



[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. FAA-2015-4279; Special Conditions No. 25-612-SC]

**Special Conditions: Gulfstream Aerospace Corporation, Gulfstream GVI Airplane;
Non-Rechargeable Lithium Battery Installations**

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final special conditions.

SUMMARY: These special conditions are issued for the Gulfstream Aerospace Corporation (Gulfstream) GVI 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 non-rechargeable lithium batteries. 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 April 22, 2017.

FOR FURTHER INFORMATION CONTACT: Nazih Khaouly, Airplane and Flight Crew Interface Branch, ANM-111, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue SW., Renton, Washington, 98057-3356; telephone 425-227-2432; facsimile 425-227-1149.

SUPPLEMENTARY INFORMATION

Future Requests for Installation of Non-Rechargeable Lithium Batteries

The FAA anticipates that non-rechargeable lithium batteries will be installed in other makes and models of airplanes. We have determined to require special conditions for all applications requesting non-rechargeable lithium battery installations, except the installations excluded in the Applicability section, until the airworthiness requirements can be revised to address this issue. Applying special conditions to these installations across the range of all transport-airplane makes and models will ensure regulatory consistency among applicants.

These are the first special conditions the FAA has issued for non-rechargeable lithium battery installations on any airplane. The FAA has determined that these special conditions become effective 1 year after their publication in the **Federal Register** for reasons explained below in response to a public comment. The FAA intends for future special conditions for other makes and models to be effective on this same date or 30 days after their publication, whichever is later.

Background

Gulfstream applied for several changes to type certificate no. T00015AT to install non-rechargeable lithium batteries in the Model GVI airplane. The Gulfstream Model GVI airplane is a twin-engine, transport-category airplane with a maximum passenger capacity of 19 and maximum takeoff weight of 99,600 pounds.

Type Certification Basis

Under the provisions of Title 14, Code of Federal Regulations (14 CFR) 21.101, Gulfstream must show that the design change and areas affected by the change continue to meet the applicable provisions of the regulations listed in type certificate no. T00015AT, or the

applicable regulations in effect on the date of application for the change, except for earlier amendments as agreed upon by the FAA. The regulations listed in the type certificate are commonly referred to as the “original type certification basis.” The regulations listed in type certificate no. T00015AT are 14 CFR part 25 effective February 1, 1965, including Amendments 25-1 through 25-120, 25-122, 25-124, and 25-132. The certification basis also includes certain special conditions, exemptions, and equivalent-safety findings that are not relevant to these special conditions.

In addition to the applicable airworthiness regulations and special conditions, the Gulfstream Model GVI 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.

If the Administrator finds that the applicable airworthiness regulations (i.e., 14 CFR part 25) do not contain adequate or appropriate safety standards for the Gulfstream Model GVI 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 Gulfstream Model GVI airplane 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.

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 Gulfstream Model GVI airplane will incorporate non-rechargeable lithium batteries.

A battery system consists of the battery and any protective, monitoring, and alerting circuitry or hardware inside or outside of the battery, and venting capability where necessary. For the purpose of these special conditions, we refer to a battery and battery system as a battery.

Discussion

The FAA derived the current regulations governing installation of batteries in transport-category airplanes from Civil Air Regulations (CAR) 4b.625(d) as part of the re-codification of CAR 4b that established 14 CFR part 25 in February 1965. This re-codification basically reworded the CAR 4b battery requirements, which are currently in § 25.1353(b)(1) through (b)(4). Non-rechargeable lithium batteries are novel and unusual with respect to the state of technology considered when these requirements were codified. These batteries introduce higher energy levels into airplane systems through new chemical compositions in various battery-cell sizes and construction. Interconnection of these cells in battery packs introduces failure modes that require unique design considerations, such as provisions for thermal management.

Recent events involving rechargeable and non-rechargeable lithium batteries prompted the FAA to initiate a broad evaluation of these energy-storage technologies. In January 2013, two independent events involving rechargeable lithium-ion batteries revealed unanticipated failure modes. A National Transportation Safety Board (NTSB) letter to the FAA, dated May 22, 2014, which is available at <http://www.nts.gov>, filename A-14-032-036.pdf, describes these events.

On July 12, 2013, an event involving a non-rechargeable lithium battery, in an emergency-locator-transmitter installation, demonstrated unanticipated failure modes. The United Kingdom's Air Accidents Investigation Branch Bulletin S5/2013 describes this event.

Some known uses of rechargeable and non-rechargeable lithium batteries on airplanes include:

- Flight deck and avionics systems such as displays, global-positioning systems, cockpit voice recorders, flight-data recorders, underwater locator beacons, navigation computers, integrated avionics computers, satellite network and communication systems, communication-management units, and remote-monitor electronic line-replaceable units;
- Cabin safety, entertainment, and communications equipment, including emergency-locator transmitters, life rafts, escape slides, seatbelt air bags, cabin-management systems, Ethernet switches, routers and media servers, wireless systems, internet and in-flight entertainment systems, satellite televisions, remotes, and handsets;
- Systems in cargo areas including door controls, sensors, video-surveillance equipment, and security systems.

Some known potential hazards and failure modes associated with non-rechargeable lithium batteries are:

- Internal failures: In general, these batteries are significantly more susceptible to internal failures that can result in self-sustaining increases in temperature and pressure (i.e., thermal runaway) than their nickel-cadmium or lead-acid counterparts. The metallic lithium can ignite, resulting in a self-sustaining fire or explosion.
- Fast or imbalanced discharging: Fast discharging or an imbalanced discharge of one cell of a multi-cell battery may create an overheating condition that results in an uncontrollable venting condition, which in turn leads to a thermal event or an explosion.
- Flammability: Unlike nickel-cadmium and lead-acid batteries, lithium batteries use higher energy and current in an electrochemical system that can be configured to

maximize energy storage of lithium. They also use liquid electrolytes that can be extremely flammable. The electrolyte, as well as the electrodes, can serve as a source of fuel for an external fire if the battery casing is breached.

Special condition no. 1 requires that each individual cell within a non-rechargeable lithium battery be designed to maintain safe temperatures and pressures. Special condition no. 2 addresses these same issues but for the entire battery. Special condition no. 2 requires the battery be designed to prevent propagation of a thermal event, such as self-sustained, uncontrolled increases in temperature or pressure from one cell to adjacent cells.

Special condition nos. 1 and 2 are intended to ensure that the non-rechargeable lithium battery and its cells are designed to eliminate the potential for uncontrollable failures. However, a certain number of failures will occur due to various factors beyond the control of the battery designer. Therefore, other special conditions are intended to protect the airplane and its occupants if failure occurs.

Special condition nos. 3, 7, and 8 are self-explanatory; the FAA does not provide further explanation for them at this time.

The FAA requires special condition no. 4 to make it clear that the flammable-fluid fire-protection requirements of § 25.863 apply to non-rechargeable lithium battery installations. Section 25.863 is applicable to areas of the airplane that could be exposed to flammable-fluid leakage from airplane systems. Non-rechargeable lithium batteries contain an electrolyte that is a flammable fluid.

Special condition no. 5 requires each non-rechargeable lithium battery installation to not damage surrounding structure or adjacent systems, equipment, or electrical wiring from corrosive fluids or gases that may escape.

Special condition no. 5 addresses corrosive fluids and gases, whereas special condition no. 6 addresses heat. Special condition no. 6 requires each non-rechargeable lithium battery installation to have provisions to prevent any hazardous effect on airplane structure or systems caused by the maximum amount of heat the battery installation can generate due to any failure of it or its individual cells. The means of meeting these special conditions may be the same, but they are independent requirements addressing different hazards.

These special conditions apply to all non-rechargeable lithium battery installations in lieu of § 25.1353(b)(1) through (b)(4) at Amendment 25-113. Sections 25.1353(b)(1) through (b)(4) at Amendment 25-113 remain in effect for other battery installations.

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.

Discussion of Comments

Notice of proposed special conditions no. 25-15-09-SC, for the Gulfstream GVI airplane, was published in the **Federal Register** on November 20, 2015 (80 FR 72618). Five commenters provided comments.

The Aerospace Industries Association (AIA) recommended revising proposed special condition no. 1 to read (see italics), "...each non-rechargeable lithium battery installation must maintain safe cell temperatures and pressure under all foreseeable operating conditions to prevent fire and explosion *by validating that the performance of non-rechargeable lithium cells selected for use are acceptable with regards to the operating environment.*" AIA stated that this revision helps clarify the term "foreseeable operating conditions" as "airplane operating and environmental conditions over which proper functioning of the equipment, systems, and

installations is required to be considered includes the full normal operating envelope of the airplane as defined by the Airplane Flight Manual together with any modification to that envelope associated with abnormal or emergency procedures.” AIA referenced FAA Advisory Circular (AC) 25.1309-1A and AC 25-11A to support this definition. The FAA does not agree with the proposal. The FAA intends for the term “foreseeable operating conditions” in these special conditions to not only apply at the airplane level but also at the battery-cell level. Therefore, we have not incorporated this proposed revision into the special condition.

AIA recommended revising proposed special condition no. 2 to read, “...each non-rechargeable lithium battery installation must prevent the occurrence of self-sustaining, uncontrolled increases in temperature or pressure *which would preclude continued safe flight and landing.*” AIA states that this change allows the use of airplane-level mitigation or design change to appropriately address the hazard. The FAA does not agree with the proposal. The FAA has determined that these special conditions are intended to require the battery, which includes its installation provisions, to be designed to prevent uncontrollable failure, and to not rely only on mitigation of a battery failure at the airplane level. Therefore, we have not revised proposed special condition no. 2.

AIA recommended revising proposed special condition no. 3 to read, “...each non-rechargeable lithium battery installation must not emit explosive or toxic gases in normal operation, or as a result of *any failure which is not shown to be extremely remote...*” The FAA does not agree with the proposal to exclude extremely remote failures. To ensure that all failures that are not extremely improbable are properly anticipated and accounted for, we have not revised proposed special condition no. 3 to include the proposed words. Note that service history currently shows that battery failure is more frequent than extremely remote.

AIA recommended deleting proposed special condition no. 4. AIA stated that it does not introduce a new airworthiness requirement and that it seems more appropriate to clarify applicability of an existing airworthiness requirement via policy. The FAA does not agree with the proposal. Section 25.863 historically has been applied to flammable fluids related to propulsion and hydraulic systems. The FAA has not issued guidance material at this time that would ensure a proper understanding that this section also applies to non-rechargeable lithium battery installations, which contain flammable fluid. We have determined to not delete proposed special condition no. 4.

AIA recommended revising proposed special condition no. 5 to read, “...each non-rechargeable lithium battery installation must not *allow escape of corrosive fluids or gases that may* damage surrounding structure or any adjacent systems, equipment, or electrical wiring *of the aircraft in such a way as to cause a hazardous or catastrophic failure condition.*” The FAA agrees with the comment in that the special condition requires clarification. The FAA intends for special condition no. 5 to be consistent with § 25.1309. So, we added the words “...in such a way as to cause a major or more-severe failure condition.” The revised special condition now reads, “...each non-rechargeable lithium battery installation must not damage surrounding structure or adjacent systems, equipment, or electrical wiring from corrosive fluids or gases that may escape in such a way as to cause a major or more-severe failure condition.” The FAA does not concur with excluding major failure conditions, nor limiting the types of failure conditions as proposed.

AIA recommended revising proposed special condition no. 6 to read, “...each non-rechargeable lithium battery installation must have provisions to prevent any hazardous effect on airplane structure or systems caused by the maximum amount of heat it can generate due to any failure of *a single cell within a battery pack, which precludes continued safe flight and landing.*”

AIA stated that they believe the intent of this special condition is to show that the battery design can tolerate a failure of a single cell. The FAA does not concur with AIA's recommendation. We intend for special condition no. 6 to require consideration of the maximum heat the battery can generate if it fails (that is, not just the heat from one cell for multi-cell batteries), including the heat generated from thermal runaway propagating from one cell to the other cells. AIA's proposed wording could be interpreted as only requiring consideration of the heat generated from a single cell. AIA also stated that design mitigation or analysis at the airplane level may be applied to show the design to be compliant. This comment addresses how to show compliance with the special condition and would not change the special condition. This comment can be addressed during the type certification projects.

AIA recommended deleting proposed special condition no. 7, which reads, "...each non-rechargeable lithium battery installation must be capable of automatically controlling the discharge rate of each cell to prevent cell imbalance, back-charging, overheating, and uncontrollable temperature and pressure." AIA stated that the hazard intended to be addressed by this special condition would be prevented by meeting special condition nos. 1, 2, 4 and 5. The intent of proposed special condition no. 7 was to also address charge imbalance because an in-service event demonstrated that a charge imbalance is one of many failure modes that can lead to a thermal runaway condition. However, the FAA agrees with deleting proposed special condition no. 7 because compliance with special condition nos. 1 and 2 accomplish the safety objectives of proposed special condition no. 7.

AIA recommended deleting proposed special condition no. 8, which reads, "...each non-rechargeable lithium battery installation must have a means to automatically disconnect from its discharging circuit in the event of an over-temperature condition, cell failure, or battery failure."

The FAA agrees with deleting this proposed special condition because doing so does not relieve applicants from the need to comply with § 25.1309. In addition to § 25.1309, all applicable system-level requirements may require the connected system to automatically disconnect from the battery discharging circuit in the event of an over-temperature condition, cell failure, or battery failure.

AIA recommended revising proposed special condition no. 9 (which is now special condition no. 7 in these special conditions) to read, “...each non-rechargeable lithium battery installation must have a failure sensing and warning system to alert the flightcrew if its failure ~~affects~~ *precludes continued safe flight and landing* of the airplane.” AIA stated that this proposed special condition repeats the criteria defined in § 25.1309, and therefore is a duplication of current Federal aviation requirements. Proposed special condition no. 9 has the same purpose as that of § 25.1309(c), which is to require flightcrew alerting if failure of a battery installation, in itself or in relation to a system that performs an airplane-level function, could result in “unsafe system operating conditions” as stated in § 25.1309(c). The FAA’s intent for this special condition is to emphasize this requirement specifically for non-rechargeable lithium battery installations. We do not concur with AIA’s recommendation because the revised wording does not fully address the “unsafe system operating conditions” as required in § 25.1309(c).

AIA recommended revising proposed special condition no. 10 (which is now special condition no. 8 in these special conditions) to read, “...each non-rechargeable lithium battery installation must have a means for the flightcrew or maintenance personnel to determine the battery charge state if the battery’s function is required for *continued safe flight and landing* of the airplane.” AIA stated that this proposed special condition repeats the criteria defined in § 25.1309, and therefore is a duplication of current Federal aviation requirements. For similar

reasons given in our response to the AIA comment on proposed special condition no. 9, we do not concur with AIA's recommendation. The FAA's intent for this special condition is to emphasize this requirement specifically for non-rechargeable lithium battery installations. We do not concur with AIA's recommendation because the revised wording does not fully address the "unsafe system operating conditions" as required in § 25.1309(c).

The Boeing Company commented that they concur with AIA's comments.

The Boeing Company also requested that the FAA provide adequate time before non-rechargeable lithium battery special conditions become effective, to support validation activities by foreign civil airworthiness authorities (FCAA) and to not adversely impact future airplane deliveries by all applicants. The Boeing Company stated that they have been "informed by FCAAs that validation activities for FAA type certificate data sheet certification basis changes can take up to 12 months after receipt of application." The FAA agrees that adequate time is necessary to allow Gulfstream, and other applicants for which similar special conditions will be issued, to coordinate with FCAAs, and to conduct other activities associated with implementing these special conditions, which have not been required for previous approvals. These are the first special conditions the FAA has issued for a non-rechargeable lithium battery installation on any airplane. Likewise, we have determined that an effective date of one year after special conditions publication is appropriate. The FAA also has been coordinating with other applicants to develop proposed special conditions for their projects involving non-rechargeable lithium batteries. The FAA intends for future special conditions, for other airplane makes and models, to be effective on this same date or 30 days after their publication, whichever is later.

The Boeing Company commented that "...these special conditions should clearly indicate the scope of changes for which the certification basis is deemed inadequate and requires

application of the special conditions.” The Boeing Company made this comment in regards to the applicability of these special conditions to batteries that have less than 2 watt-hours of energy and meet Underwriters Laboratories (UL) 1642 or UL 2054. The FAA has determined that the use of UL 1642 and UL 2054 should be addressed as a method-of-compliance issue rather than exclusion criteria for certain battery sizes. These special conditions are to apply to all non-rechargeable lithium batteries regardless of their size. These special conditions require this where it states “...each non-rechargeable lithium battery installation must...”

Airbus commented that they assume that the FAA considers the standards in Radio Technical Commission for Aeronautics (RTCA) DO-227, *Minimum Operational Performance Standard for Lithium Batteries*, to be an acceptable means of compliance with the special conditions that address battery-qualification aspects. Airbus also commented that they assume that compliance with the other special conditions is demonstrated through analysis of battery integration in the airplane physical and functional environment. These comments address how to show compliance with the special conditions and would not change the special conditions. These comments can be addressed during the type certification projects.

Airbus commented that batteries that are Category I, as defined in RTCA DO-227, should be excluded from proposed special condition nos. 1 through 8 (which are special condition nos. 1 through 6 in these special conditions). RTCA DO-227 defines these batteries as “solid-cathode cells that contain less than 0.15 grams of lithium or lithium alloy, and batteries that use not more than four such cells.” The FAA does not concur. These special conditions are intended to provide an appropriate level of safety for all non-rechargeable lithium battery installations.

Bombardier provided the following comment on proposed special condition no. 3: “The quantity of [lithium battery] gas that will constitute a hazard is difficult to define and test. An

outgassing limit in corresponding to cell size/number would be easier to comply with and test. This should only apply in the failure case, as in normal cell operation non-rechargeable [lithium batteries] are expected to remain sealed. We recommend wording that would instead limit cell size/number and require cell isolation to minimize hazard to airplane and occupant in case of failure and be sealed in normal operation. Exposure to occupants may be achieved by locating battery installations away from occupant areas on the airplane.” The FAA does not agree with the proposal. The FAA considers that a special condition that limits the number of cells and their size would be unnecessarily restrictive. Note that this special condition does not require applicants to determine the quantity of gas that would constitute a hazard. For example, an acceptable means of complying with this special condition is to demonstrate, through tests, that all emitted gasses are contained or vented overboard through designed ports. However, this special condition does allow explosive and toxic gases to be uncontained and not vented overboard if they do not accumulate in hazardous quantities within the airplane.

Bombardier commented that a design that prevents fluids and gases from escaping the installation should be an acceptable means of complying with proposed special condition no. 5. Bombardier recommended addressing the need for fluid containment. These comments address how to show compliance with the special conditions and would not change the special conditions. These comments can be addressed during the type certification projects.

Transport Canada recommended revising proposed special condition no. 1 to address “all hazards.” We have not revised this special condition because it is intended to address only the cell-level hazards, which are fire and explosion. All hazards are addressed through compliance with the complete set of applicable special conditions.

Transport Canada recommended adding a sentence to proposed special condition no. 2 that reads, “*Batteries that are capable of venting toxic gases shall not be installed or used in the aircraft cockpit.*” Transport Canada stated that adding this sentence would harmonize the special condition with Technical Standard Order (TSO) TSO-C142a, *Non-Rechargeable Lithium Cells and Batteries*, and RTCA DO-227, *Minimum Operational Performance Standard for Lithium Batteries*. The FAA does not agree with the proposal and did not add this sentence to special condition no. 2. We consider the special condition without this sentence more appropriate because it allows an applicant to demonstrate that the amount of gases a battery vents is not a hazard to the flight deck, and allows installation of those batteries.

Transport Canada recommended revising proposed special condition no. 5 to read, “...each non-rechargeable lithium battery installation must not damage surrounding structure or adjacent systems, equipment, or electrical wiring from corrosive fluids or gases that may escape *in such a way as to cause a major or more severe failure condition.*” The FAA concurs, and has incorporated the recommended wording into special condition no. 5. We explain our agreement with adding these words in our above response to AIA’s comment on this special condition.

Transport Canada recommended revising proposed special condition no. 6 to refer to “essential systems” instead of “systems,” because the FAA previously found that wording acceptable for rechargeable lithium battery special conditions. Alternatively, Transport Canada recommended that the FAA be consistent and use “systems” for both rechargeable and non-rechargeable lithium battery special conditions in the future. The intent of this special condition is to address the hazards to the airplane regardless of the system critically. The FAA agrees with using “systems” in this special condition and in the next special conditions we propose for a rechargeable lithium battery installation.

Transport Canada recommended revising proposed special condition no. 6 to read, “...each non-rechargeable lithium battery installation must have provisions to prevent any hazardous effect on airplane structure or systems caused by the maximum amount of heat it can generate due to any *discharge condition and/or* failure of it or its individual cells.” The FAA does not agree with the proposal. The maximum heat generated due to any battery or cell failure (for example, the heat generated during thermal runaway) represents the worst-case condition. The maximum heat generated during “any discharge condition” will not exceed this worst-case condition. Therefore, the FAA did not revise this special condition.

Transport Canada recommended including “unbalanced discharge” in the list of conditions intended to be prevented in proposed special condition no. 7. As a result of a comment from AIA addressed above, the FAA deleted proposed special condition no. 7 because compliance with special condition nos. 1 and 2 accomplish its safety objectives. Special conditions 1 and 2 also address unbalanced discharge.

Transport Canada recommended revising proposed special condition no. 8 to read, “...each non-rechargeable lithium battery installation must have a means to automatically *and permanently* disconnect from its discharging circuit in the event of an over-temperature condition, *over-current condition*, cell failure, or battery failure.” Transport Canada recommended this change to raise awareness of issues associated with positive temperature coefficient protective devices in lithium battery design. As discussed above in response to an AIA comment, the FAA deleted proposed special condition no. 8, and therefore, has not incorporated the recommended revision.

Transport Canada recommended adding a special condition to require instructions for continued airworthiness (ICAs) to address handling and storage of non-rechargeable lithium

batteries at a minimum. The FAA has not added the recommended special condition because § 25.1529 requires ICAs for non-rechargeable lithium battery installations. To ensure compliance with § 25.1529, the FAA is documenting acceptable methods of compliance with § 25.1529 for non-rechargeable lithium battery installations as part of the certification process. These methods of compliance address the issues Transport Canada raised. The FAA previously included a special condition that requires compliance with § 25.1529 in rechargeable lithium battery special conditions. For consistency and the above-stated reasons, the FAA plans to no longer include that special condition in special conditions applicable to rechargeable lithium batteries.

Transport Canada recommended “the special condition be written in such a way as to drive the requirement for original equipment manufacturers to complete an adequate failure modes and effects analysis (FMEA) in order to discover and mitigate for all failure modes, including those that are less well known.” The FAA does not agree with the proposal. The current FAA AC 25.1309-1A and Aviation Rulemaking Advisory Committee (ARAC) recommended AC 25.1309-Arsenal contain guidance to utilize FMEA in the safety-assessment process. The FAA believes that these special conditions, and the hazards identified, drive the FMEA or any other system-safety assessment tool to comprehensively assess the risk of battery failures. We believe that we have accomplished Transport Canada’s recommendation.

Transport Canada recommended changes to FAA TSO-142a, *Non-Rechargeable Lithium Cells and Batteries*. Their comment did not recommend changes to these special conditions; as such, this comment does not affect these special conditions.

Transport Canada recommended adding a special condition that reads, “*Equipment manufacturers intending to use lithium-metal batteries in aircraft equipment must demonstrate*

that the battery design incorporates an acceptable level of circuit protection to mitigate against known failure modes including, but not limited to, external short-circuits and unbalanced discharge.” Transport Canada referenced Air Accidents Investigation Branch (AAIB) Safety Recommendation 2015-016 to support this recommendation, which states, *“It is recommended that the Federal Aviation Administration, in conjunction with the European Aviation Safety Agency and Transport Canada, require equipment manufacturers intending to use lithium-metal batteries in aircraft equipment to demonstrate that the battery design incorporates an acceptable level of circuit protection to mitigate against known failure modes including, but not limited to, external short-circuits and unbalanced discharge.”* The FAA does not concur with adding this special condition. The AAIB wrote their recommendation based on a non-rechargeable lithium battery installation that was approved before the FAA determined the need to apply special conditions. Their recommendation is specific to incorporating circuit protection, which is a means to achieve the safety level defined in these special conditions. The FAA intends for these special conditions to be performance-based. Additionally, type certificate and supplemental type certificate applicants, and not the equipment manufacturers who have not applied for the installation approval, are required to demonstrate compliance to applicable special conditions.

The FAA has determined that “uncontrolled” in special condition no. 2 should be “uncontrollable” to more accurately describe the concern. This revision does not change the intended meaning of this special condition.

Except as discussed above, the special conditions are adopted as proposed.

Applicability

As discussed above, these special conditions are applicable to the Gulfstream Model GVI airplane. Should Gulfstream apply at a later date for a change to the type certificate to include

another model incorporating the same novel or unusual design feature, these special conditions would apply to that model as well.

These special conditions are only applicable to design changes applied for after its effective date. The existing airplane fleet and follow-on deliveries of airplanes with previously certified non-rechargeable lithium battery installations are not affected.

These special conditions are not applicable to changes to previously certified non-rechargeable lithium battery installations where the only change is either cosmetic or relocating the installation to improve the safety of the airplane and occupants. The FAA determined that this exclusion is in the public interest because the need to meet all of the special conditions might otherwise deter design changes that solely involve relocating batteries to improve safety. A cosmetic change is a change in appearance only, and does not change any function or safety characteristic of the battery installation.

Conclusion

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

List of Subjects in 14 CFR Part 25

Aircraft, Aviation safety, Reporting and record keeping requirements.

The authority citation for these special conditions is as follows:

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

The Special Conditions

Accordingly, the following special conditions are part of the type certification basis for Gulfstream Model GVI airplanes.

Non-Rechargeable Lithium Battery Installations

In lieu of § 25.1353(b)(1) through (b)(4) at Amendment 25-113, each non-rechargeable lithium battery installation must:

1. Maintain safe cell temperatures and pressures under all foreseeable operating conditions to prevent fire and explosion.
2. Prevent the occurrence of self-sustaining, uncontrollable increases in temperature or pressure.
3. Not emit explosive or toxic gases, either in normal operation or as a result of its failure, that may accumulate in hazardous quantities within the airplane.
4. Meet the requirements of § 25.863.
5. Not damage surrounding structure or adjacent systems, equipment, or electrical wiring from corrosive fluids or gases that may escape in such a way as to cause a major or more-severe failure condition.
6. Have provisions to prevent any hazardous effect on airplane structure or systems caused by the maximum amount of heat it can generate due to any failure of it or its individual cells.
7. Have a failure sensing and warning system to alert the flightcrew if its failure affects safe operation of the airplane.
8. Have a means for the flightcrew or maintenance personnel to determine the battery charge state if the battery's function is required for safe operation of the airplane.

Note 1: A battery system consists of the battery and any protective, monitoring, and alerting circuitry or hardware inside or outside of the battery. It also includes vents (where

necessary) and packaging. For the purpose of these special conditions, a “battery” and “battery system” are referred to as a battery.

Issued in Renton, Washington, on April 14, 2016.

Victor Wicklund,

*Acting Manager, Transport Airplane Directorate,
Aircraft Certification Service.*

[FR Doc. 2016-09311 Filed: 4/21/2016 8:45 am; Publication Date: 4/22/2016]