

capability of at least one crossfeed valve must be able to be powered by a back-up electrical generation source other than the primary engine driven or APU driven generators, unless the required fuel boost pressure or crossfeed valve actuation is not provided by electrical power.

(ii) Alerts must be displayed to the flight crew when the quantity of fuel available to the engines falls below that level required to complete the mission. These alerts must include provisions for abnormal fuel management or transfer between tanks, and possible loss of fuel.

(2) *APU design.* If operation of the APU installation is required to comply with this appendix, the applicant must substantiate that:

(i) The APU has adequate reliability for that operation, and;

(ii) If in-flight start and run capability is necessary, the APU in-flight operating envelope shall extend to the maximum operating altitude of the airplane, but need not exceed 45,000 feet.

(3) *Engine oil tank design.* The engine oil tank filler cap must comply with section 33.71(c)(4).

(c) *Engine condition monitoring.* Procedures for an engine condition monitoring process must be defined and validated in accordance with Part 33 Appendix A, paragraph 33.3(c).

(d) *Configuration, maintenance and procedures.* If the airplane, propulsion, and ETOPS Significant System assessments identify configuration, maintenance or operational standards necessary to maintain appropriate reliability for ETOPS, the applicant must identify the appropriate standards in a Configuration, Maintenance and Procedures (CMP) document.

(e) *Airplane flight manual.* The airplane flight manual must contain the following information.

(1) Special limitations, including any limitations associated with operation of the airplane up to the maximum diversion time being approved.

(2) Required markings or placards.

(3) The airborne equipment, installation, and flight crew procedures required for extended operations.

(4) The maximum diversion time capability of the airplane for ETOPS required by paragraph (a)(3) of this appendix in accordance with § 25.1581(a)(2), "Furnishing information."

(5) The following statement: "The type design reliability and performance of this airframe-engine combination has been evaluated in accordance with § 25.1535 and found suitable for (state maximum diversion time) extended operations (ETOPS) with the incorporation of the approved airplane configuration CMP standard contained in (state description or reference to a document containing the approved CMP standard). This finding does not constitute approval to conduct ETOPS."

Section II—Two Engine Airplanes

An applicant for a two engine airplane must use one of the methods described in paragraphs (a), (b), or (c) of Section II of this appendix to certify the airplane for Extended Operations.

(a) *Service experience method.* The applicant must demonstrate that the airplane and engine combination for which approval is sought has the required airplane and propulsion system capability to safely conduct an ETOPS mission and maximum diversion and has achieved required airframe and propulsion system reliability based upon fleet in-service experience.

(1) *Required service experience.* After accumulating 250,000 worldwide fleet engine hours on the airplane and engine combination for which approval is sought, a reliability review must be performed. The number of hours may be reduced if adequate compensating factors are identified which give a reasonable equivalent database. Where experience on another airplane is applicable, a significant portion of the 250,000 hours must be obtained on the candidate airplane.

(2) *Propulsion system assessment.* (i) The applicant must conduct a propulsion system assessment based on the following data, collected from the entire fleet of the specific airplane and engine combination for which approval is sought:

(A) A list of all engine shutdown events both ground and in-flight for all causes (excluding normal training events) including flameouts. The list should provide identification (engine and airplane model and serial number), engine configuration and modification history, engine position, circumstances leading up to the event, phase of flight or ground operation, weather/environmental conditions, and reason for shutdown. In addition, similar information should be provided for all occurrences where control of desired thrust level was not attained.

(B) Unscheduled engine removal rate (accumulated 6- and 12-month rolling averages), removal summary, time history of removal rate and primary causes for unscheduled removal.

(C) Dispatch delays, cancellations, aborted takeoffs (includes those induced by maintenance or crew error) and en-route diversions chargeable to the propulsion system.

(D) Total engine hours and cycles and engine hour population (age distribution).

(E) Mean time between failure of propulsion system components that affect reliability.

(F) IFSD rate based upon a 6- and 12-month rolling average.

(ii) All causes or potential causes of engine in-flight shutdowns or loss of thrust control occurring in service must have corrective actions that are shown to be effective in preventing future occurrences.

(3) *Airplane systems assessment.* Airplane systems must comply with the requirements of § 25.1535(a) using available in-service reliability data for ETOPS significant systems. All causes or potential causes of ETOPS significant system failures occurring in service must have corrective actions that are shown to be effective in preventing future occurrences.

(4) *In-flight shutdown (IFSD) rates.* The demonstrated airplane and engine combination world fleet propulsion system 12 month rolling average IFSD rate must be commensurate with the level of ETOPS approval being sought.

(i) For operations up to 120 minutes: A rate of approximately 0.05 or less per 1,000 fleet engine hours with a required list of corrective actions in the CMP document that would result in continuing improvement toward an IFSD rate of 0.02 per 1,000 fleet engine hours.

(ii) For operations up to 180 minutes: A rate of approximately 0.02 or less per 1,000 fleet engine hours with an existing 120 minute CMP standard, or new or additional CMP requirements that have been demonstrated to achieve this in-flight shutdown rate.

(iii) For operations beyond 180 minutes: A rate of approximately 0.01 or less per 1,000 fleet engine hours with an existing 120 minute or 180 minute CMP standard, or new or additional CMP requirements that have been demonstrated to achieve this in-flight shutdown rate.

(5) *Airplane flight test requirements.* A flight test must be conducted to validate the adequacy of the airplane's flying qualities, performance and the flight crew's ability to deal with engine inoperative and non-normal worst case system failure conditions expected to occur in service.

(b) *Early ETOPS method.*

(1) *Relevant experience assessment.* The applicant must identify specific corrective actions taken on the airplane design to address relevant design, manufacturing, operational and maintenance problems experienced on previously certified Part 25 airplanes manufactured by the applicant. Specific corrective actions are not required if the nature of the problem is such that the problem would not significantly impact the safety or reliability of the system. Relevant problems are those problems on ETOPS Group 1 Significant Systems that have or could have resulted in in-flight shutdowns or diversions. To experience of supplier-provided ETOPS Group 1 Significant Systems and similar or identical equipment utilized on aircraft built by other manufacturers must be included.

(2) *Propulsion system design.* (i) *Engine ETOPS eligibility.* The engine must be approved for ETOPS eligibility in accordance with § 33.200.

(ii) *Design to preclude in-flight shutdowns.* The applicant must design the propulsion system to preclude failures or malfunctions that could result in an engine in-flight shutdown. The applicant must substantiate compliance with this requirement by analysis, test, in-service experience on other airplanes, or other means. The analysis must show that the propulsion system design will minimize failures and malfunctions with the objective of achieving the following in-flight shutdown rates: 0.02 per 1,000 engine fleet hours for ETOPS (180 minutes or less) 0.01 per 1,000 engine fleet hours for ETOPS (beyond 180 minutes).

(3) *Maintenance and operational procedures.* The applicant must validate all ETOPS significant systems maintenance and operational procedures. Any problems found as a result of the validation must be tracked and resolved through the Problem Tracking and Resolution System required by Section II, paragraph (b)(8) of this appendix.

(4) *Propulsion system validation test.* The installed engine configuration for which