



# Federal Aviation Administration

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## 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-1

Regulatory Ref: 14 CFR 21.21 and 33.27

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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) 33.27(c) requires the integrity of the most critically stressed component of each turbine, compressor, and fan rotor be demonstrated through an overspeed test.

GE proposed an ELOS to the overspeed test requirements of §33.27(c) using compensating factors in accordance with the provisions of 14 CFR 21.21(b)(1). The ELOS proposal used analyses validated by component overspeed tests for compliance to § 33.27(c) test requirement for the low pressure compressor (LPC), high pressure turbine (HPT), and low pressure turbine (LPT) rotors.

GE proposed to use analyses to establish that the capabilities of the following GENx-2B67/P critical components exceed those demonstrated in prior certification test of similar parts:

- the LPC spool stage 2 disk, validated by the CFM56-5C LPC spool overspeed test,
- the HPT stage 2 disk, validated by the GE90 HPT stage 2 disk 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 will use their Overspeed and Burst Design Process based on their Design Practice Burst Methodology.
2. The analytical methodology must be validated based on tested rotors with same material, similar geometry, test conditions, and burst/deformation capability.
3. The validated analytical methodology must have the ability to accurately predict rotor burst and growth.
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**

The overspeed requirements intended to demonstrate that the rotors possess sufficient strength with a margin to burst above certified operating conditions and above failure conditions leading to rotor overspeed; and do not exhibit a level of growth or damage that could lead to a hazardous condition, such as fire, uncontainment, or loads greater than the ultimate loads of the engine mounts.

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, 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 analysis in lieu of 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 ELOS findings in GENx-2B67/P 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 AT3138EN-E-P-1)

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Manager, Engine & Propeller Directorate  
Aircraft Certification Service

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Date

ELOS Originated by ACO:	ACO Manager:	Routing Symbol:
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