

confidently grant an early ETOPS approval.

Beyond a certain level of commonality, past experience may not be relevant to a new design. This is particularly true where a specific design feature that contributed to problems in previous airplanes is not a part of the new airplane design. However, the demonstration of the applicability of past experience to the new design is inherent in the relevant experience assessment.

This proposed rule would require that the applicant identify corrective actions taken to preclude similar problems from occurring on the new airplane. Removal from the design of a system, sub-system, or component that has had problems in the past may be an acceptable corrective action, as long as it precludes similar problems from occurring.

Where new technology is introduced, the lessons learned assessment becomes impractical, as there is no previous experience with this technology. While this is true, there may still be applicable relevant experience. For example, an applicant's previous experience with new technology introductions may lead to changes in manufacturing and quality control processes. Further, lessons learned of general applicability can be introduced into the new technology design, such as a general design practice to prevent cross-connector installation.

II(b)(2) Propulsion System Design

II(b)(2)(i) Engine ETOPS Eligibility

This paragraph would require that the engines to be installed on the airplane be approved for ETOPS eligibility in accordance with proposed new section 33.200.

Explanation

Proposed new section 33.200 would require that an engine intended for a two engine ETOPS airplane that does not have the service experience required by part 25, section II(a), would have to comply with certain requirements. The ARAC proposed rule draft did not specifically state that the engines installed in an early ETOPS airplane must be certified in accordance with section 33.200. We have corrected that oversight in this notice.

We intend that section II(b) of this notice apply to all new airplanes and engines. We have considered the possibility that an applicant may install an already certified engine with existing service experience onto a new airplane. In this case, the combined service experience and early ETOPS approval method of proposed section II(c) would provide a way of certifying this type of mixed configuration.

II(b)(2)(ii) Design To Preclude In-Flight Shutdowns

The applicant would have to design the propulsion system to preclude failures and malfunctions that could result in an engine in-flight shutdown. In addition, the applicant would have to substantiate compliance with this requirement by analysis, test, in-service experience on other airplanes, or other means that the propulsion system will minimize failures and malfunctions with the objective of achieving the following in-flight shutdown rates:

- (i) 0.02 or less per 1,000 engine fleet hours for 180 minute ETOPS or less;
- (ii) 0.01 or less per 1,000 engine fleet hours for ETOPS beyond 180 minutes.

Explanation

ARAC provided the following justification for this proposed rule. "This rule section requires that the propulsion system be designed to preclude failures and malfunctions that could result in an engine in-flight shutdown. Propulsion systems on previous airplanes were designed and certified to be "fail-safe," in compliance with section 25.901 of part 25; in other words, any single failure, or probable combination of failures, would not jeopardize continued safe flight and landing of the airplane. Because safe flight following an engine shutdown is required by part 25, preventing engine in-flight shutdowns has not been a major design objective on some previous airplane designs. The additional design requirement in this section to preclude failures and malfunctions that could result in an engine in-flight shutdown has an enormous effect on propulsion system reliability in that normal design decisions must now consider whether a failure or malfunction might result in an engine in-flight shutdown. The method of compliance to this section may vary from applicant to applicant, but the intent remains—all design features of the propulsion system must preclude shutdowns or power losses. This intent is also captured in the proposed part 33 rule."

We agree with the justification that ARAC provided. The "design to preclude failures and malfunctions that could result in an engine in-flight shutdown" is one of the most important features of the early ETOPS special conditions that we required for the Boeing Model 777 airplane. The FAA had a similar justification for this requirement in the preamble to those special conditions. However, the proposed rule that ARAC recommended did not clearly state this intent. We have modified the original ARAC proposal to

clarify this stated ARAC intent and bring the proposed rule in line with the existing Boeing Model 777 ETOPS special conditions.

ARAC did not provide a specific justification for the proposed in-flight shutdown rate analysis requirement. Boeing has submitted such an analysis under compliance with paragraph (c)(5) of the ETOPS special conditions for the Model 777 airplane. Paragraph (c)(5) of those special conditions requires the applicant to define specific new analyses that will be used to assure engine and airplane system design integrity. The addition of a predicted in-flight shutdown rate analysis into this proposed rule would codify this method of compliance with the Boeing ETOPS special conditions.

Since in-service experience does not exist on a new airplane, we have also changed the ARAC proposed rule language for the in-flight shutdown rate analysis to clarify that the in-service experience to be considered in this analysis would be from other airplanes. Applicable service experience would include the same basic engine design or other propulsion system components on other airplanes manufactured by the applicant, or by other manufacturers if the applicant has access to that data and can substantiate its applicability to the new airplane design.

II(b)(3) Maintenance and Operational Procedures

The applicant would have to validate all ETOPS significant systems maintenance and operational procedures. Any problems found would have to be tracked and resolved through the problem tracking system and resolution system proposed in paragraph II(b)(8).

Explanation

This proposed rule would codify the intent of paragraph (d)(2) of the Boeing Model 777 ETOPS special conditions. The special conditions paragraph requires the applicant to have a program to systematically detect and correct problems occurring as a result of improper execution of maintenance and flight operations. Boeing has complied with this requirement by validating maintenance and operational procedures important to the safety of ETOPS operations. This proposed rule would codify this method of compliance.

Human error continues to be a major cause of engine in-flight shutdowns and forced airplane diversions. The proposed maintenance validation requirement, combined with the proposed requirement to operate and