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DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. FAA–2021–0894; Special Conditions No. 25–791A–SC]

Special Conditions: The Boeing Company Model 777–9 Airplane; Operation Without Normal Electrical Power

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final special conditions; amendment.

SUMMARY: These special conditions are issued for the Boeing Company (Boeing) Model 777–9 series airplane. This airplane will have a novel or unusual design feature when compared to the state of technology envisioned in the airworthiness standards for transport category airplanes. This design feature is electrical and electronic systems that perform critical functions, the loss of which could be catastrophic to the airplane. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. These special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

DATES: Effective June 23, 2025.

FOR FURTHER INFORMATION CONTACT: Nazih Khaouly, Electrical Systems, AIR–626A, Technical Policy Branch, Policy and Standards Division, Aircraft Certification Service, Federal Aviation Administration, 2200 South 216th Street, Des Moines, Washington 98198; telephone 206–231–3160; email; *nazih.khaouly@faa.gov.*

SUPPLEMENTARY INFORMATION:

Background

On September 30, 2018, Boeing applied for an amendment to Type Certificate No. T00001SE to include the new Model 777–9 series airplane. The Boeing Model 777–9 airplane, which is a derivative of the Boeing Model 777 airplane currently approved under Type Certificate No. T00001SE, is a twin-engine, transport category airplane with seating for 495 passengers, and a maximum takeoff weight of 775,000 lbs.

On September 29, 2021, special conditions (No. 25–791–SC) were issued for this design feature and became effective on October 4, 2021 (86 FR 54588, Oct. 4, 2021).

Type Certification Basis

Under the provisions of title 14, Code of Federal Regulations (14 CFR) 21.101, Boeing must show that the Model 777–9 series airplane meets the applicable provisions of the regulations listed in Type Certificate No. T00001SE, or the applicable regulations in effect on the date of application for the change, except for earlier amendments as agreed upon by the FAA.

If the Administrator finds that the applicable airworthiness regulations (*e.g.,* 14 CFR part 25) do not contain adequate or appropriate safety standards for the Boeing Model 777–9 series airplane because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

Special conditions are initially applicable to the model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same novel or unusual design feature, or should any other model already included on the same type certificate be modified to incorporate the same novel or unusual design feature, these special conditions would also apply to the other model under § 21.101.

In addition to the applicable airworthiness regulations and special conditions, the Boeing Model 777–9 series airplane must comply with the fuel vent and exhaust emission requirements of 14 CFR part 34 and the noise-certification requirements of 14 CFR part 36.

The FAA issues special conditions, as defined in 14 CFR 11.19, in accordance with § 11.38, and they become part of the type certification basis under § 21.101.

Novel or Unusual Design Features

The Boeing Model 777–9 series airplane will incorporate the following novel or unusual design feature:

Electrical and electronic systems that perform critical functions, the loss of which may result in loss of flight controls and other critical systems and may be catastrophic to the airplane.

Discussion

The Boeing Model 777–9 series airplane has a fly-by-wire flight control system that requires a continuous source of electrical power in order to maintain an operable flight control system. Section 25.1351(d), ''Operation without normal electrical power,'' requires safe operation in visual flight rule (VFR) conditions for at least 5 minutes after the loss of normal electrical power excluding the battery. This rule is structured around a traditional design using mechanical control cables and linkages for flight control. These manual controls allow the crew to maintain aerodynamic control of the airplane for an indefinite period of time after loss of all electrical power. Under these conditions, a mechanical flight control system provides the crew with the ability to fly the airplane while attempting to identify the cause of the electrical failure, restart engine(s) if necessary, and attempt to re-establish some of the electrical power generation capability.

A critical assumption in § 25.1351(d) is that the airplane is in VFR conditions at the time of the failure. This is not a valid assumption in today's airline operating environment where airplanes fly much of the time in instrument meteorological conditions (IMC) on air traffic control defined flight paths. Another assumption in the existing rule is that the loss of all normal electrical power is the result of the loss of all engines. The 5-minute period in the rule is to allow at least one engine to be restarted following an all-engine power loss in order to continue the flight to a safe landing. However, service experience on airplane models with similar electrical power system architecture as the Boeing Model 777–9 airplane has shown that at least the temporary loss of all electrical power for causes other than all-engine failure is not extremely improbable.

To maintain the same level of safety envisioned by the existing rule with

traditional mechanical flight controls, the Boeing Model 777–9 series airplane design must not be time-limited in its operation under all reasonably foreseeable conditions, including loss of all normal sources of engine or auxiliary power unit (APU)-generated electrical power. Unless Boeing can show that the non-restorable loss of the engine and APU power sources is extremely improbable, Boeing must demonstrate that the airplanes can maintain safe flight and landing (including steering and braking on the ground for airplanes using steer/brake-by-wire and/or fly-by-wire speed brake panels) with the use of its emergency/alternate electrical power systems. These electrical power systems, or the minimum restorable electrical power sources, must be able to power loads that are essential for continued safe flight and landing, including those required for the maximum length of approved flight diversion.

The FAA is amending two paragraphs from the original special conditions. Those paragraphs are (d)(2) and (e)(4). Paragraph (d)(2) of the original special conditions states that the operating limitations section of the airplane flight manual (AFM) must incorporate non-normal procedures that direct the pilot to take appropriate actions to activate the APU after loss of normal engine-driven generated electrical power. The FAA is requiring that these non-normal procedures be incorporated in the AFM instead of requiring them to be in the operating limitations section of the AFM.

Paragraph (e)(4) of the original special conditions states that the airplane must provide adequate indication of loss of normal electrical power to direct the pilot to the non-normal procedures, and the operating limitations section of the AFM must incorporate non-normal procedures that will direct the pilot to take appropriate actions. As in paragraph (d)(2), the FAA is requiring that these non-normal procedures be incorporated in the AFM instead of specifying the particular section of the AFM that these procedures need to reside.

These are to remedy an oversight that occurred during the issuance of the original special conditions where the FAA inadvertently required the non-normal procedures to be in the limitations section of the AFM. The FAA found that this requirement is inconsistent with similarly issued special conditions for other transport category airplanes. The Boeing 777–9 electrical power system does not require pilot activation of the APU after loss of normal engine-driven generated electrical power. Paragraph (d) does not apply to designs that do not rely on the APU for an alternate source of power. The intent of paragraphs (d)(2) and (e)(4) is to ensure that non-normal procedures that provide instructions to the pilot to take appropriate action are incorporated into the AFM. These procedures are more appropriate for the operating procedures section of the AFM and were not intended to be an operating limitation.

The special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

Discussion of Comments

To provide the public with an opportunity to comment on this amendment, the FAA issued Notice of Proposed Special Conditions No. 25–791–SC for the Boeing Company Model 777–9 series airplane, which was published in the **Federal Register** on August 2, 2024 (89 FR 63111).

The FAA received responses from two commenters.

An individual requested that the FAA not issue this amendment, stating that the company should not receive special treatment. The FAA's special conditions process is established by regulation and is available to all applicants. FAA made no change as a result of this comment.

The Air Line Pilots Association (ALPA) commented that after reviewing the FAA's proposal to change two paragraphs of this special condition, ALPA does not support design features which increase the psychological and workload burden on flightcrew to recover the supply of the electrical generation and distribution system to the aircraft through manual activation of the APU, in addition to the required multiple start attempt to the engines.

The FAA does not agree that the special conditions, as now amended, require design features that would increase the psychological and workload burden on the flightcrew in order to recover the supply electrical generation and distribution system to the aircraft. Special conditions are issued by the FAA when a proposed aircraft, aircraft engine, or propeller incorporates a design feature that is novel or unusual, *i.e.,* it was not envisaged by the existing design regulations. Aircraft were originally designed using mechanical cables and linkages to control flight surfaces. Modern aircraft use fly-by-wire designs to incorporate enhanced flight envelope protections to increase safety over the earlier mechanical flight control designs. The FAA's generally-applicable design standard for operation of transport airplanes that lack electrical power, 14 CFR 25.1351, envisaged mechanical flight control systems, therefore the FAA issues special conditions to address modern fly-by-wire aircraft designs.

Boeing 777–9 Special Conditions No. 25–791–SC, as originally issued, includes procedures for pilot manual activation of the APU after loss of normal engine-driven generated electrical power. This procedure is performed by the pilot, while the flight controls are operating on battery power to ensure APU electrical power is available for the flight controls until engine-driven electrical power is restored. Therefore, these revised special conditions do not change the flightcrew burden but instead remove the prior requirement that the procedure be in the Limitations section of the airplane flight manual (AFM). Activation of the APU after loss of normal engine-driven generated electrical power is a non-normal pilot procedure, which is properly in the procedures rather than limitations section. Therefore, this amendment only changes the location in the AFM for this procedure from the Limitations section to the Non-Normal section and removes the requirement for the procedure to be in the Limitation section.

The FAA has also restored the statement that these special conditions are in lieu of 14 CFR 25.1351(d); this statement was inadvertently left out of the notice but was part of the original special conditions.

The special conditions are adopted as proposed with the edit as mentioned above.

Applicability

As discussed above, these special conditions, as amended, are applicable to the model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same novel or unusual design feature, or should any other model already included on the same type certificate be modified to incorporate the same novel or unusual design feature, these special conditions would apply to the other model as well.

Conclusion

This action affects only a certain novel or unusual design feature on one model series of airplane. It is not a rule of general applicability.

List of Subjects in 14 CFR Part 25

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

Authority Citation

The authority citation for these special conditions is as follows:

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

The Special Conditions

Accordingly, the Federal Aviation Administration (FAA) issues the following special conditions, as amended, as part of the type certification basis for The Boeing Company Model 777–9 series airplanes.

In lieu of 14 CFR 25.1351(d), the following special conditions apply:

(a) The applicant must show by test or a combination of test and analysis that the airplane is capable of continued safe flight and landing with all normal electrical power sources inoperative, as prescribed by paragraphs (a)(1) and (a)(2), below. For purposes of these special conditions, normal sources of electrical power generation do not include any alternate power sources such as the battery, ram air turbine, or independent power systems such as the flight control permanent magnet generating system. In showing capability for continued safe flight and landing, the applicant must account for systems capability, effects on crew workload and operating conditions, and the physiological needs of the flightcrew and passengers for the longest diversion time for which the applicant is seeking approval.

(1) In showing compliance with this requirement, the applicant must account for common-cause failures, cascading failures, and zonal physical threats.

(2) The applicant may consider the ability to restore operation of portions of the electrical power generation and distribution system if it can be shown that unrecoverable loss of those portions of the system is extremely improbable. The design must provide an alternative source of electrical power for the time required to restore the minimum electrical power generation capability required for safe flight and landing. The applicant may exclude unrecoverable loss of all engines when showing compliance with this requirement.

(b) Regardless of any electrical generation and distribution system recovery capability shown under paragraph (a) of these special conditions, sufficient electrical system capability must be provided to:

(1) Allow time to descend, with all engines inoperative, at the speed that provides the best glide distance, from the maximum operating altitude to the top of the engine restart envelope; and

(2) Subsequently allow multiple start attempts of the engines and auxiliary power unit (APU). The design must provide this capability in addition to the electrical capability required by existing part 25 requirements related to operation with all engines inoperative.

(c) The airplane emergency electrical power system must be designed to supply:

(1) Electrical power required for immediate safety, which must continue to operate without the need for crew action following the loss of the normal electrical power, for a duration sufficient to allow reconfiguration to provide a non-time-limited source of electrical power.

(2) Electrical power required for continued safe flight and landing for the maximum diversion time.

(d) If the applicant uses APU-generated electrical power to satisfy the requirements of these special conditions, and if reaching a suitable runway for landing is beyond the capacity of the battery systems, then the APU must be able to be started under any foreseeable flight condition prior to the depletion of the battery or the restoration of normal electrical power, whichever occurs first. Flight test must demonstrate this capability at the most critical condition.

(1) The applicant must show that the APU will provide adequate electrical power for continued safe flight and landing.

(2) The airplane flight manual (AFM) must incorporate non-normal procedures that direct the pilot to take appropriate actions to activate the APU after loss of normal engine-driven generated electrical power.

(e) As part of showing compliance with these special conditions, the tests to demonstrate loss of all normal electrical power must also take into account the following:

(1) The assumption that the failure condition occurs during night instrument meteorological conditions (IMC) at the most critical phase of the flight, relative to the worst possible electrical power distribution and equipment-loads-demand condition.

(2) After the un-restorable loss of normal engine generator power, the airplane engine restart capability is provided, and operations continued in IMC.

(3) 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. The applicant must account for airspeed reductions resulting from the associated failure or failures.

(4) The airplane must provide adequate indication of loss of normal electrical power to direct the pilot to the non-normal procedures, and the AFM must incorporate non-normal procedures that will direct the pilot to take appropriate actions.

Issued in in Kansas City, Missouri, on May 20, 2025.

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DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 97

[Docket No. 31604; Amdt. No. 4165]

Standard Instrument Approach Procedures, and Takeoff Minimums and Obstacle Departure Procedures; Miscellaneous Amendments

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final rule.

SUMMARY: This rule establishes, amends, suspends, or removes Standard Instrument Approach Procedures (SIAPS) and associated Takeoff Minimums and Obstacle Departure procedures (ODPs) for operations at certain airports. These regulatory actions are needed because of the adoption of new or revised criteria, or because of changes occurring in the National Airspace System, such as the commissioning of new navigational facilities, adding new obstacles, or changing air traffic requirements. These changes are designed to provide safe and efficient use of the navigable airspace and to promote safe flight operations under instrument flight rules at the affected airports.

DATES: This rule is effective May 23, 2025. The compliance date for each SIAP, associated Takeoff Minimums, and ODP is specified in the amendatory provisions.

The incorporation by reference of certain publications listed in the regulations is approved by the Director of the Federal Register as of May 23, 2025.

ADDRESSES: Availability of matters incorporated by reference in the amendment is as follows: