



Federal Aviation Administration

Memorandum

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To: SEE DISTRIBUTION

From: Manager, Engine and Propeller Directorate, Aircraft Certification Service

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Subject: **ACTION**: Engine Reliability in Extended Operations (ETOPS) – Continued Operational Safety (COS) Assessments (PS-ANE-2011-33-1)

1. Purpose.

a. This policy memorandum provides guidance for the engine certification office (ECO) and aircraft certification offices (ACOs) delegated responsibility for engine COS to assess the safety impact of engine reliability in ETOPS. This memorandum also provides guidance on the reporting requirements in § 21.4(b) for engine type certificate (TC) holders with engines installed on airplanes approved for ETOPS. This guidance is not intended for operators.

b. This policy memorandum applies to the ECO and ACOs (both referred to herein as the “ACO”) responsible for the COS of engines type certificated by the FAA with ETOPS approval.

2. Background.

a. Since the first ETOPS approvals, engine reliability has increased significantly. Consequently, industry has asked the FAA to recognize these technological advances and allow two-engine airplanes to fly further from airports than previously allowed. In recognition of these advances and to ensure that these long-range flights continue to operate safely, the FAA published a final rule on Extended Operations of Multi-Engine Airplanes in the Federal Register on January 16, 2007 (72 FR 1808).

b. Section 21.4(b) of this rule requires airplane TC holders for airplanes approved for ETOPS and engine TC holders for engines installed on airplanes approved for ETOPS to:

- Report monthly on the reliability of the world fleet to their FAA TC holding office. The FAA may also approve quarterly reporting in accordance with §21.4(b);

- Investigate any cause of any in-flight shutdown (IFSD) attributable to its design of the product and to report the results of that investigation to the FAA office responsible for administering their TC; and
- Issue service information to operators to maintain the specified world fleet 12-month rolling average IFSD rate.

3. Policy.

a. ETOPS Airplane-Engine Combination Reliability Reporting. Section 21.4 does not define what constitutes an “airplane-engine” combination. However, § 21.4 discusses world fleet reliability in the context of airplane-engine combinations. Historically we have defined an airplane-engine combination as the top-level or major airplane model and the engine model or sub-model installed on that airplane. An airplane-engine combination normally includes all sub-models of an engine installed on the same airplane major model. Exceptions to this practice are noted based on the differences between sub-models that would cause us to require separate tracking. The ACO should review the TC holder’s proposed reporting plan to ensure that the reported airplane-engine combinations include all appropriate models and submodels. Likewise, the engine TC holder should develop a reporting process that properly combines similar models for the purpose of § 21.4 reporting.

b. Review of World Fleet IFSD Rate Data.

(1) The ACO with TC oversight responsibilities of engines installed on airplanes approved for ETOPS should review the engine IFSD 12-month rolling average data provided by the engine TC holder. The ACO should compare the reported engine reliability levels (measured by world fleet IFSD rate) to the appropriate allowable § 21.4(b) IFSD rate for each ETOPS approved airplane-engine combination.

(2) Section 21.4(b)(1) requires that the responsible TC holder investigate any cause of an IFSD resulting from an occurrence attributable to the design of its product. The regulation also requires the TC holder report the results of their investigation to the FAA office responsible for administering the TC. The TC holder investigation and reporting should include trending the IFSD rate, issuing service information to prevent products from exceeding the permissible rate, and reporting both the trending data and service information to the responsible ACO.

(3) The ACO should evaluate the results of these investigations including the TC holder’s proposed service information to ensure that the TC holder issues service information sufficient to maintain the world fleet 12-month rolling average IFSD rate at or below the specified level.

(a) The TC holder should determine if the maintenance manual, engine manual, fault isolation manual, or other ICA documents led to improper maintenance or problems with a specific operator’s fleet. The ACO should work with the cognizant AEG office to ensure the TC holder makes appropriate changes to the ICA when the TC holder finds manual(s) led to improper maintenance. The engine ASE should share this information with the airplane ASE. If

applicable, the ACO should also inform the certificate managing foreign authority to ensure the engine ICA changes are incorporated into the airplane maintenance manual.

(b) If the high IFSD rate is caused by design or other issues, such as quality escapes, the ACO should ensure that the TC holder identifies effective corrective actions to address the root cause.

(4) If the worldwide fleet IFSD rate exceeds the limits of § 21.4, the ACO should review the TC holder's IFSD investigation. The investigation should determine if shutdowns that occurred in the non-ETOPS fleet would have been prevented if the engine had been configured, operated, and maintained to ETOPS standards. Although an airplane-engine combination must have type design approval for ETOPS, only specific airplanes, referred to as the "ETOPS fleet," are approved to conduct ETOPS under the operating rules. Engines in the ETOPS fleet conform to the build standard identified in the configuration, maintenance, and procedures (CMP) document. In accordance with § 121.374, ETOPS operators must maintain those ETOPS fleet engines under an ETOPS maintenance program. The ETOPS maintenance program may result in increased engine reliability compared to engine reliability for non-ETOPS fleet engines maintained under other programs.

(5) If the ACO determines that the IFSDs are predominately occurring on engines not configured, operated, and maintained to ETOPS standards, the ACO should inform the cognizant AEG office. If applicable, the ACO should also inform the certificate managing foreign authority.

(6) If the world fleet IFSD rate exceeds the corresponding § 21.4 IFSD rate, then determine the risk per flight using the guidance of paragraph 3c of this policy.

c. Perform Risk Analysis.

(1) When the appropriate §21.4(b) IFSD rate is exceeded, the ACO should work with the TC holder to evaluate the risk of continued ETOPS operation. The guidance of AC 39-8 or an equation such as the one in paragraph 3c(2) below may be used to analyze the risk of continued ETOPS operation.

(2) The risk per flight for two-engine airplanes may be quantified with the equation $2\lambda^2t(T-t)$, where:

(i) λ is the world fleet IFSD rate (IFSDs per engine flight hour);

(ii) t is the average diversion time from the ETOPS portion of the flight (hours);

and

(iii) T is the total average flight time of an ETOPS flight in hours.

(3) Alternatively, the IFSD risk per flight may be established by more detailed quantitative methods, such as those described in AC 39-8. This approach may consider

additional factors, such as the range of ETOPS flight durations and ETOPS diversion service experience.

(4) The acceptable dual engine IFSD rate is 4×10^{-8} failures per flight for evaluating the combined effects of multiple IFSD failure modes.

(5) The risk per flight of an individual failure mode resulting in a CAAM level 4 event should meet the long-term risk guidelines of AC 39-8.

(6) If the risk guidelines of paragraph 3c(4) or 3c(5) are exceeded, then action is required. Action may include an AD, SAIB, ICA changes, or some other appropriate change.

(7) If the risk guidelines of paragraphs 3c(4) or 3c(5) of this policy are not exceeded, then the actions described in paragraphs 3b(1) – 3b(5) of this policy apply.

4. Effect of Policy.

The general policy stated in this document does not constitute a new regulation or create what the courts refer to as a “binding norm.” The office that implements policy should follow this policy when applicable to the specific project. Whenever an applicant's proposed method of compliance is outside this established policy, the applicant’s proposal must be coordinated with the policy issuing office. Similarly, if the implementing office becomes aware of reasons that an applicant's proposal that meets this policy should not be approved, the office must coordinate its response with the policy issuing office.

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for

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