



# Moving Forward With the 787

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*March 15, 2013*

# Welcome

A close-up, front-facing view of a Boeing 787 Dreamliner aircraft. The image shows the cockpit windows, the nose cone, and the wing with a large engine. The background is a soft, hazy sunset sky with orange and yellow tones.

- Commitment to safety
- 787 systems
- Event details
- Comprehensive solution set
- Go-forward plan

# Our Commitment to Safety

- The safety of passengers and crew members is our highest priority.
- Working together with customers, suppliers and global regulators, we have made air travel the safest form of transportation in the world.
- We stand behind the integrity of every Boeing product.



**Every Boeing Employee Is Focused on Safety**

# Batteries Perform Limited Functions

## Main Battery

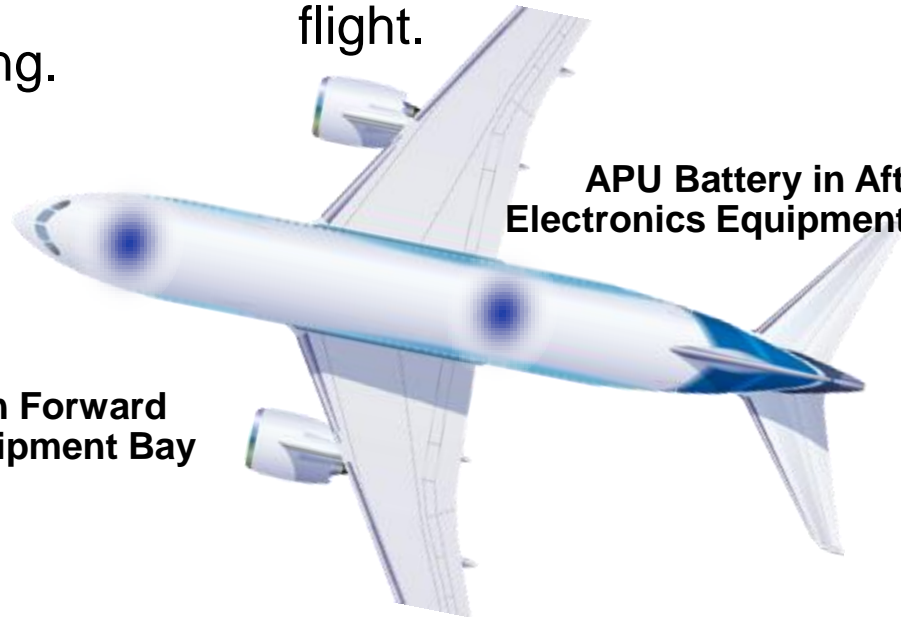
- Ground maintenance operations:
  - ❖ Refueling.
  - ❖ Brake power while towing.
  - ❖ Navigation lights while towing.
- Backup power.

## Auxiliary Power Unit Battery

- APU start
  - ❖ APU provides ground power and serves as backup power in flight.

Main Battery in Forward  
Electronics Equipment Bay

APU Battery in Aft  
Electronics Equipment Bay



**Primarily Ground Operations, Not Flight Critical**

# Lithium-Ion Provides an Advantage

- High power for ground operations
- Less weight / less volume
- Improved charging characteristics
- No memory effect
- Improved storage life



**The Right Technology for Peak Performance**

# System Design Objectives

- Prevent failure but be capable of handling one if it occurs.
- Redundancy provides multiple layers of protection.
- Ensure that no single failure will endanger the airplane or occupants.



**Continued Safe Flight and Landing Assured**

# Facts About Battery Events

- No major airplane structure was damaged
- Minor damage within 20 inches of battery
- Two three-inch flames at connector outside of the battery box (Boston)
- No fire in Takamatsu event
- Cells vented, which is a protective feature of the battery
- Airplane systems functioned as intended



*Electrical equipment bay –  
Boston event*

**Damage Limited to Battery Area and Function**

# Facts About Battery Events

- The only possible cause for thermal runaway at an airplane level is overcharging.
- The 787 has four independent protections against overcharging
- Following detailed review no evidence of overcharging was found in either event.



*Boston battery*

## Propagation of Overheating and Venting



# Boeing Responded Immediately

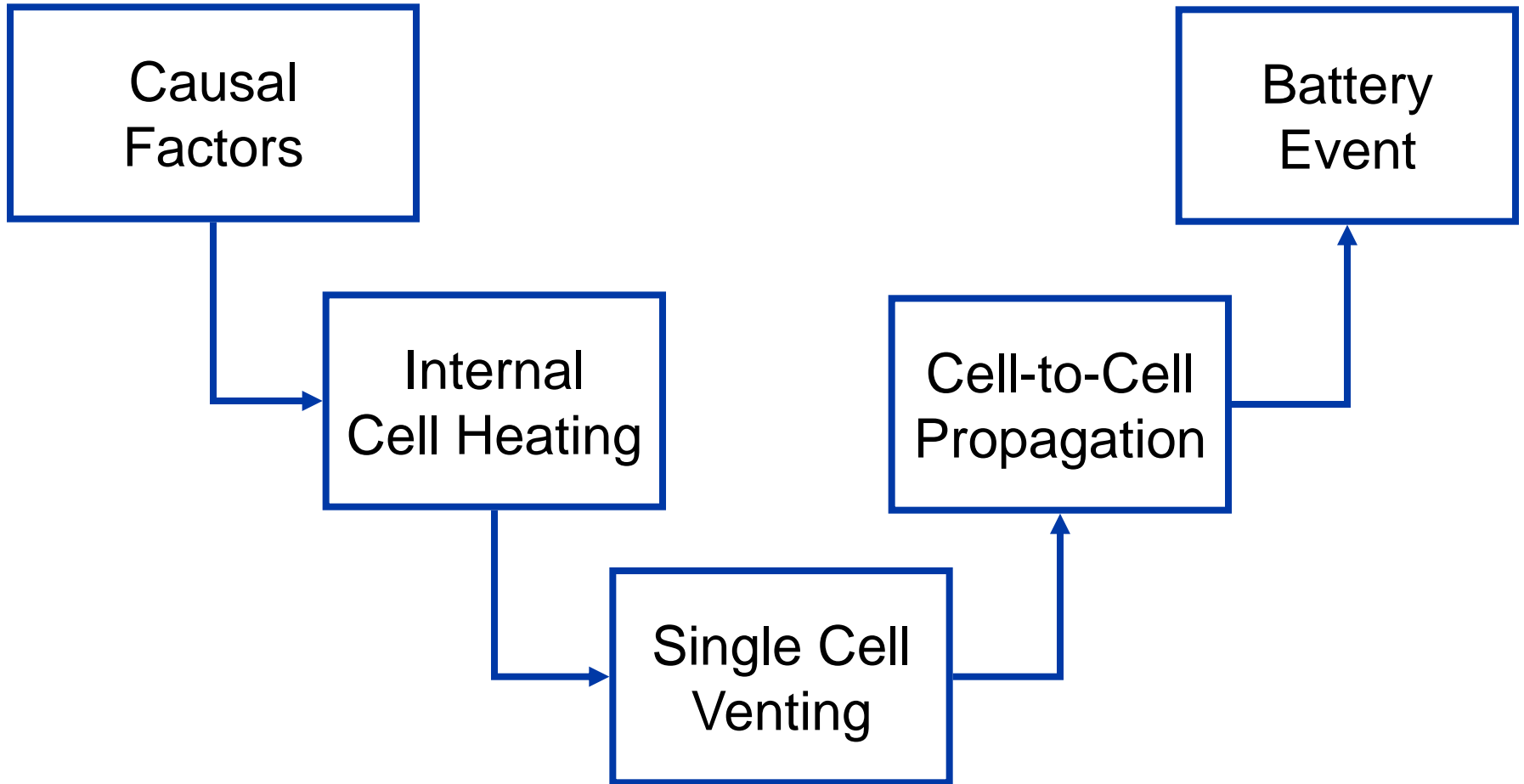
- Teams deployed to support investigations
- Technical team activated to analyze potential faults
- Development team gathered to create solutions
- Industry experts reviewed work, concurred with findings and solution



*Boeing, NTSB experts*

**+ 200,000 Engineering Hours Applied**

# Event Analysis Led to Causal Factors



**Rigorous Process Focused Development of Solution**

# Three Layers of Protection

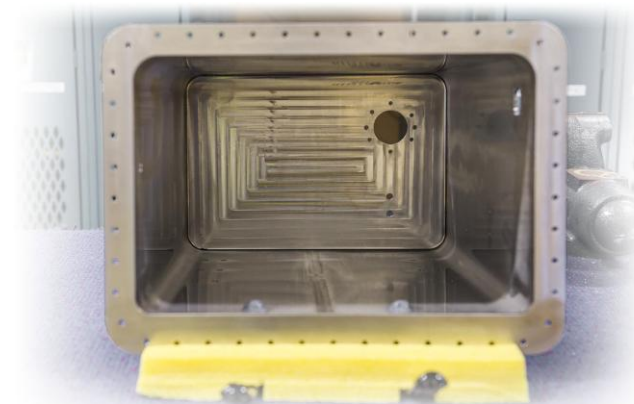
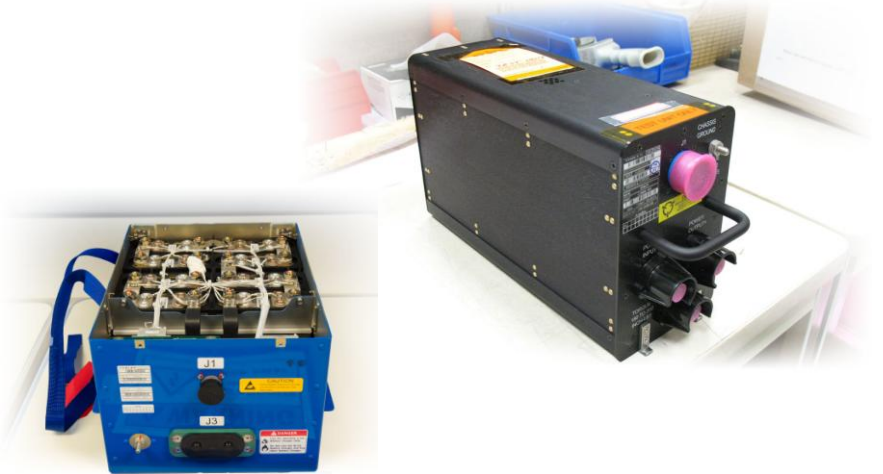
- Prevent initiation of event
- Prevent propagation of event
- Prevent impact to airplane



**Causal Factors Addressed**

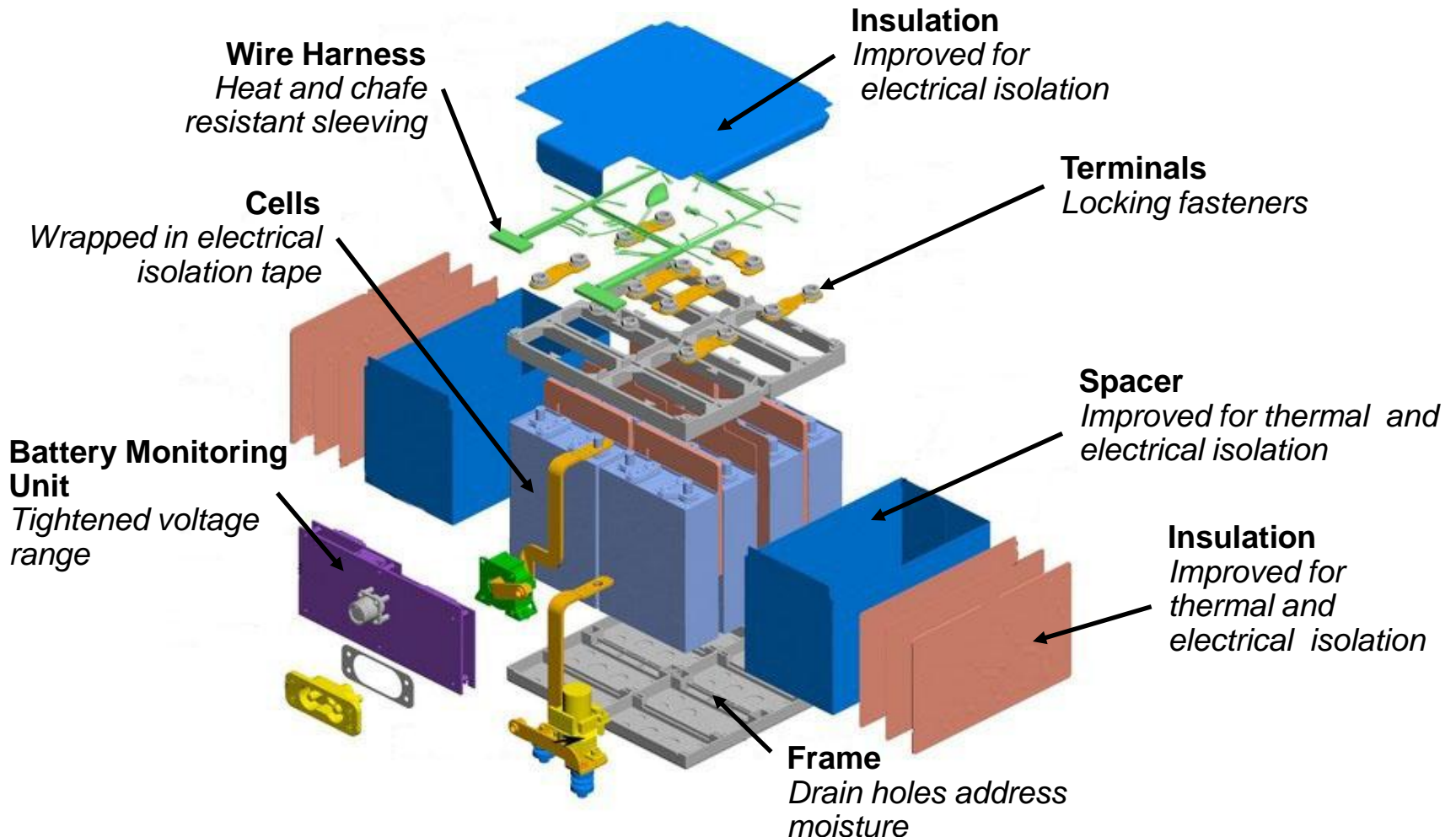
# Comprehensive Solution

- Enhanced cell and battery build processes
- Enhanced production tests for cells and batteries
- Tightened voltage range
- Battery design improvements
- Charger design improvements
- Added battery enclosure



**Multiple Layers of Improvements**

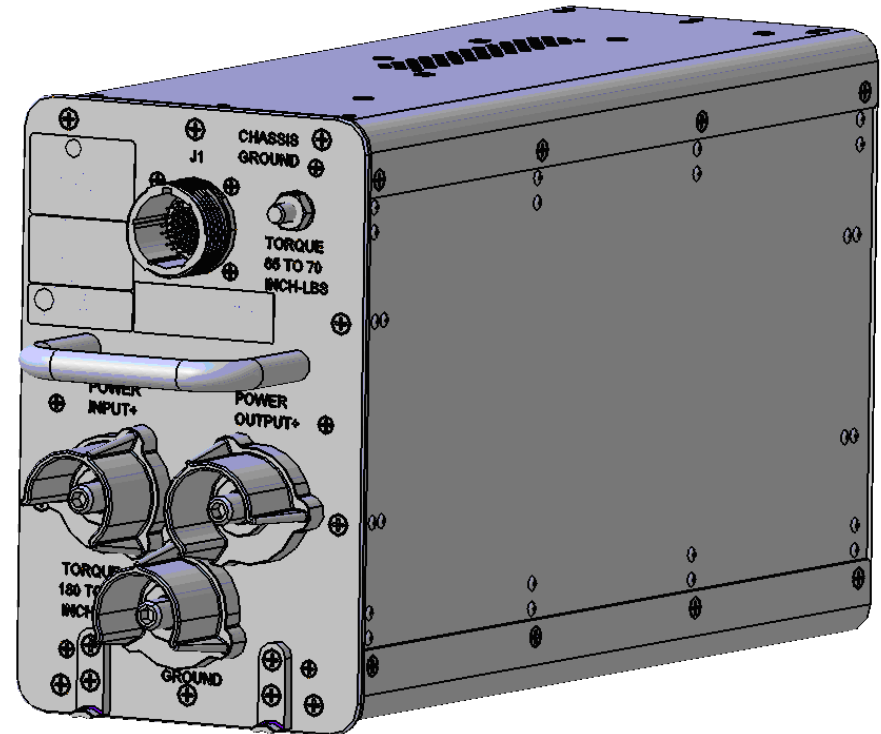
# Comprehensive Set of Solutions: Battery



**Prevent Issues, Reduce Impact of Issues**

# Comprehensive Set of Solutions: Charger

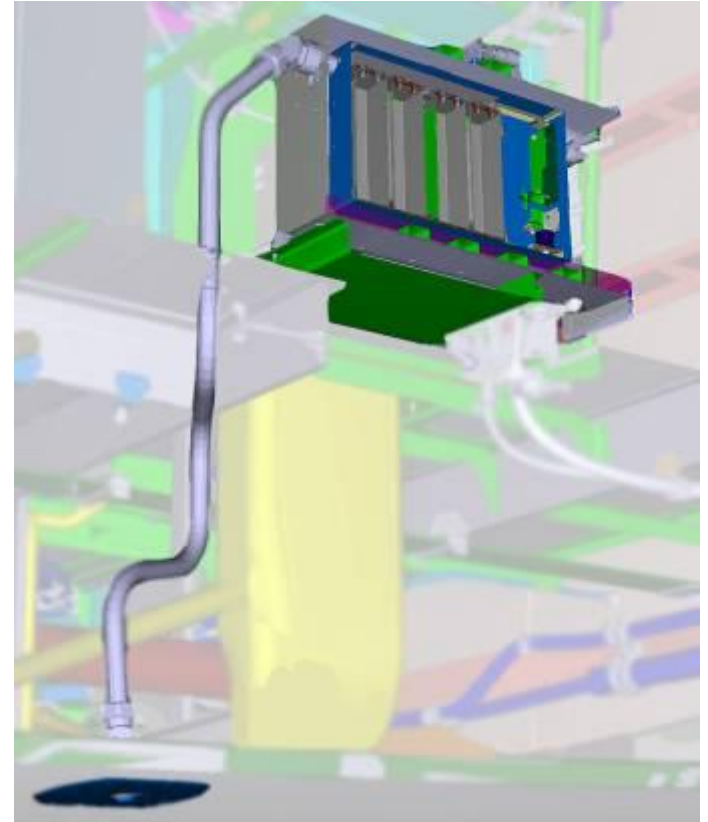
- Reduced maximum charging levels
- Increased minimum charging levels = increased maximum discharge level
- Softened charging sequence



**Decreases Workload on the Battery**

# Comprehensive Set of Solutions: Enclosure

- Eliminates potential for fire
- Vented electrolyte released safely within enclosure
- Heat and pressure released safely within enclosure
- Dedicated vent line
- All vapors and odors vented immediately overboard



*Enclosure and vent line*

**Another Layer of Protection**

# Safeguarding Your 787 Flight

- Prevent Initiation
  - ❖ Enhanced manufacturing controls
  - ❖ Enhanced post-production testing
  - ❖ Protection limits strengthened
  - ❖ Improved design features
- Prevent Propagation
  - ❖ Design changes increase cell isolation (thermal and electrical)
  - ❖ Vapors controlled by dedicated vent system
  - ❖ Vapors immediately released overboard
- Prevent impact to airplane
  - ❖ Enclosure prevents fire from occurring



**Consistent with Boeing Design Philosophy**



# Go-Forward Plan

- Complete certification testing and analysis
- Certification
- Fleet installations
- Airlines return to flight
- Resume Boeing production test flights
- Resume deliveries



# Your Safety Is Our Priority

- We have applied vast resources to understand the battery events.
- Our focus has been on developing a comprehensive set of solutions that addresses causal factors.
- We look forward to flying with you on the 787 soon.



**The 787 Continues the Proud Boeing Legacy of Safety**

