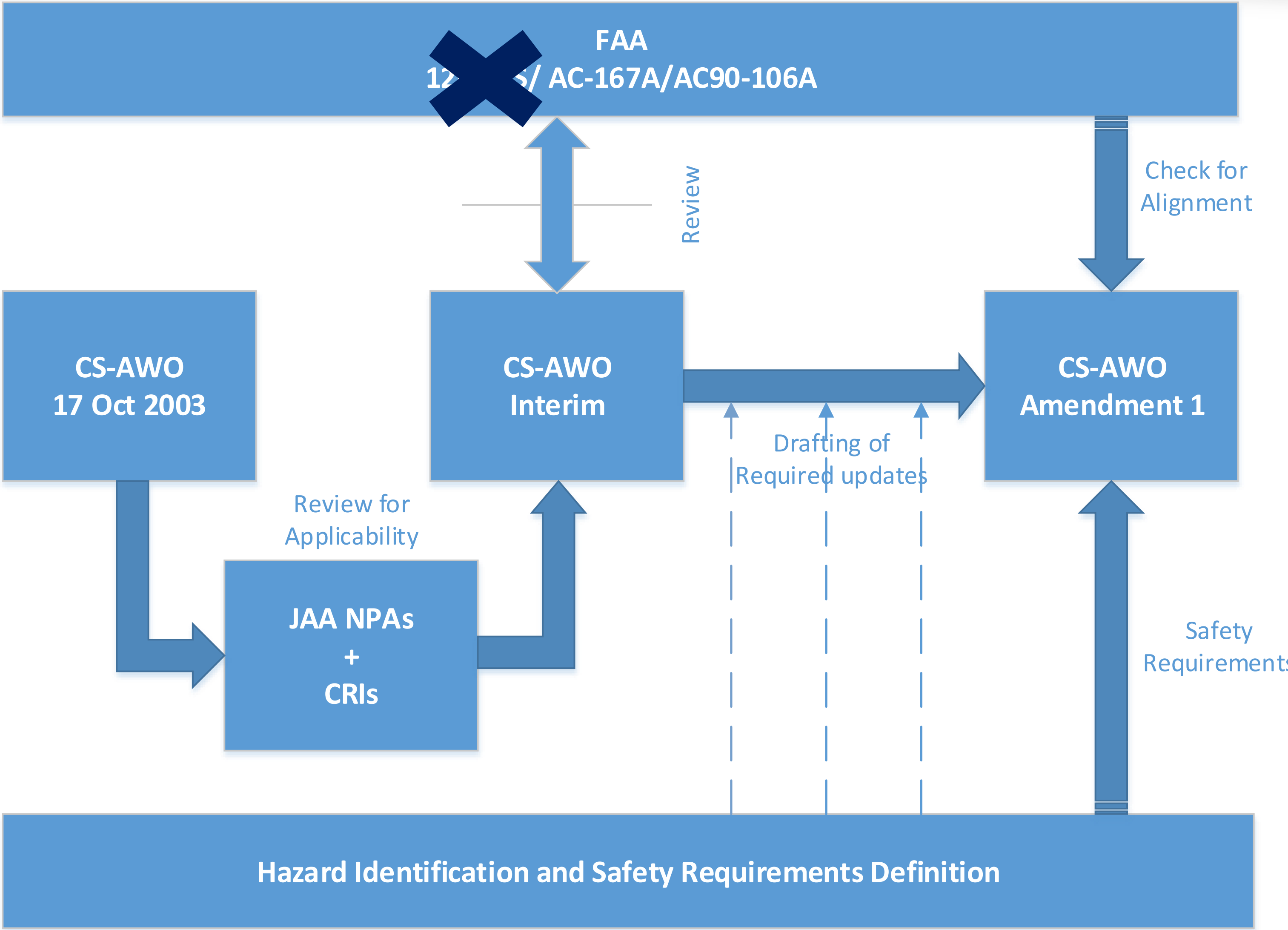
All Weather Operations

CS-AWO
Book 1

Airworthiness code

1 1-0-1

Strategy/Concept



Strategy/Concept

- The following JAA NPAs were incorporated in the interim document:

NPA No.	Description
JAR AWO-11	High Altitude Landing System Performance
JAR AWO-13	Introduction of Head-Up Guidance Landing System Requirements
JAR AWO-14	Structural Limit Loads and Lateral Touchdown Performance
JAR AWO-15	Autobrake for Category 3B and Anti-Skid Issues
JAR AWO-16	JAR/FAR 25.1329 harmonization plus other points
JAR AWO-17	Super Fail-Passive Cat 3 Operations and additional Guidance Material

Strategy/Concept

- The following EASA Certification Review Items were incorporated in the interim document:

CRI	Description
CRI K-02	Automatic Landing Distance
CRI K-07	GBAS Landing System for Cat 1 Operations
CRI K-09	Extrapolation of Wind Limits for Autoland Demonstration
CRI K-XX	Landing Distances using Head-Up Display

Original CS-AWO Structure

Subpart 1	Automatic Landing Systems
Subpart 2	Airworthiness certification of aeroplanes for operations with decision heights below 60 m (200 ft) down to 30 m (100 ft) – Category 2 operations
Subpart 3	Airworthiness certification of aeroplanes for operations with decision heights below 30 m (100 ft) or no decision height – Category 3 operations
Subpart 4	Directional guidance for take-off in low visibility

Proposed CS-AWO Structure

Subpart A ENABLING EQUIPMENT	
Section 1	Automatic Landing Systems
Section 2	Head Up Displays (HUD)
Section 3	Enhanced Flight Vision Systems (EFVS)
Section 4	Synthetic Vision Guidance Systems (SVGS)
Section 5	Combined Vision Systems (CVS)

Proposed CS-AWO Structure

SUBPART B APPROACH AND LANDING	
Section 1	Airworthiness certification of aeroplanes for Type B operations with decision heights/altitude below 250 ft down to 200 ft – Category 1 operations (CAT I)
Section 2	Airworthiness certification of aeroplanes for operations with decision heights below 60 m (200 ft) and down to 45 m (150 ft) – Special Authorisation Category 1 operations (SA CAT I)
Section 3	Airworthiness certification of aeroplanes for operations with decision heights below 60 m (200 ft) and down to 30 m (100 ft) – Category 2 operations (CAT II)
Section 4	Airworthiness certification of aeroplanes for operations with decision heights below 30 m (100 ft) or no decision height – Category 3 operations (CAT III)
Section 5	Airworthiness certification of aeroplanes for operational credits for visual segment in reduced Runway Visual Range (RRVR)

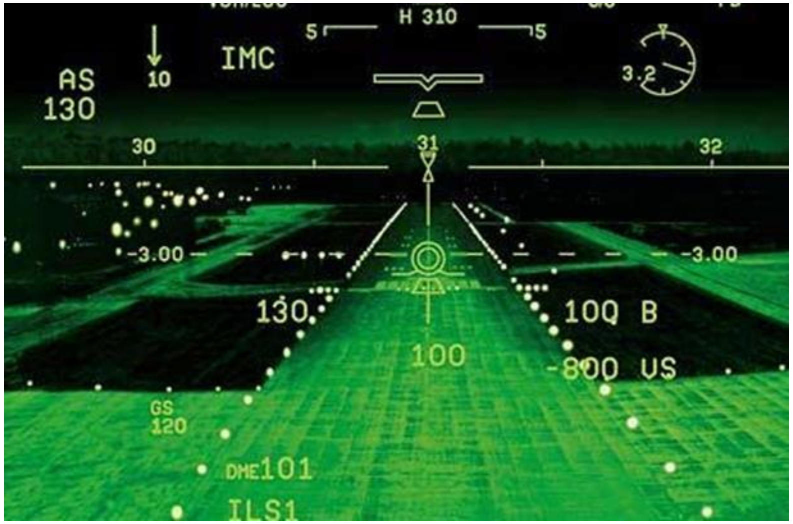
Subpart C Take Off	
Section 1	Airworthiness certification of aeroplanes for take-off operations in low visibility (TOO)

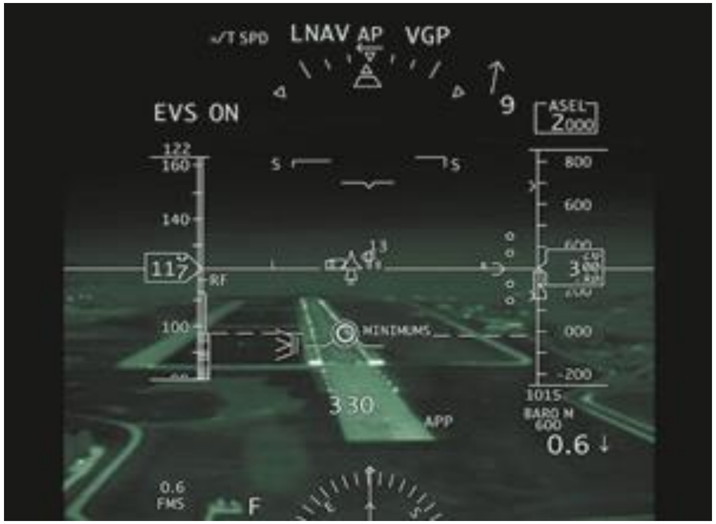
Additional contents for CS-AWO

- Head-Up Displays:
- Based on JAA NPAs and JAA HUD papers

Additional contents for CS-AWO

- Enhanced Flight Vision Systems
- Based on FAA AC 20-167A and DO-315B
- Both Approach (100ft) and Landing System (Touchdown)





Additional contents for CS-AWO

- Synthetic Vision Guidance System (SVGS)
- Based on DO-359

- Also includes Combined Vision Systems

Additional contents for CS-AWO

- Special Authorisation CAT I (SA CAT I) section is based on amended CS-AWO CAT II Section.
- Current suggested eligible SA CAT I technologies include:
  - HUD (or equivalent) with flight guidance which is approved for ILS (or equivalent) manual operation down to 36 m (120ft).
  - Synthetic Vision and Guidance System displayed on the primary flight display or HUD (or equivalent), and high precision position assurance monitoring.

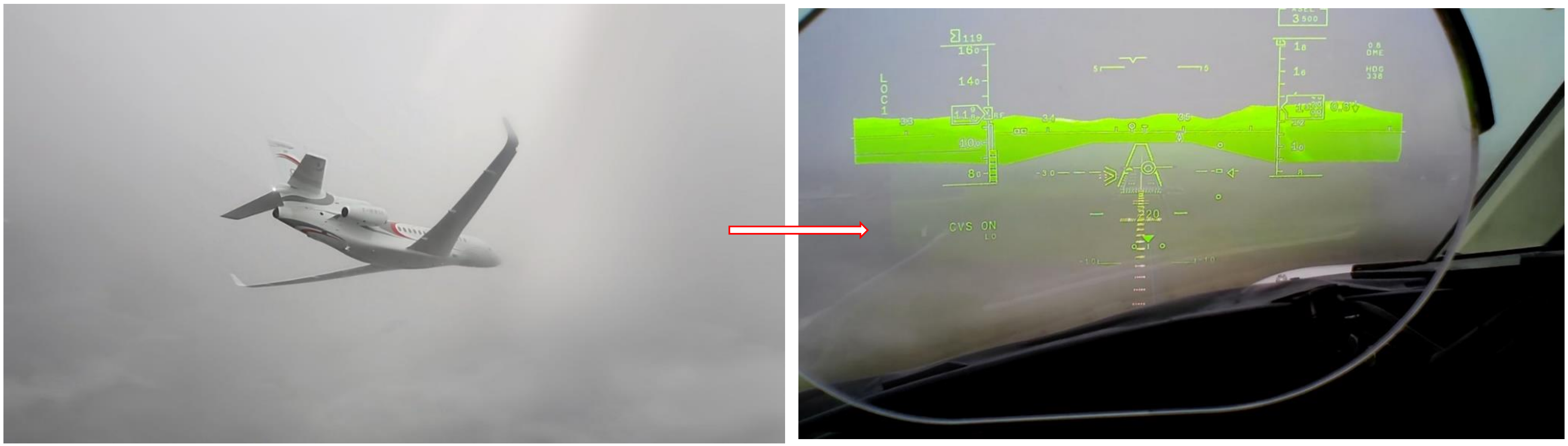
Additional contents for CS-AWO

- Based on the assumption that there is protection of the ILS critical and sensitive areas the following configurations are also eligible for SA CAT I:
  - Automatic approach system coupled down to 36 m (120 ft) with a HUD (or equivalent)
  - Automatic landing system alone, provided it is demonstrated that failures linked to Category 1 beam can be recognised by pilot in visibility conditions.
  - Automatic landing system with a HUD (or equivalent) to monitor the autoland path along the Category 1 beam before and after decision height.

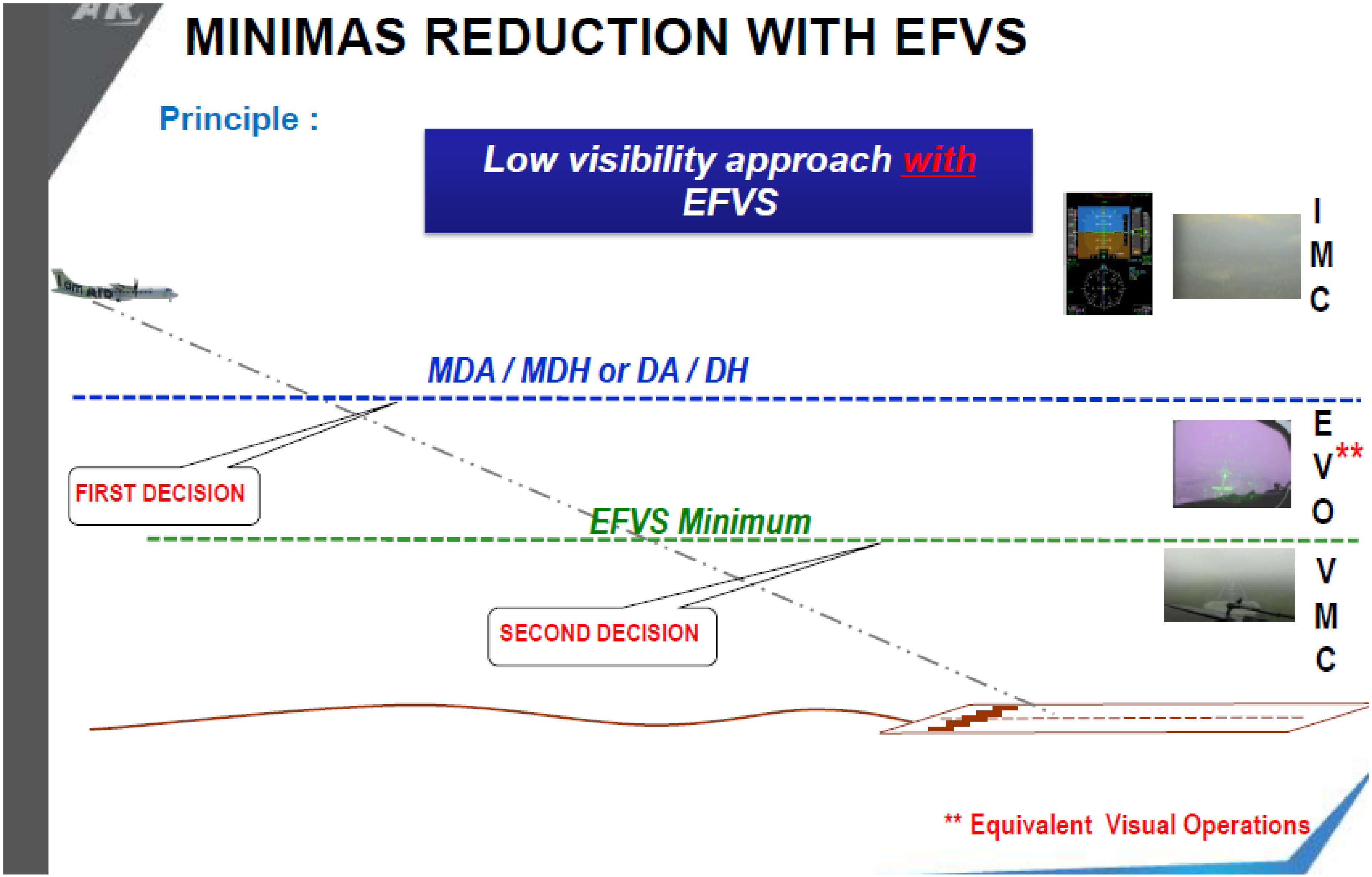
Next Steps

- CS-AWO has been reviewed by key stakeholders during 4 dedicated workshops and is considered to be mature enough for an NPA to be published.
- CS-AWO amendment (ED Decision) in Q1 2018

Enhanced Flight Vision System

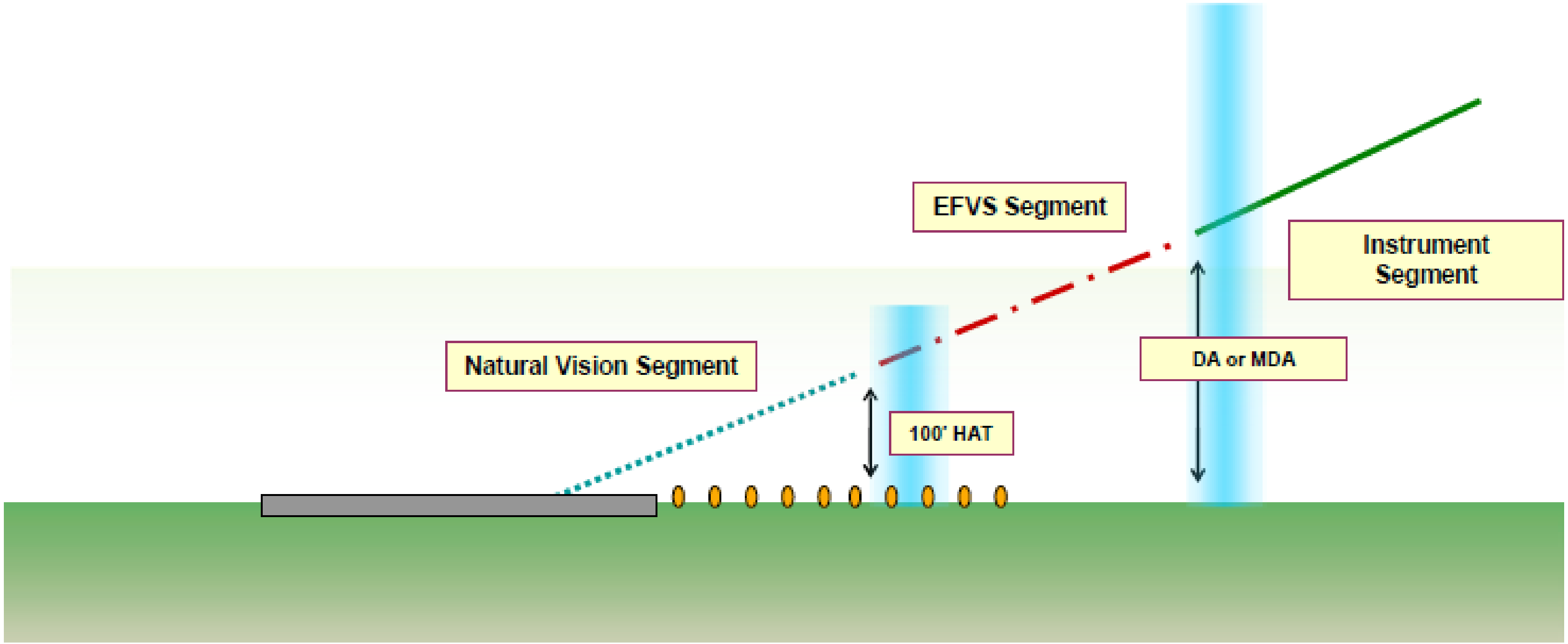

CVS ON

Low visibility approach with EFVS

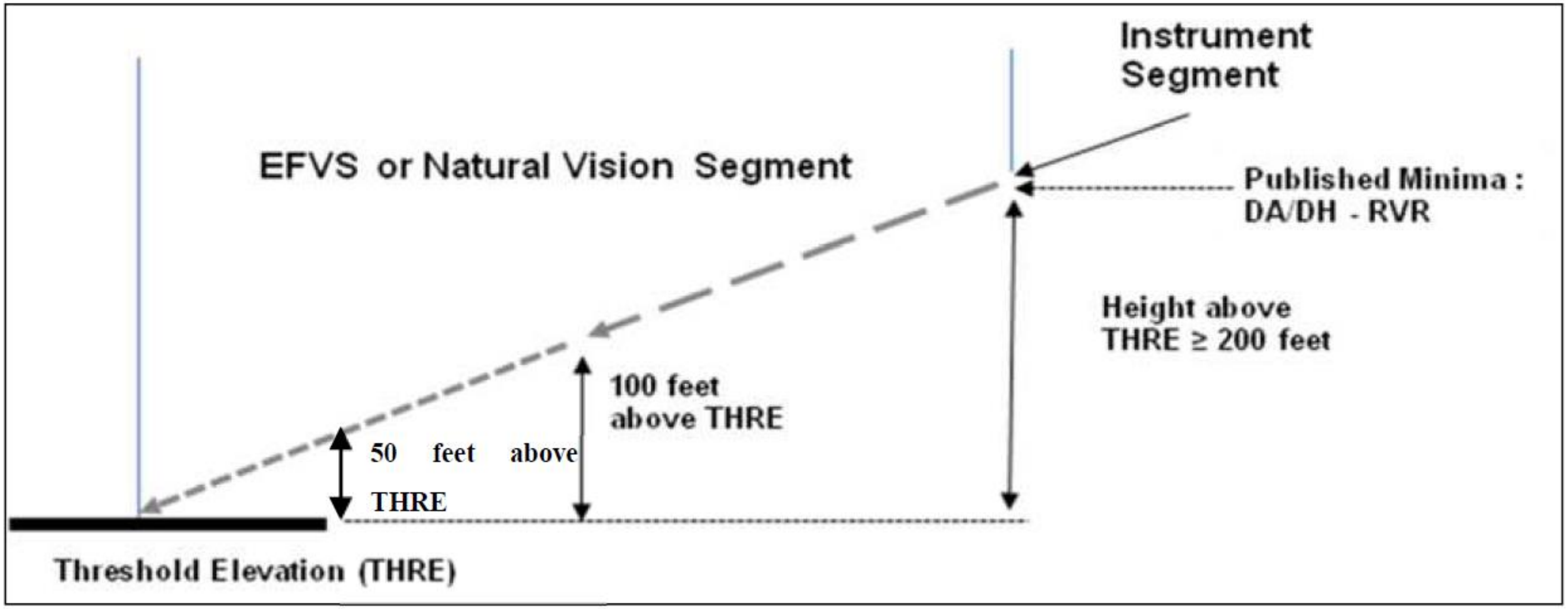


Operational Concept for EFVS

At 100’ HAT visual references must be distinctly visible and identifiable (lighting, marking)



EFVS Landing concept



- Minimum RVR of 1000ft will allow pilots to acquire the visual references through natural vision at or above 50ft above THRE.
- There is no defined decision point at which the flight crew must see required outside visual references with natural vision

EFVS considerations

- EFVS vision/image is not identical to the natural outside view a pilot would have at and below the DA/DH/MDA.
- The EFVS image is processed by a system and therefore it may be subject to failure conditions and/or pilot misinterpretation.
- For EFVS Approach, mitigation is provided by the DA.
- For EFVS Landing, the DA has been “replaced” by an RVR limitation.

EFVS consideration

- Actual RVR at the landing runway may be lower than the reported RVR and therefore mitigation can't be guaranteed.
- Hence, there is no defined decision point at which the flight crew must see required outside visual references with natural vision.
- Therefore, in case of RVRs lower than reported, they may continue the approach (and landing) based on the EFVS image alone.
- Our approach should be that the SSA/FHA needs to address the failure condition of misleading information provided by EFVS in RVRs lower than reported and that the corresponding hazard classification will have to be mitigated by the system integrity.
- The need for a "repeater" display for the pilot monitoring is an important consideration and may need to be in the pilot monitoring field of view[1](CS.AWO.A.EFVS.104 EFVS Display)

- [1]CS.AWO.A.EFVS.104 EFVS Display

EASA
European Aviation Safety Agency

Thank you!

Your safety is our mission.

An agency of the European Union

EASA
European Aviation Safety Agency

Spare slides

Your safety is our mission.

An agency of the European Union

HUD landing distance

- HUD with flare guidance
  - Changes in operational procedures and/or piloting control techniques which may invalidate the landing distances scheduled in compliance with CS 25.125.
  - AMC….states…
    - That if there is any feature of the system or the associated procedures which would result in an increase to the landing distance required, the appropriate increment must be established and scheduled in the aeroplane Flight Manual.

HUD/EFVS LANDING DISTANCE

AMC AWO.A.EFVS.109 (h) 1. - EFVS Performance – landing distance

(a) The flare guidance provided by the HUD during landing and any procedure associated with using the HUD in EFVS landing, may result in an increase to the landing distance.

(b) The EFVS landing distance referred to should be established as follows:

(1) The requirements of CS 25.125 should be applied, except that the configuration, procedure and speed should be that recommended in the associated procedures for using an EFVS.

(2) The landing distance as derived under (a) above should be compared with the normal landing distance as per CS 25. 125. If the EFVS landing distance is longer than without using an EFVS, the EFVS landing distance should be furnished in the AFM. This landing distance may not be shorter than the landing distance established in accordance with CS 25.125 without using EFVS.

(3) The operating procedures, aeroplane configuration, approach speed, thrust management, piloting control techniques and the landing distance data applicable for EFVS landings should be furnished in the AFM.

Manual HUD CAT III

AMC AWO.B.CATIII.118 Landing distance

This applies when using HUD in manual CAT III operations. A relevant feature of the HUD system to consider would be flare guidance.

Relevant procedural elements associated with using the HUD would be any specific aeroplane configuration, approach speed increment, thrust management or ATHR speed target.

The increment of the landing distance referred to in CS.AWO.B.CATIII.118 Landing distance when using a HUD may be derived as follows:

(a) The configuration, procedure and speed should be that recommended in the associated procedures.

(b) The distance from the runway threshold to the touchdown point should be the distance from the runway threshold to the glide-slope origin (SO) plus the mean distance from the glide-slope origin to touchdown (STD) plus three times the standard deviation of the distance from the glide-slope origin to touchdown (σSTD).

(c) The gross distance from touchdown to come to a complete stop should be determined in accordance with the requirements of CS 25.125 (b) (1) through (5), assuming a touchdown speed equal to the main touchdown speed plus three standard deviations of the touchdown speed.

Note: The main values and standard deviations considered in paragraphs (b) and (c) should be based on random variations as determined by AMC AWO.HUD.107. Systematic variation of parameters should cover the normal range of Flight Manual conditions.

(d) The Landing Distance should be taken as the distance from the runway threshold to the touchdown point, as defined in (b) above, i.e., (SO + STD + 3σ(STD), plus the ground roll distance defined in (c) above.

(e) The Landing Distance should include corrections for variations in glide-slope angle and variations in glide-slope height at the threshold. Alternatively, these effects may be included by use of conservative assumptions in the basic presentation of data, with the applicable ranges stated in the Flight Manual.

From FAA AC 20-167A

Figure 3. Minimum Detection Range