



Federal Aviation Administration

Memorandum

Date: July 29, 2013

To: Manager, Engine Certification Office, ANE-140

From: Manager, Engine & Propeller Directorate, ANE-100

Prepared by: Carlos Fernandes, ANE-141

Subject: INFORMATION: Equivalent Level of Safety (ELOS) Finding for General Electric Company's (GE's) project on GEnx-2B67/P Engine Model, FAA Project # AT3138EN-E

ELOS Memo#: AT3138EN-E-P-2

Regulatory Ref: 14 CFR 21.21 and 33.87(a), (b) and 33.93

This memorandum informs the Engine Certification Office (ECO) of an evaluation made by the Engine & Propeller Directorate on the establishment of an equivalent level of safety finding for the GEnx-2B67/P engine model.

Background

On October 6, 2010, General Electric Company (GE) submitted an application to the ECO to amend the GEnx series Type Certificate to include a new derivative model, the GEnx-2B67/P.

Title 14, Code of Federal Regulations (14 CFR) 33.87(a) requires that each new turbofan engine model completes a 150 hour endurance test conducted in accordance with §§ 33.87(a)(1) through (8), and 33.87(b). Section 33.93(a) requires that after completing the endurance test, each engine part must conform to type design and be eligible for continued operation in accordance with the Instructions for Continued Airworthiness (ICA) submitted in compliance with § 33.4.

GE proposed an ELOS to the endurance test and teardown inspection requirements of §§ 33.87 and 33.93 using compensating factors in accordance with the provisions of 14 CFR 21.21(b)(1). The ELOS proposal used a modified low pressure turbine (LPT) endurance test and teardown inspections and comparative analysis for the fan and core

modules as the method of compliance for §§ 33.87 and 33.93, for the GEnx-2B67/P engine model, instead of running a standard endurance test and complete teardown.

Applicable regulations

14 CFR 21.21, 33.87 and 33.93

Regulation requiring an ELOS finding

14 CFR 33.87(a) and (b), and 33.93

Description of compensating design features or alternative Methods of Compliance (MoC) which allow the granting of the ELOS (including design changes, limitations or equipment need for equivalency)

The FAA determined that the following compensating factors provide an equivalent level of safety with the requirements of §§ 33.87(a) and (b), and 33.93:

1. Comparative analysis to the baseline engine test must address the differences between the proposed modified test and the required endurance test of § 33.87, and the effects of such differences on the test outcome.
2. Substantiation that the use of multiple individual tests represents the testing of the proposed engine model as a single system.

Explanation of how design features or alternative Methods of Compliance (MoC) provide an equivalent level of safety to the level of safety intended by the regulation

The § 33.87 endurance test is an accelerated severity test intended to demonstrate a minimum level of engine operability and durability within the approved engine ratings and operating limitations. The test requirements are to demonstrate that the engine is in an airworthy condition and is safe for continued operation at the end of the test. In the case where the complete test data is not acquired, other sources may be used to augment the test data obtained. These sources may include additional § 33.87 testing in the cases where design changes occurred after the initial test demonstration, previously run tests on engines similar in design and construction, and previously run tests that demonstrate aspects of the § 33.87 endurance test, such as durability.

The § 33.93 tear-down inspection shows that the post-endurance test engine hardware is in a condition for safe operation per ICA applicable to the engine. In the case where an engine does not complete the entire test, data from other sources may be used to augment the tear down inspection. These sources may include additional § 33.87 testing in the cases where design changes occurred after the initial test demonstration and previously run tests on engines similar in design and construction.

GE used comparative analysis to the previously completed GEnx-2B67 triple redline endurance test, to satisfy the requirements of §§ 33.87 and 33.93 for the fan and low pressure compressor (LPC) modules. The GEnx-2B67/P and GEnx-2B67 have hardware commonality or similarity, and equivalent operating environment and limitations.

GE used comparative analysis to the previously completed GEnx-1B78/P2 triple redline endurance test, to satisfy the requirements of §§ 33.87 and 33.93 for the high pressure compressor (HPC), combustor and HPT modules. The GEnx-2B67/P and GEnx-1B78/P2 have hardware commonality or similarity, and equivalent operating environment and limitations.

GE combined the proposed modified test and inspections with comparative analysis to the GEnx-2B67 baseline endurance test and inspections to show compliance for the new LPT module to the requirements of §§ 33.87 and 33.93.

GE substantiated the use of multiple individual tests to represent the testing of the proposed engine model as a single system.

FAA approval and documentation of the ELOS finding:

The FAA has approved the aforementioned ELOS findings in GEnx-2B67/P issue paper P-2. This memorandum provides standardized documentation of the ELOS findings that are nonproprietary and can be made available to the public. The Engine and Propeller Directorate has assigned a unique ELOS Memorandum number (see front page) to facilitate archiving and retrieval of these ELOS. This ELOS Memorandum number must be listed in the Type Certificate Data Sheet under the Certification Basis section (TCs & ATCs) or in the Limitations and Conditions section of the STC. An example of an appropriate statement is provided below.

Equivalent Level of Safety Findings have been made for the following regulations:

14 CFR 33.87(a) and (b) Endurance Test and 33.93 Teardown Inspection (documented in ELOS Memo AT3138EN-E-P-2)

Manager, Engine & Propeller Directorate
Aircraft Certification Service

Date

ELOS Originated by ACO: Engine Certification Office	ACO Manager: Thomas Boudreau	Routing Symbol: ANE-140
--	---------------------------------	----------------------------