



Federal Aviation Administration

Memorandum

Date: April 5, 2013

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 (GE's) project on GENx-1B/P2 Engine Models, FAA Project # AT3129EN-E

ELOS Memo#: AT3129EN-E-P-1

Regulatory Ref: 14 CFR 21.21 and 33.27

This memorandum informs the Engine Certification Office (ECO) of an evaluation made by the Engine and Propeller Directorate on the establishment of an equivalent level of safety finding for the GENx-1B78/P2 family of engine models.

Background

On October 6, 2010, GE submitted an application for Type Certificate to the ECO for ten new engine models, under a common GENx-1B78/P2 designation. The new engine models are the GENx-1B54/P2, GENx-1B58/P2, GENx-1B64/P2, GENx-1B67/P2, GENx-1B70/P2, GENx-1B70/72/P2, GENx-1B70/75/P2, GENx-1B74/75/P2, GENx-1B75/P2, and GENx-1B78/P2.

14 CFR 33.27(c) requires the integrity of the most critically stressed component of each turbine, compressor, and fan rotor be demonstrated through an overspeed test. GE has proposed comparative analyses for compliance to § 33.27(c) test requirement for the low pressure compressor (LPC), high pressure compressor (HPC), high pressure turbine (HPT), and low pressure turbine (LPT) rotors.

GE proposed to use analyses to establish that the capabilities of the following GENx-1B78/P2 critical components exceed those demonstrated in prior certification test of similar parts:

- the LPC spool stage 2 disk, validated by the CFM56-5 LPC spool overspeed test,

- the HPC spool stage 2 blisk, validated by the original GENx-1B78 HPC stage 2 blisk overspeed test,
- the HPT stage 2 disk, validated by the GE90 HPT rotor overspeed test,
- the LPT stage 4 disk, validated by the GE90-115B LPT stage 3 disk overspeed test.

Applicable regulations

14 CFR 21.21, 33.27

Regulation requiring an ELOS finding

14 CFR § 33.27(c)

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 33.27(c):

1. GE shall use its Design Practice Burst Methodology to identify the most critical component in each of the affected rotor modules and predict the overspeed burst speeds.
2. The analytical methodology shall be validated based on prior approved overspeed data acquired from testing of rotors with same material, similar geometry, burst and deformation capabilities, performed at comparable test conditions.
3. The validated analytical methodology must have the ability to accurately predict rotor burst speed and dimensional growth, identify the rotor stage or component with the lowest burst margin in each rotor module, and reliably predict applicable results from engine tests or rig tests.
4. The rotors similarity to prior certification tests must satisfy the identified pass/fail criteria.

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 substantiated which of the overspeed conditions listed in § 33.27(c) was the most critical with respect to rotor integrity for each rotor module (LPC, HPC, HPT, and LPT). This substantiation considered the entire flight envelope. Once these conditions and the critical rotor stages have been identified, GE submitted a validated analysis acceptable to the FAA to substantiate these ELOS findings. In the case of GE's proposed analyses validated by prior certification test, the criteria for component similarity to the previously tested article were met. Since GE proposed an analysis in lieu of a test, GE based the calibration and validation of the analytical technique on prior overspeed test that met the compensating factors.

FAA approval and documentation of the ELOS finding:

The FAA has approved the aforementioned equivalent level of safety finding in project issue paper P-1. This memorandum provides standardized documentation of the ELOS finding that is nonproprietary and can be made available to the public. The Accountable Directorate has assigned a unique ELOS Memorandum number (see front page) to facilitate archiving and retrieval of this 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 § 33.27(c) section Turbine, compressor, fan, and turbosupercharger rotors (documented in ELOS Memo AT3129EN-E-P-1)

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

4/5/13

Manager, Engine & Propeller Directorate
Aircraft Certification Service

Date

ELOS Originated by ACO:	ACO Manager:	Routing Symbol:
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