Federal Aviation Administration

Memorandum

Date: June 14, 2012

To: Manager, Engine Certification Office, ANE-140

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

Prepared by: Tomasz Rakowski, ANE-141

Subject: INFORMATION: Equivalent Level of Safety (ELOS) Finding for General Electric Company's project on GEnx-1B75/P1 Series Engine Models, FAA Project# AT3024EN-E

ELOS Memo#: 8040-ELOS-12-NE03

Regulatory Ref: 14 CFR 21.21, 33.87 and 33.93

This memorandum informs the Engine Certification Office of an evaluation made by the Engine and Propeller Directorate on the establishment of two equivalent level of safety findings (ELOS) for the GEnx-1B75/P1 series engine models, including GEnx-1B54/P1, GEnx-1B58/P1, GEnx-1B64/P1, GEnx-1B67/P1, GEnx-1B70/P1, GEnx-1B70/72/P1, GEnx-1B70/75/P1, GEnx-1B74/75/P1, and GEnx-1B75/P1.

Background

GEnx-1B75/P1 certification engine failed during the initial § 33.87 endurance test attempt. The engine had completed approximately 95 percent of the required test when the high pressure turbine (HPT) stage 1 blade airfoils broke off, causing secondary damage to the HPT and low pressure turbine (LPT) flowpath components. After HPT redesign, additional endurance testing was accomplished. The General Electric Company (GE) proposed to substantiate an ELOS finding to the endurance test requirements of § 33.87(a) and § 33.87(b). GE also proposed to substantiate an ELOS finding to the teardown inspection requirements of § 33.93(a).

Applicable regulation(s)

14 CFR 21.21, 33.87 and 33.93

Regulation(s) requiring an ELOS finding

14 CFR 33.87 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 § 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 Instructions for Continued Airworthiness 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.

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

GE used the data from the GEnx-1B75/P1 endurance tests, data from the original GEnx-1B70 endurance test and comparative analysis to the original GEnx-1B70 endurance test results, as well as data from previously run vibration signature testing, and previously run vibratory stress survey testing to satisfy the requirements of § 33.87.

GE demonstrated compliance to § 33.93 with inspections of hardware used in the GEnx-1B75/P1 endurance tests and the original GEnx-1B70 endurance test.

FAA approval and documentation of the ELOS finding:

The FAA has approved the aforementioned ELOS findings in GEnx-1B75/P1 Issue Paper P-3. 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's. 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 Endurance Test and 33.97 Teardown Inspection (documented in ELOS Memo 8040-ELOS-12-NE03)

// Original signed by Robert Ganley
for ANE-100 //

6/14/12

Manager, Engine and Propeller Directorate
Aircraft Certification Service

Date

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