Federal Deposit Insurance Corporation.

Robert E. Feldman,

Acting Executive Secretary.

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DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 33

[Docket No. 94–ANE–18; Special Conditions No. SC–33–ANE–08]

Special Conditions; General Electric (GE) Aircraft Engines Model(s) GE90–75B/–85B/–76B Turbofan Engines

AGENCY: Federal Aviation Administration, DOT.

ACTION: Final special conditions.

SUMMARY: These special conditions are issued for the General Electric (GE) Aircraft Engines Model(s) GE90–75B/–85B/–76B turbofan engines. These special conditions contain the additional safety standards which the Administrator considers necessary to establish a level of safety equivalent to that established by the airworthiness standards of part 33 of the Federal Aviation Regulations (FAR).

EFFECTIVE DATE: March 6, 1995.

FOR FURTHER INFORMATION CONTACT: Tim Mouzakis at (617) 238–7114 or Karen Grant at (617) 238–7133, Engine and Propeller Standards Staff, ANE–110, Engine and Propeller Directorate, Aircraft Certification Service, FAA, New England Region, 12 New England Executive Park, Burlington, Massachusetts 01803–5229; fax (617) 238–7199.

SUPPLEMENTARY INFORMATION:

Background

On December 16, 1991, General Electric Aircraft Engines applied for type certification of Model(s) GE90–75B/–85B/–76B turbofan engines. These engines incorporate a first stage fan blade manufactured using carbon graphite composite material. This unusual design feature results in the GE90 fan blade having significant differences in material property characteristics when compared to conventionally designed fan blades using non-composite materials. For example, the probability that a composite fan blade will fail below the inner annulus flowpath line may be highly improbable, questioning the appropriateness of the requirement contained in § 33.94(a)(1) to show blade containment after a failure of the blade at the outermost retention feature.

The current requirements of § 33.94 are based on metallic blade characteristics and service history, and are not appropriate for the unusual design features of the composite fan blade found on the GE90 series turbofan engines. The FAA has determined that a more realistic blade out test will be achieved with a fan blade failure at the inner annulus flowpath line (only the airfoil) instead of the outermost retention feature as is currently required by § 33.94(a)(1).

The FAA has also determined that the composite fan blades construction presents other factors that must be considered. Tests and analyses must account for the effects of in-service deterioration of, manufacturing and materials variations in, and environmental effects on the composite material. Further, tests and analyses must show that a lightning strike on the composite fan blade will not result in a hazardous condition to the aircraft, and that the engine will meet the requirements of § 33.75. Therefore, these special conditions are additional requirements which the Administrator considers necessary to establish a level of safety equivalent to that established by the Airworthiness Standards of part 33.

Type Certification Basis

Under the provisions of § 21.101 of the Federal Aviation Regulations (FAR), General Electric Aircraft Engines must show that the Model(s) GE90–75B/–85B/–76B turbofan engines meet the requirements of the applicable regulations in effect on the date of the application. Those Federal Aviation Regulations are § 21.21, as amended through Amendment 21–68, August 10, 1990, and part 33, as amended 33–14, August 10, 1990.

The Administrator finds that the applicable airworthiness regulations in part 33, as amended, do not contain adequate or appropriate safety standards for the General Electric Aircraft Engines Model(s) GE90–75B/–85B/–76B turbofan engines because of unique design criteria. Therefore, the Administrator prescribes special conditions under the provisions of § 21.16 to establish a level of safety equivalent to that established in the regulations.

Special conditions, as appropriate, are issued in accordance with § 11.49 of the FAR after public notice and opportunity for comment, as required by §§ 11.28 and 11.29(b), and become part of the type certification basis in accordance with § 21.101(b)(2).

Discussion of Comments

Interested persons have been afforded the opportunity to participate in the making of these special conditions. Due consideration has been given to comments received.

Two commenters express no objection to the adoption of these special conditions as proposed.

Two commenters cite the apparent departure by the FAA from its general practice of involving industry prior to effecting significant changes to certification requirements, and recommend that the FAA evaluate the proposed changes in harmony with industry through the Aviation Rulemaking Advisory Committee (ARAC).

The FAA has not determined that these special conditions will form the basis to a rulemaking change to amend 14 CFR part 33. These special conditions prescribe for a specific design, the testing and analyses necessary to achieve an equivalent level of safety. The FAA may consider whether it is necessary to revise § 33.94 to include the requirements of these special conditions. The ARAC may be used to gather industry and public participation in that rulemaking project. For this specific application for type certification, however, the FAA has followed the rulemaking procedures provided by 14 CFR part 11 that allow for industry and public comment.

Two commenters state that applying the maximum load criteria used for propellers to a fan blade, with significantly different mechanical arrangement and dynamic behavior, is technically unjustified.

The FAA disagrees. The two times maximum load criteria test is designed to show the capability of the fan blade retention system to withstand without separation centrifugal loads significantly greater than will be seen in service. A safety factor of two is a reasonable safety factor as demonstrated by its success in propeller applications. The blade and its retention system must be capable of retaining the blade under this load condition.

Two commenters state that the additional requirements, in conjunction with any available analyses, cannot guarantee that the failure probability will be extremely improbable. Inherent characteristics of complex composite hardware design, latent defects and susceptibility to manufacturing variations, and nonconformance are identified as reasons for the statement.

The FAA agrees in part. The FAA has reviewed its position and concurs with the commenters that a failure

probability of extremely improbable can not be guaranteed. However, the FAA believes that the applicant has constructed a test program that demonstrates the blade retention features have sufficiently improved reliability to provide an equivalent level of safety to that provided by § 33.94. While extensive testing is required for material certification in accordance with § 33.15 to determine material characteristics and the effects of defects on blade life, additional test requirements were established within the compliance plan to determine the effect of defects and manufacturing variations on material capability.

One commenter suggests adding an additional paragraph to these special conditions as follows:

''(a)(3) By appropriate test and analysis it must be shown that the most adverse blade vibratory stresses, as determined per § 33.83, will not result in failure of the fan blade retention system when consideration is given to the most limiting manufacturing defect which could go undetected.''

The FAA disagrees with the commenter that the suggested paragraph be added, as these considerations are well within the interpretation of § 33.83 and no additional safety standards are deemed necessary.

One commenter suggests adding an additional paragraph to the special condition to minimize the risk of hazard which would result from potential failure of the fan blade retention system as follows:

''(a)(4) Although the above test requires release of the fan blade at the inner flowpath, additional testing and/or analysis shall be performed to define the engine behavior for the case of a fan blade release at the outermost retention groove. The data obtained shall be used when establishing:

(i) Any installation limitations to be included on the Type Certificate Data Sheet; and,

(ii) Load requirements of § 33.23.''

The FAA disagrees. As stated in § 33.75, Safety Analysis, the applicant must consider all probable malfunctions which will cause the engine to catch fire, burst, generate loads greater than those ultimate loads specified in § 33.23(a), or lose the capability of being shut down. These special conditions also require such analyses and tests to show that the failure of the fan blade retention system is not a probable malfunction. Establishment of the maximum stop-start stress cycles for the blade retention system is also required to assure the structural integrity of the blade attachment system.

One commenter states that the requirements should show that the failure rate of the fan blade retention system, for any cause, during the service life of the engine, be extremely improbable and can not be established at the time of type design approval for a new technology composite.

The FAA agrees in part. While the FAA agrees that a failure probability of extremely improbable can not be guaranteed, the FAA remains receptive to advances in technology, approaches, and new test methods which adequately simulate those effects typically verified by in-service experience. Further, the FAA believes that these same principles have been successfully used by engine manufacturers to ensure the airworthiness of rotor structural parts. It should be recognized that failure to demonstrate acceptable reliability of the blade retention features, results in non-compliance with these special conditions and that would require testing to occur at the outer most retention groove.

Two commenters suggest the energy levels and trajectories of any particles that would penetrate the engine cases by conducting an engine test in accordance with the test conditions of current §§ 33.94(a) and 33.94(b) be defined in the Engine Installation Manual or on the Engine Type Certificate Data Sheet. The definition of results should also include determination of the loads that would be transmitted through the engine to airframe interface. One commenter states that the energy levels, trajectories and loads must be included in each airplane type's design precautions taken to minimize the hazards in the event of an engine rotor failure, as required by current FAR 25.903 and JAR 25.903.

The FAA agrees that the requirements for defining energy levels, trajectories of particles, and a resultant loads already exist in §§ 33.19(a) and 33.23. The FAA also agrees that if such energy levels, trajectories, and resultant loads are defined, the appropriate data should be included in the Engine Installation Manual. The FAA does not agree with the commenters suggestion relative to complying with §§ 33.94(a) and 33.94(b) in addition to these special conditions. These special conditions provide safety standards which apply to the composite blade design as an alternative to the requirements of § 33.94. The applicant must demonstrate reliability of the blade root and the blade retention system.

One commenter criticizes the explanations and logic presented for justification of these proposed special conditions. The commenter cites that there was insufficient information in the notice by which to test the validity of the FAA's determination.

The FAA disagrees. The notice of proposed special condition identifies two bases on which the FAA determined that the current requirements of part 33 do not provide adequate or appropriate safety standards because of the novel or unusual design of the GE90 engine. The FAA also determined that additional safety standards were needed to ensure that the GE composite fan blades met an equivalent level of safety established by § 33.94. Given the number and the nature of the comments received, the FAA believes that the notice gave an adequate description of the proposed action to allow critical comment on the basis for that action.

One commenter states that they do not believe that use of graphite composite material for a turbofan blade retention system warrants a departure from the current requirements of § 33.94.

The FAA disagrees. The FAA supports the use of composite technology and the necessary methods of testing and analyses to show that the product meets an equivalent safety standard as established by § 33.94.

One commenter states that the demonstration means for showing ''extremely improbable'' should be specifically part of these proposed special conditions. The commenter suggests to establish and define a methodology by which to rigorously assess the probability of fan blade retention system failure as extremely improbable, and by which to assess the associated level of confidence in the assessment, particularly at the time of initial certification.

The FAA agrees in part. The FAA agrees that the assessment of the fan blade retention system should be conducted rigorously, but disagrees with the need to establish and define a methodology in these special conditions. The FAA believes it should not define a specific means to meet a safety standard, or publish an applicant's proprietary methodology. To publish a specific demonstration means would presume the FAA has predetermined the composite blade material property characterization. The methodology for assessing the fan blade retention system will be proposed by the applicant, and will be evaluated by the FAA.

One commenter states that lightning test conditions should be specifically identified in the special condition.

The FAA disagrees. Existing regulatory guidance material and standard industry practices for lightning

tests may be used to develop appropriate test criteria.

One commenter suggests that the term ''inner annulus flowpath line'' be substituted for ''inner flowpath diameter'' to eliminate ambiguity of definition.

The FAA concurs. The inner annulus flowpath line provides a better description of the flowpath contour because flowpath diameter suggests a line of constant radius. These Final Special Conditions will be revised to include this term.

One commenter states it is an issue of unnecessary additional risk that, in the absence of full compliance to § 33.94, these proposed special conditions are insufficient in scope and detrimental to aviation safety.

The FAA disagrees. The FAA has concluded that upon compliance with all of the requirements of these special conditions, together with additional testing beyond that typically employed for metallic blades within the scope of 14 CFR part 33, an equivalence to the safety standard provided in § 33.94 has been achieved and no additional risk has been assumed.

One commenter states that the most significant feature of the notice is the proposed probability of fan blade retention system failure of ''extremely improbable'' is a reduction in severity of the effects of a blade failure.

The FAA agrees. The FAA recognizes that certain loads associated with a blade release at the inner annulus flowpath line may be less than the loads associated with release of a fan blade at the outermost retention. Those loads imparted to the engine mount system based on the inner annulus flowpath line will be identified in the Engine Installation Manual. Since there is potential for a reduction in certain loads, it is imperative that the blade retention system demonstrates sufficiently improved reliability to provide an equivalent level of safety to that provided by § 33.94.

One commenter requested on what basis has it been decided that a failure along the inner flowpath line is the most critical for failures which are not assessed as being extremely improbable.

The FAA selected the inner annulus flowpath line as the critical location for blade release based on design, blade stresses, and demonstrated fatigue and impact testing.

One commenter states that these proposed special conditions make no mention of the design and construction requirements of either § 33.19 relating to containment design and uncontained blade fragments, or § 33.23 relating to mounting attachments and structure.

The FAA concluded that the requirements of §§ 33.19 and 33.23 were adequate and appropriate when applied to this design of the GE90 engine, and no additional special conditions were necessary.

One commenter suggests that these special conditions should also address the effects of possible detachment of those metallic portions of the blade.

The FAA disagrees. These special conditions provide an alternative to the release failure location on the blade. The metal to composite blade bonding capability has been addressed through tests conducted under 14 CFR part 33. There were no additional special conditions that are required.

One commenter suggests that the text of these proposed special conditions paragraph (a), has been mis-compiled.

The FAA concurs. The intent of the paragraph (a) is to identify the location of the release point for the fan blade containment test and to prescribe the additional safety standards to be demonstrated. These special conditions will be modified by reorganizing paragraph (a) to more clearly express this intent.

One commenter states that some re-wording is also necessary to make it clear that the fan blade test must be conducted as a full engine test.

The FAA concurs. These special conditions will be modified to incorporate this change.

One commenter states that these special conditions ought to make more visible how there can be meaningful confidence in ''extremely improbable'' as the assessed probability of fan blade retention system failure if the stress levels are not so conservative as to result in an infinite fatigue life.

The FAA disagrees. The intent is to assure that within the service life of the blade, that the fan blade retention system is not likely to fail due to manufacturing and material variations, in-service deterioration, and environmental effects.

One commenter asks how will it be established that any large bird ingestion is not a possible cause of fan blade retention system failure, a mode of failure that is likely to be much more severe than an airfoil only fan blade containment tests.

The damage effects on the blade retention system will be substantiated by developmental and certification testing. It is incumbent upon the applicant to demonstrate that the blade attachment system is designed to withstand the affects of an eight pound bird impact on the blade airfoil, and is less severe than the effects from fan blade release.

One commenter requests a definition of ''without failure,'' with regard to the two times centrifugal load test.

The FAA definition for ''without failure'' in this context is to demonstrate the blade root is retained within the disk dovetail slot, and that there are no conditions present which would indicate impending release.

One commenter suggests relative to paragraph (a)(2) of the proposed special conditions, that there is a need for explicit reference to consideration of both high cycle and low cycle fatigue during start stop stress cycles.

The FAA concurs. The determination of the life cycle of the composite fan blade must include the effects of combined high cycle and low cycle fatigue with enhanced load factors. These special conditions will be modified to include the requirement for high cycle and low cycle fatigue tests.

One commenter requests clarification of the term ''extremely improbable.''

For the purpose of these special conditions, ''extremely improbable'' refers to the unlikelihood that a failure will occur during the engine's operational life.

One commenter questions why paragraph (d) of these proposed special conditions is applicable only to the tests and analyses required by paragraphs (a)(1) and (a)(2) of the proposed special conditions.

The effects of in-service deterioration, manufacturing and material variations, and environmental effects must be accounted for during the centrifugal load test and in lifting determinations. The intent is to determine the effects on material capability under centrifugal loads significantly greater than will be seen in service. Combined high cycle and low cycle tests will further determine the effects on material capability. The blade releases demonstration, however, may or may not be conducted accounting for these effects.

After careful review of the available data, including the comments noted above, the FAA determined that air safety and the public interest require the adoption of these special conditions as proposed with the changes as noted above.

Conclusion

This action affects only General Electric Aircraft Engines on Model(s) GE90–75B/–85B/–76B turbofan engines. It is not a rule of general applicability and affects only the manufacturer who applied to the FAA for approval of these engines containing this novel or unusual design feature.

List of Subjects in 14 CFR Part 33

Air transportation, Aircraft, Aviation safety, Safety.

The authority citation for these special conditions continues to read as follows:

Authority: 49 U.S.C. App. 1354(a), 1421, 1423; 49 U.S.C. 106(g); and 14 CFR 11.49 and 21.16.

The Special Conditions

Accordingly, pursuant to the authority delegated to me by the Administrator, the following special conditions are issued as part of the type certification basis for the General Electric Aircraft Engines Model(s) GE–90–75B/–85B/–76B turbofan engines:

(a) In lieu of the fan blade containment test with the fan blade failing at the point specified in § 33.94(a)(1), conduct the following:

(1) An engine fan blade containment test with the fan blade failing at the inner annulus flowpath line.

(2) The following must be shown by test and analyses, or other methods acceptable to the Administrator, that:

(i) The disk and fan blade retention system can withstand without failure a centrifugal load equal to two times the maximum load which the engine could experience within approved operating limitations, and

(ii) By a procedure approved by the Administrator, an operating limitation must be established which specifies the maximum allowable number of start-stop stress cycles for the fan blade retention system. The stress cycle shall include the combined effects of high cycle and low cycle fatigue. The fan blade retention system includes the portion of the fan blade from the inner annulus flowpath line inward to the blade dovetail, the blade retention components and the fan disk and fan blade attachment features.

(b) It must be shown that the probability of fan blade retention system failure, for any cause, during the service life of the engine to be extremely improbable.

(c) It must be shown by test or analysis that a lightning strike to the composite fan blade structure will not result in a hazardous condition, and that the engine will meet the requirements of § 33.75.

(d) The tests and analyses required by (a)(2)(i) and (a)(2)(ii) of these special conditions must account for the effects of in-service deterioration, manufacturing and material variations, and environmental effects.

Issued in Burlington, Massachusetts, on February 1, 1995.

James C. Jones,

Acting Manager, Engine and Propeller Directorate, Aircraft Certification Service.

[FR Doc. 95–2928 Filed 2–2–95; 9:32 am]

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14 CFR Part 71

[Airspace Docket No. 94–AAL–4]

Realignment of G–8, G–10, G–12, R–99, B–27, B–37, V–308, and V–328; AK

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final rule.

SUMMARY: This action will extend Colored Federal Airways G–10 and R–99 and realign Colored Federal Airway B–37 as a result of the decommissioning of the Cape Spencer Marine Nondirectional Beacon (NDB); revise the descriptions of Colored Federal Airways G–8, G–12, and B–27; and, as a result of the decommissioning of the Quinhagak, AK, Very High Frequency Omnidirectional Range/Distance Measuring Equipment (VOR/DME), realign Federal Airway V–328 and remove a segment of V–308. In addition, this action will remove ''via INT Campbell Lake NDB 032° and Skwentna, AK, NDB 111° bearings'' from Colored Federal Airway G–8. These actions will enhance navigation and reduce both pilot and air traffic controller workload.

EFFECTIVE DATE: 0901 UTC, March 30, 1995.

FOR FURTHER INFORMATION CONTACT: Norman W. Thomas, Airspace and Obstruction Evaluation Branch (ATP–240), Airspace-Rules and Aeronautical Information Division, Air Traffic Rules and Procedures Service, Federal Aviation Administration, 800 Independence Avenue, SW., Washington, DC 20591; telephone: (202) 267–9230.

SUPPLEMENTARY INFORMATION:

History

On September 27, 1994, the FAA proposed to amend part 71 of the Federal Aviation Regulations (14 CFR part 71) to extend Colored Federal Airways G–10 and R–99 and realign Colored Federal Airway B–37 as a result the decommissioning of the Quinhagak, AK, VOR/DME, realign Federal Airway V–328 and remove a segment of V–308 in Alaska (59 FR 49220).

Interested parties were invited to participate in this rulemaking proceeding by submitting written comments on the proposal to the FAA. No comments objecting to the proposal were received. Except for editorial changes and the removal of ''via INT Campbell Lake NDB 032° and Skwentna, AK, NDB 111° bearings'' from Colored Federal Airway G–8, and a change to Federal Airway V–328 from ''Dillingham, AK, to Kipnuk'' to ''INT Dillingham 295° and Kipnuk, AK 099° radials, to Kipnuk,'' this amendment is the same as that proposed in the notice. Colored Federal Airways are published in paragraphs 6009(a), 6009(b) and 6009(d), respectively, and Alaskan VOR Federal airways are published in paragraph 6010(b), of FAA Order 7400.9B dated July 18, 1994, and effective September 16, 1994, which is incorporated by reference in 14 CFR 71.1. The Colored Federal airways and the Alaskan VOR Federal airways listed in this document will be published subsequently in the Order.

The Rule

This amendment to part 71 of the Federal Aviation Regulations extends Colored Federal Airways G–10, R–99, and realigns Colored Federal Airway B–37 as a result of the decommissioning of the Cape Spencer Marine NDB. Colored Federal Airways G–10 and R–99 will be extended and will include an extension of G–10 from Woody Island to Kachemak. King Salmon, AK, NDB was inadvertently used in the descriptions of Colored Federal Airways G–8 and G–12, and as a result of this rule, Saldo, AK, NDB will replace King Salmon, AK, NDB. King Salmon, AK, Locator Outer Marker in the description of B–27 will replace Saldo, AK, NDB. Finally, as a result of the Quinhagak, AK, VOR/DME being decommissioned, this action will remove that segment of V–308 between Quinhagak, AK, and Bethel, AK, and will realign V–328 between Dillingham, AK, and Kipnuk, AK.

The FAA has determined that this regulation only involves an established body of technical regulations for which frequent and routine amendments are necessary to keep them operationally current. It, therefore—(1) Is not a ''significant regulatory action'' under Executive Order 12866; (2) is not a ''significant rule'' under DOT Regulatory Policies and Procedures (44 FR 11034; February 26, 1979); and (3) does not warrant preparation of a regulatory evaluation as the anticipated impact is so minimal. Since this is a routine matter that will only affect air traffic procedures and air navigation, it is certified that this rule will not have a significant economic impact on a substantial number of small entities under the criteria of the Regulatory Flexibility Act.

List of Subjects in 14 CFR Part 71

Airspace, Incorporation by reference, Navigation (air).