European Union Aviation Safety Agency

EASA Validation of FAA State of Design – CS-E Turbine Engines
EASA Safety Emphasis Items (SEI)
Technical Implementation Procedures (TIP)

TIP Revision	SEI Issue & Date	
Rev 6, Amendment 2	Revision 1 15 October 2019	CS-E vs. 14 CFR Part 33

SEI #	Title	CS-E par.	Reference Document	Remarks
1	Compressor and Turbine Blade Failure	810(a)	SSD No. 13	Refer to SSD. Applicable in case of Integrally Bladed Rotors.
2	ETOPS	1040	SSD No. 15	Refer to SSD. IFSD rate demonstration; service experience since EIS to be assessed if applicable.
3	Exposure to Volcanic Cloud Hazards	1050	SSD No. 16	Refer to SSD. E 1050 has no equivalent in Part 33. See acceptable means of compliance in AMC E 1050.
4	ED79A-ARP4754A EECS Development Assurance	50; 510	EUROCAE ED-79A / SAE ARP4754A	Legacy methods of demonstrating compliance to CS-E 50/CS-E 510 using development assurance techniques at the software and airborne electronic hardware levels do not adequately address potential errors in the development of Electronic Engine Control Systems. Therefore, EASA requests additional methods to reduce and mitigate development errors in the Electronic Engine Control System development process in line with the objectives of EUROCAE ED-79A / SAE ARP4754A, "Guidelines for Development of Civil Aircraft and Systems". A CRI IM may be needed for Engines intended to be installed on: ▪ Aeroplanes for which CS 25.1309 Type Certification basis is CS-25 Amendment 11 or later; ▪ Rotorcrafts for which CS 29.1309 Type Certification basis is CS-29 Amendment 4 or later. ▪ CS-23 Commuters (pre CS-23 Amendment 5) & Level 4 certification (post CS-23 Amendment 5). There is no equivalent FAA policy or IP. The generic EASA CRI IM is recent and confidence building is necessary to ensure a consistent usage of EUROCAE ED-79A / SAE ARP4754A by the CA and VA when assessing the applicant's development assurance processes.

5	Development Assurance for Software & Airborne Electronic Hardware (AEH)	50	*See Appendix*	*See further details in Appendix.*
6	Icing Conditions	780	AMC E 780	CS-E Amendment 4 and Part 33.68 Amendment 34 introduced a harmonised requirement for a Critical Point Analysis (CPA) to ensure that the selected icing test conditions address all of the worst conditions found in the applicable icing envelope. AMC E 780 Amendment 4 introduced new means of compliance guidance for CS-E 780, which is not addressed by Part 33 or AC 20-147A:- ▪ AMC E 780 Paragraph 5 introduces specific guidance for Engine Air Data Probe Icing These aspects of CS-E 780 compliance are therefore identified as an SEI until experience of applying the CPA requirements has been gained, and pending introduction of harmonised guidance in Part 33 or AC 20-147 addressing air data probes.
7	Additive Manufacturing	70		Applicable to the following parts produced from additive manufacturing : - Critical Parts, - Critical Influencing parts, - Parts produced from additive manufacturing method different than Laser Powder Bed Fusion (PBF) and Electron Beam PBF. See also EASA CM-S-008 for guidance.

SEI 'Part 2':

Per TIP 6.1 EASA will accept FAA's finding of compliance with these items where direct compliance is shown with the listed documents and remarks. Items on this list, when affected, will not result in Non-Basic classification.

SEI #	Title	CS-E par.	Reference Document	Remarks
8	Damage Tolerance Assessment	515	CM-PIFS-007	EASA CM-PIFS-007, paragraph 3.1.A1.(c) states: "The assumptions used in this analysis (i.e. material properties, reference engine cycle, operating environment and its effect on the stress cycle etc.) should be declared." Change 1 of FAA AC 33.70-1 revised the applicable requirements to define the damage tolerance cycle as the major stress cycle (min-max-min) from the missions used in the LCF certification analysis for standard day conditions. For EASA the engine flight cycle analysed should include the various flight segments that describe a complete mission such that detrimental effects are appropriately evaluated. Examples of such affects are dwell and minor cycles.

9	Turbine Engine Relighting In Flight	910	AMC E 910 (3)	FAA Policy PS-ANE-33.89-1 is not applicable to turboshaft engines. It also does not specifically address "Quick engine shut-down and relight". AMC E 910 (3) is applicable to all turbine engines, including turboshafts. AMC E 910 (3)(a) requires the applicant to justify that the engine design, and in particular the engine control system, will not introduce an unnecessary delay in the engine returning to the previous power setting.
10	Integrity of Nickel Powder Metallurgy Rotating Critical Parts for Gas Turbines	515	CM-PIFS-013	No equivalent FAA policy to EASA CM-PIFS-013. This SEI should be applied if the applicant has no sufficient design or service experience in powder metallurgy rotating critical parts**.**
11	Fuel System Contaminated Fuel	560; 670	AMC E 560 (4) AMC E 670 (3)	No equivalent MoC in Part 33. AMC E 560 (4) and AMC E 670 (3) require to consider transient fuel icing and provides acceptable MoC. Note: FAA Issue Paper may be found equivalent.

Revision Table

SEI Revision	Date	Changes
Revision 0	22 March 2018	Initial Issue
Revision 1	15 October 2019	<u>Items deleted</u>: - Time Limited Dispatch - Fire Testing – Burners - Fire Testing – Fireproofness of Firewalls - Turbine Over-speed Resulting from Shaft Failure (Note: now included in SSD Compressor and Turbine Shafts) <u>Items updated</u>: - Compressor and Turbine Blade Failure - ED79A-ARP4754A EECS Development Assurance - Development Assurance for Software & Airborne Electronic Hardware (AEH) - Icing Conditions - Turbine Engine Relighting in Flight <u>New items</u>: - 'Part 1': Additive Manufacturing (Note: was previously addressed under Non-basic criteria 'New technology' or 'Novel applications of existing technology") - 'Part 2': Fuel System / Contaminated Fuel

Appendix

Guidance for EASA/FAA SEI CS-E

CS-E vs. CFR 14 Part 33

SEI #6 Development Assurance for Software (SW) & Airborne Electronic Hardware (AEH)

The following text describes the individual SW&AEH subjects for SEI. Their applicability is dependent from the applicable MoC on projects.

ID	Subject	Description	EASA position
#6-01	Management of Open Problem Reports	Open Problem Report management guidance is needed if an applicant or any of their suppliers intends to defer the resolution and correction of AEH or Software problems past the date of certification. This subject qualifies as an SEI when insufficient guidance is applied to a project. Note: this SEI addresses only the process aspects of OPR management aspect and does not imply a specific involvement in the review of OPRs for specific systems of the product.	A means of compliance CRI is needed when guidance is insufficient. Note: SEI not applicable for validation of FAA approved products when an equivalent OPR management FAA IP or DO-178C DP#9, or AC 20-189 *(to be published)* has been applied to the project. **Applicable references for EASA**: CM-SWCEH-001 and CM-SWCEH-002 section 16, or AMC 20-189 *(to be published)*.
#6-02	Use of Multicore Processors	Additional guidance on use of Multi-Core Processors is needed for new or modified airborne systems containing Multicore Processors devices, hosting Software components on different cores. This subject qualifies as an SEI when insufficient guidance is applied to a project.	Multi-Core processors include features that may impact the behaviour, and therefore the safety, of a system if not well managed. A means of compliance CRI is needed for new or modified airborne systems containing Multicore Processors devices, hosting Software components on different cores, when guidance is insufficient. Note: SEI is applicable - when FAA Generic MCP IP rev 11 (or later) has not been applied - or when the type of MCP usage is not covered by the FAA IP (e.g. dynamic allocation). **Applicable references for EASA:** Generic EASA MCP CRI Issue 3.0

#6-03	Software Guidance	Additional guidance is needed for the development of new or modified airborne systems/equipment containing Software, when harmonized FAA/EASA guidance has not been applied. This subject qualifies as an SEI when insufficient guidance is applied to a project.	A means of compliance CRI is needed for new or modified airborne systems/equipment containing Software, when insufficient Software development assurance guidance has been applied to a project. Note: SEI not applicable - when AC 20-115D has been applied, - or when DO-178C has been applied, - or when DO-178B has been applied with use of Software techniques for which specific guidance has been raised by the CA (MBD, OOT, FM, CM/PDI, Pseudocode) - or when DO-178B has been applied without use of specific Software techniques (MBD, OOT, FM, CM/PDI, Pseudocode). Applicable references for EASA: AMC 20-115D Note: For projects using DO-178B, the means of compliance CRI will cover, as applicable, guidance extracted from some Software CM-SWCEH-002 sections that are related to the applicable Software techniques.
#6-04	Hardware Guidance for custom devices	Guidance is needed for the development of new or modified airborne systems/equipment containing custom devices. This subject qualifies as an SEI when insufficient guidance is applied to a project.	Without following a structured development process, it cannot be guaranteed that the system/equipment will perform as intended with an acceptable level of confidence. A means of compliance CRI is needed for new or modified airborne systems/equipment containing custom devices (PLD, FPGA, ASIC), when no AEH development assurance guidance has been applied to a project. Note: SEI not applicable when DO-254/ED-80 associated with the FAA Order 8110.105, or AC 20-152A *(to be published)* has been applied. **Applicable references for EASA:** CM-SWCEH-001 section 8 or AMC 20-152A *(to be published)*
#6-05	Use of COTS IPs (Intellectual Property)	The use of COTS IPs requires specific guidance that is not available in current material.	FAA order 8110.105 and EASA CM-SWCEH-001 do not cover COTS IP with adequate guidance, considering the nowadays complexity and usage of COTS IPs in projects. Given the impact of use of COTS IP on the overall safety level of an aircraft, a means of compliance CRI is needed for new or modified airborne systems/equipment using COTS IP in custom devices. Notes: SEI not applicable when AC 20-152A section 5.11 *(to be published)* has been applied. SEI only applicable for DAL A, B, C hardware. **Applicable references for EASA:** AMC 20-152A section 5.11 *(to be published)*.

#6-06	Use of complex COTS devices	Development assurance is needed for the usage of complex COTS devices.	Given the impact of use of COTS devices on the overall safety level of an aircraft, a means of compliance CRI is needed for new or modified airborne systems/equipment using COTS in custom devices. Note: - SEI only applies for complex COTS - SEI not applicable for COTS processor devices when FAA IP on COTS processors has been raised. - SEI not applicable when AC 20-152A section 6 *(to be published)* has been applied. **References for EASA:** AMC 20-152A section 6 *(to be published)*.
#6-07	Artificial Intelligence and Machine Learning	The use of Artificial Intelligence / Machine Learning requires specific guidance that is not available in current material.	The use of Machine Learning creates certification challenges and Development Assurance considerations. These type of systems may not be fully specified or even be non-deterministic, and thus, may not be able to satisfy all development assurance process objectives. Traditional Development Assurance methodologies are not adapted to the challenges raised by the verification of adaptive/intelligent systems and by the learning aspects of this new technology. To date, guidance does not exist.
#6-08	MBD for Hardware Development	The use of Model Based Development (MBD) within the development process of custom devices requires specific guidance that is not available in current material.	MBD for hardware is a new development technique with limited experience in the Hardware industry. The requirements capture and the development of the model, associated with the usage of tools to generate detailed design has a potential impact on the overall safety of the aircraft. To date, guidance does not exist.