

electrical power may be catastrophic to the airplane, special conditions are proposed to retain the level of safety envisioned by 14 CFR 25.1351(d).

#### *Interactions of Systems and Structures*

The Embraer Model 170–100 and 170–200 airplanes will have systems that affect the structural performance of the airplane, either directly or as a result of a failure or malfunction. These novel or unusual design features are systems that can alleviate loads in the airframe and, when in a failure state, can create loads in the airframe. The current regulations do not adequately account for the effects of these systems and their failures on structural performance.

#### **Discussion**

##### *Engine Size and Torque Loads*

In order to maintain the level of safety envisioned in 14 CFR 25.361(b), a more comprehensive criterion is needed for the new generation of high bypass engines. The proposed special conditions would distinguish between the more common seizure events and those rarer seizure events resulting from structural failures. For the rare but severe seizure events, the proposed criteria allow some deformation in the engine supporting structure (ultimate load design) in order to absorb the higher energy associated with the high bypass engines, while at the same time protecting the adjacent primary structure in the wing and fuselage by providing a higher safety factor. The criteria for the more severe events would no longer be a pure static torque load condition, but would account for the full spectrum of transient dynamic loads developed from the engine failure condition.

##### *Electrical and Electronic Systems Which Perform Critical Functions*

The Embraer Model 170–100 and 170–200 airplanes will require a continuous source of electrical power for the electronic flight control systems. Section § 25.1351(d), “Operation without normal electrical power,” requires safe operation in visual flight rule (VFR) conditions for a period of not less than five minutes with inoperative normal power. This rule was structured around a traditional design utilizing mechanical connections between the flight control surfaces and the pilot controls. Such traditional designs enable the flightcrew to maintain control of the airplane while taking the time to sort out the electrical failure, start engines if necessary, and re-establish some of the electrical power generation capability.

The Embraer Model 170–100 and 170–200 airplanes will utilize an electronic flight control system for the pitch and yaw control (elevator, stabilizer, and rudder). There is no mechanical linkage between the pilot controls and these flight control surfaces. Pilot control inputs are converted to electrical signals which are processed and then transmitted via wires to the control surface actuators. At the control surface actuators, the electrical signals are converted to an actuator command, which moves the control surface.

In order to maintain the same level of safety as an airplane with conventional flight controls, an airplane with electronic flight controls, such as the Embraer Model 170, must not be time limited in its operation, including being without the normal source of electrical power generated by the engine or the Auxiliary Power Unit (APU) generators.

Service experience has shown that the loss of all electrical power generated by the airplane’s engine generators or APU is not extremely improbable. Thus, it must be demonstrated that the airplane can continue safe flight and landing (including steering and braking on ground) after total loss of the normal electrical power with only the use of its emergency electrical power systems. These emergency electrical power systems must be able to power loads that are essential for continued safe flight and landing. The emergency electrical power system must be designed to supply electrical power for the following:

- Immediate safety, without the need for crew action, following the loss of the normal engine generator electrical power system (which includes APU power), and
- Continued safe flight and landing, and
- Restarting the engines.

For compliance purposes, a test of the loss of normal engine generator power must be conducted to demonstrate that when the failure condition occurs during night Instrument Meteorological Conditions (IMC), at the most critical phase of the flight relative to the electrical power system design and distribution of equipment loads on the system, the following conditions are met:

1. After the unrecoverable loss of normal engine and APU generator power, the airplane engine restart capability must be provided and operations continued in IMC.
2. The airplane is demonstrated to be capable of continued safe flight and landing. The length of time must be computed based on the maximum

diversion time capability for which the airplane is being certified. Consideration for speed reductions resulting from the associated failure must be made.

3. The availability of APU operation should not be considered in establishing emergency power system adequacy.

#### *Interaction of Systems and Structure*

The Embraer Model 170 has systems that affect the structural performance of the airplane. These systems can serve to alleviate loads in the airframe and, when in a failure state, can create loads in the airframe. This degree of system and structures interaction was not envisioned in the structural design regulations of 14 CFR part 25. This proposed special condition provides comprehensive structural design safety margins as a function of systems reliability.

#### **Applicability**

As discussed above, these special conditions are applicable to the Embraer Model 170–100 and 170–200 airplanes. Should Embraer apply at a later date for a change to the type certificate to include another model incorporating the same novel or unusual design features, these special conditions would apply to that model as well under the provisions of § 21.101(a)(1), Amendment 21–69, effective September 16, 1991.

#### **Conclusion**

This action affects only certain novel or unusual design features on the Embraer Model 170–100 and 170–200 airplanes. It is not a rule of general applicability, and it affects only the applicant who applied to the FAA for approval of these features on the airplane.

#### **List of Subjects in 14 CFR Part 25**

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

The authority citation for these special conditions is as follows:

**Authority:** 49 U.S.C. 106(g), 40113, 44701, 44702, 44704.

#### **The Proposed Special Conditions**

Accordingly, the Federal Aviation Administration (FAA) proposes the following special conditions as part of the type certification basis for Embraer Model 170–100 and 170–200 airplanes.

**Sudden Engine Stoppage.** In lieu of compliance with 14 CFR 25.361(b), the following special conditions apply:

1. For turbine engine installations: The engine mounts, pylons and adjacent supporting airframe structure must be designed to withstand 1g level flight loads acting simultaneously with the