DREAMLINER FIRE

Cause Map

1 Problem

What	Problem(s)	Fire
When	Date	January 7, 2013
	Time	10:21 EST
	Different, unusual, unique	Lithium-ion batteries
Where	Facility, site	Boston, Massachusetts Airport
	Unit, area, equipment	Boeing 787 Dreamliner
	Task being performed	Cleaning airplane after deplaning

Impact to the Goals

Safety	Minor burn to firefighter
	Potential for multiple deaths
Environmental	Fire/smoke aboard airplane
Customer Service	
Regulatory	Ineffective safety assessment/ testing
Production/ Schedule	Fleet grounded for 3 months
Property/ Equipment	Damage to plane
Labor/ Time	Investigation

Frequency	"Serious incident" involving the main battery occurred on a 787 flight 9 days later

The investigation determined that the internal short circuit was potentially related to defects discovered during the manufacturing process and found issues within the manufacturing process and with the oversight of subcontractors by contractors, as opposed to the manufacturers themselves.

The high temperatures resulting from the battery fire allowed it to spread to adjacent cells. The high temperatures were not detected by the monitoring system because temperatures were not monitored at individual cells, but only on two cell bus bars.

The systems were not prepared to deal with a spreading fire as the design of the aircraft assumed that a short circuit internal to the cell would not propagate. The NTSB determined that the guidance provided to determine key assumptions was ineffective and the safety assessment and testing on the battery system was also ineffective. The rate of occurrence of cell venting was calculated by the manufacturer to be 1 in 10 million flight hours. The two occurrences that resulted in the grounding both involved cell venting and occurred while the 787 fleet had less than 52,000 flight hours.

3 Solutions

Immediate actions that were required by the NTSB prior to a return to flight were to enclose the battery case, vent from the interior of the enclosure containing the battery to the exterior of the plane (keeping smoke out of the occupied spaces), and modify the battery to minimize the most severe effects from an internal short circuit. The NTSB also made multiple safety recommendations to the manufacturer, subcontractor and the FAA.

One of these recommendations was to ensure that assumptions are validated. According to the NTSB report, "Validation of assumptions related to failure conditions that can impact safety is a critical step in the development and certification of an aircraft. The validation process must employ a level of rigor that is consistent with the potential hazard to the aircraft in case an assumption is incorrect."

Firefighter injured when battery explodes

An internal short circuit within a cell of a Boeing 787 Dreamliner's auxiliary power unit (APU) battery spread to adjacent cells and led to a thermal runway which released fire and smoke aboard the just deplaned flight. A firefighter responding to the fire was injured when the battery exploded.

"Validation of assumptions related to failure conditions that can impact safety is a critical step in the development and certification of an aircraft. The validation process must employ a level of rigor that is consistent with the potential hazard to the aircraft in case an assumption is incorrect." - NTSB report

Cause Mapping is a Root Cause Analysis method that captures basic cause-and-effect relationships supported with evidence.

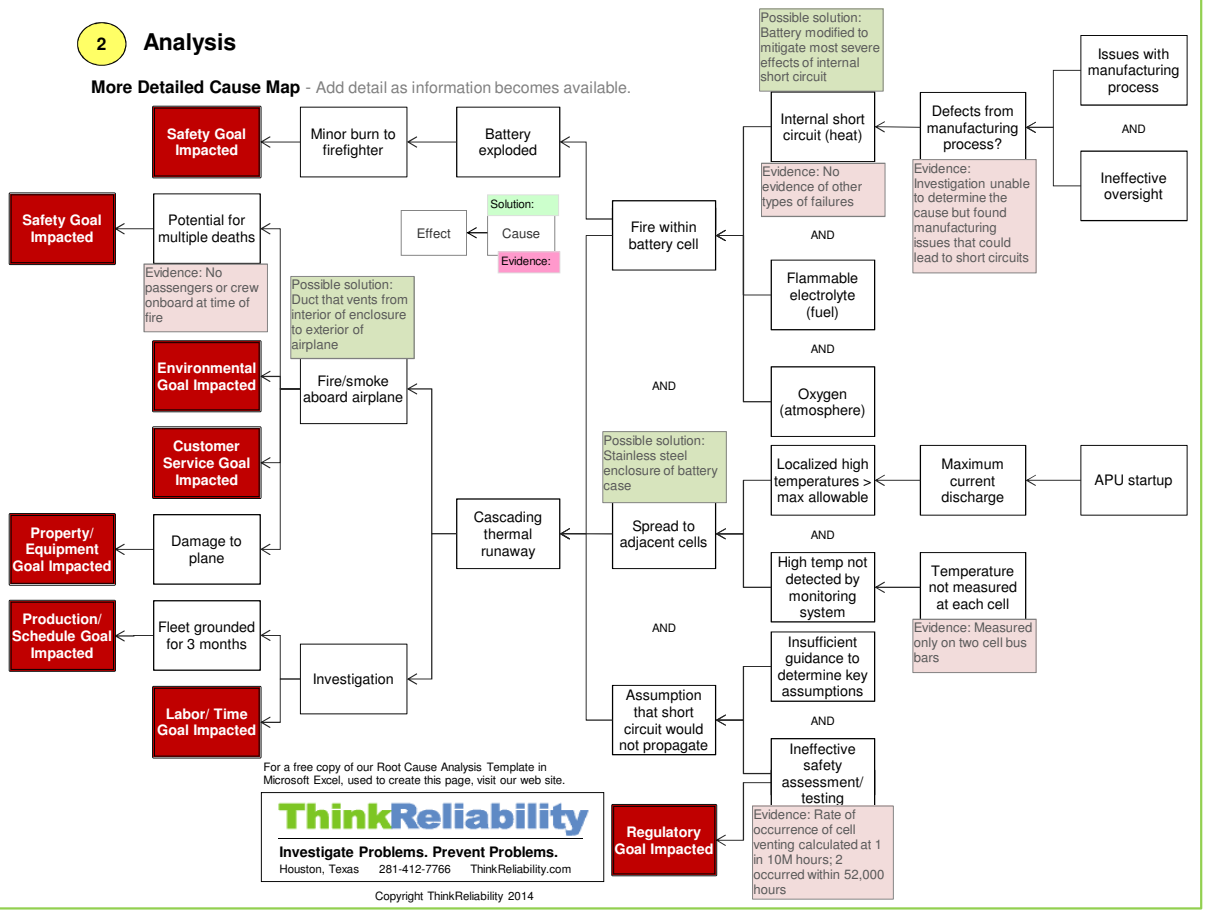
CAUSE MAPPING

Problem Solving • Incident Investigation • Root Cause Analysis

Step 1	Problem	What's the Problem?
Step 2	Analysis	Why did it happen?
Step 3	Solutions	What will be done?

2 Analysis

More Detailed Cause Map - Add detail as information becomes available.



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