

One year later, no issues for Boeing 787 battery redesign

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The US National Transportation Safety Board (NTSB) says today that it expects to release at the end of this year a probable cause for the Boeing 787 battery malfunctions that grounded the fleet for four months in 2013.

The investigative work by the NTSB should be complete by late March. The investigation team will then begin preparing a final report, which will be presented to the board at a public meeting in Washington DC in the fourth quarter, the NTSB says.

The announcement came the day after the one-year anniversary of a still mysterious incident in which an installed lithium-ion battery overheated inside a Japan Airlines 787 parked at Boston Logan airport.

A second lithium-ion battery incident eight days later caused an All Nippon Airways 787 over Japan to make an emergency landing.

The close frequency of both battery events raised alarms among regulators and some 787 operators. The US Federal Aviation Administration (FAA) grounded the 787 fleet on 16 January. It took Boeing three months to develop a technical solution that could be approved by the FAA, even as the worldwide fleet idled and deliveries halted.

In the end, the episode did not meaningfully harm Boeing financially or disrupt a 787 production ramp-up, but it did leave a mark on the industry. Airbus quickly launched a parallel certification for the A350-900 using both nickel cadmium and lithium ion batteries.

But the effects on Boeing and 787 operators were relatively short-lived. The fleet returned to flying status in May with a redesigned battery installation that has so far proven reliable despite the lack of an identified probable cause.

The new installation was presented as a compromise. Boeing rejected calls to replace the battery with a more traditional nickel cadmium unit, or to redesign the existing battery using more cells or a less volatile form of lithium-based power.

Instead, the company retained the lithium-cobalt-dioxide chemistry of the 32V batteries, as well as the configuration based on eight large cells.

Boeing also made several changes both inside and outside the battery to make it safer. It improved the software that monitors the cells to detect and control temperature fluctuations before they can spin out of control.

If the monitoring software failed to do its job, Boeing added four layers of additional protections against a battery-ignited fire, which could be catastrophic at any altitude.

The revised battery design increased the spacing between each of the eight internal cells, added ceramic heat shields between each cell, enclosed the battery in a stainless steel box and installed plumbing to vent any exhaust offboard.

If any individual cell begins to overheat, the new design should prevent the higher temperature from spreading to other cells in a condition called a thermal runaway.

Eight months later, the new battery installation has proven reliable so far. Boeing's elaborate layers of protection against over-heating have not yet been tested in service because none of the battery cells have malfunctioned.

"Since the certification of the improved battery system and the return-to-service for the 787 Dreamliner fleet, there have been no battery cell failures," Boeing says in a statement to Flightglobal.

The overall system has not been free from blemish. In November, both ANA and JAL both replaced battery chargers on the 787s after the system issued a warning that turned out to be a false alarm. It was not clear if the incidents were related.

But neither issue approached the severity of a thermal runaway inside a lithium-ion battery. Boeing designed the new battery installation to "address a range of potential causes", the company says.

It is possible that the NTSB investigation could recommend additional battery changes for the 787 fleet. The NTSB's investigators have teamed with Underwriter's Laboratories to perform system level tests of the 787's rechargeable lithium-ion batteries, the agency says. The NTSB also reviewed the standards that industry uses to analyse the safety of lithium-ion batteries.

Boeing selected the original GS Yuasa lithium-ion batteries for the 787 in 2005. At the time, such a battery's safety was judged using a nail penetration test. In 2008, the aviation industry adopted a new informal standard that rendered a nail penetration test obsolete. Boeing, however, never went back to test the 787 battery with the new standard.

The industry committee — RTCA DO-311 — that adopts such consensus standards for lithium-ion batteries meets again in February to consider new updates to the standard for testing lithium-ion batteries. Such revisions could eventually form the basis for an FAA-imposed regulation, as the agency still uses "special conditions" process to certificate the airworthiness of power systems that include lithium-ion battery cells.

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