Air Transport of Lithium Batteries

Presented to:

Energy Storage Panel

By: Ejan Petrie – FAA Hazmat

Date: 11/9/2017

FAA Key Points

- AXH Organization, Mission, & Vision
- Regulatory Focus
- Packing Instruction 965
- PHMSA Special Permits
- Working Paper 48
- Lithium Battery Cargo Incidents

AXH Mission / Vision

Mission:

Office of Hazardous Materials Safety (AXH) ensures and promotes the safe transportation of Hazardous Materials (or HAZMAT) in air commerce.

Vision:

To be recognized as the global leader for security and aviation safety by providing superior products and services through a creative environment where motivation, recognition, and collaboration come together to inspire successful innovation.

Office of Hazardous Materials Safety (AXH)

Ensures and promotes the safe transportation of Hazardous Materials (or HAZMAT) in air commerce through:

- **Regulatory oversight of HAZMAT carried by the flying public or transported on aircraft.**
- **Risk-based decision making principles and a Safety Management System (SMS) approach to identify and address prioritized risks.**
- **The coordination of national and international stakeholder engagement and safety promotion.**

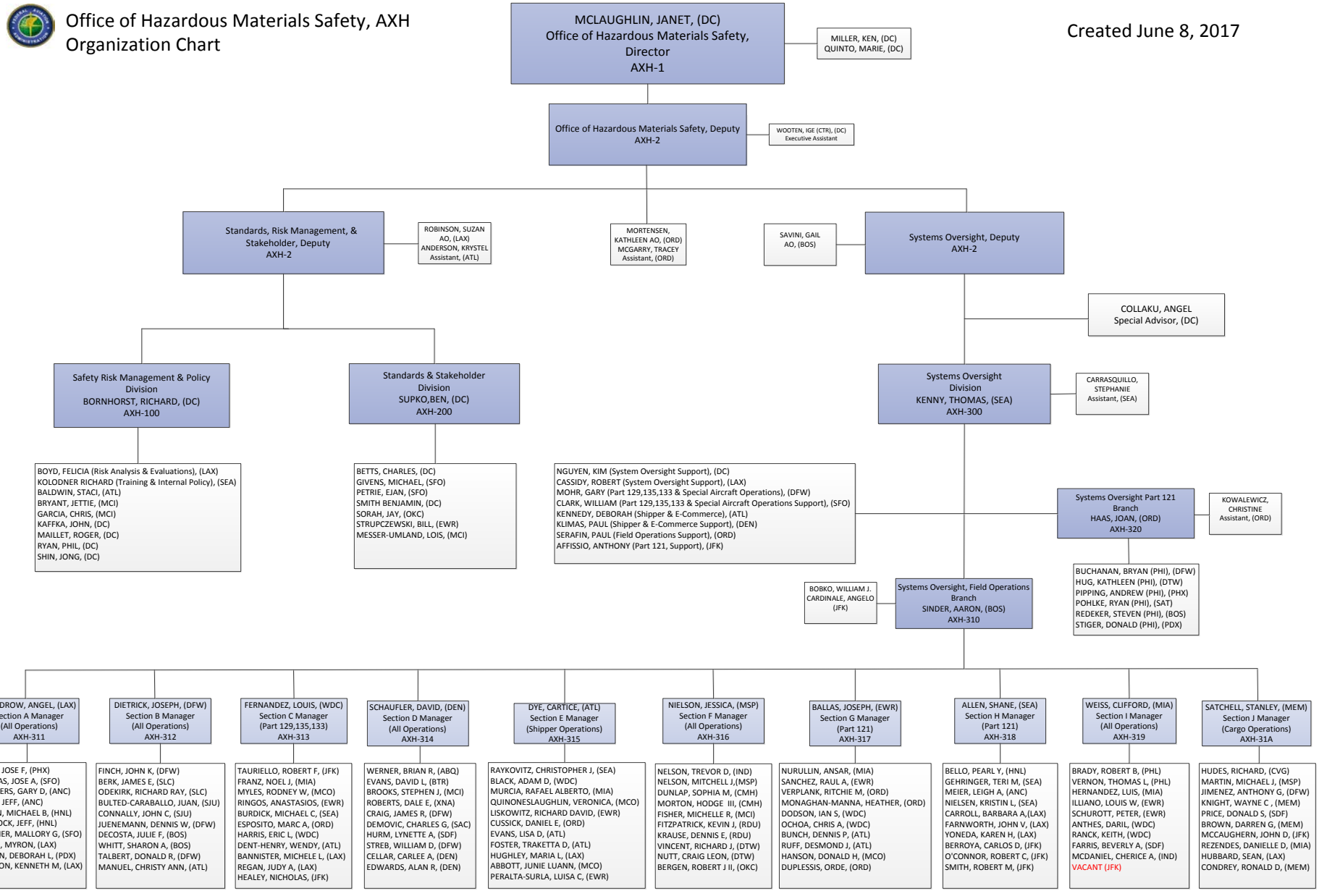
AXH Continued...

- **AXH Subject Matter Experts represent the FAA on HAZMAT-related international panels and Committees and Multi-Disciplinary Groups to develop standards, regulations, and mitigation strategies global safe transportation.**

- **Research, coordination, and oversight of rulemaking efforts and the Special Permits and Approvals through the Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHSMA).**

Office of Hazardous Materials Safety, AXH Organization Chart

Created June 8, 2017



Current Regulatory Focus

Conditions encountered outside of normal transportation present a risk that is typically not considered. The current regulatory focus includes:

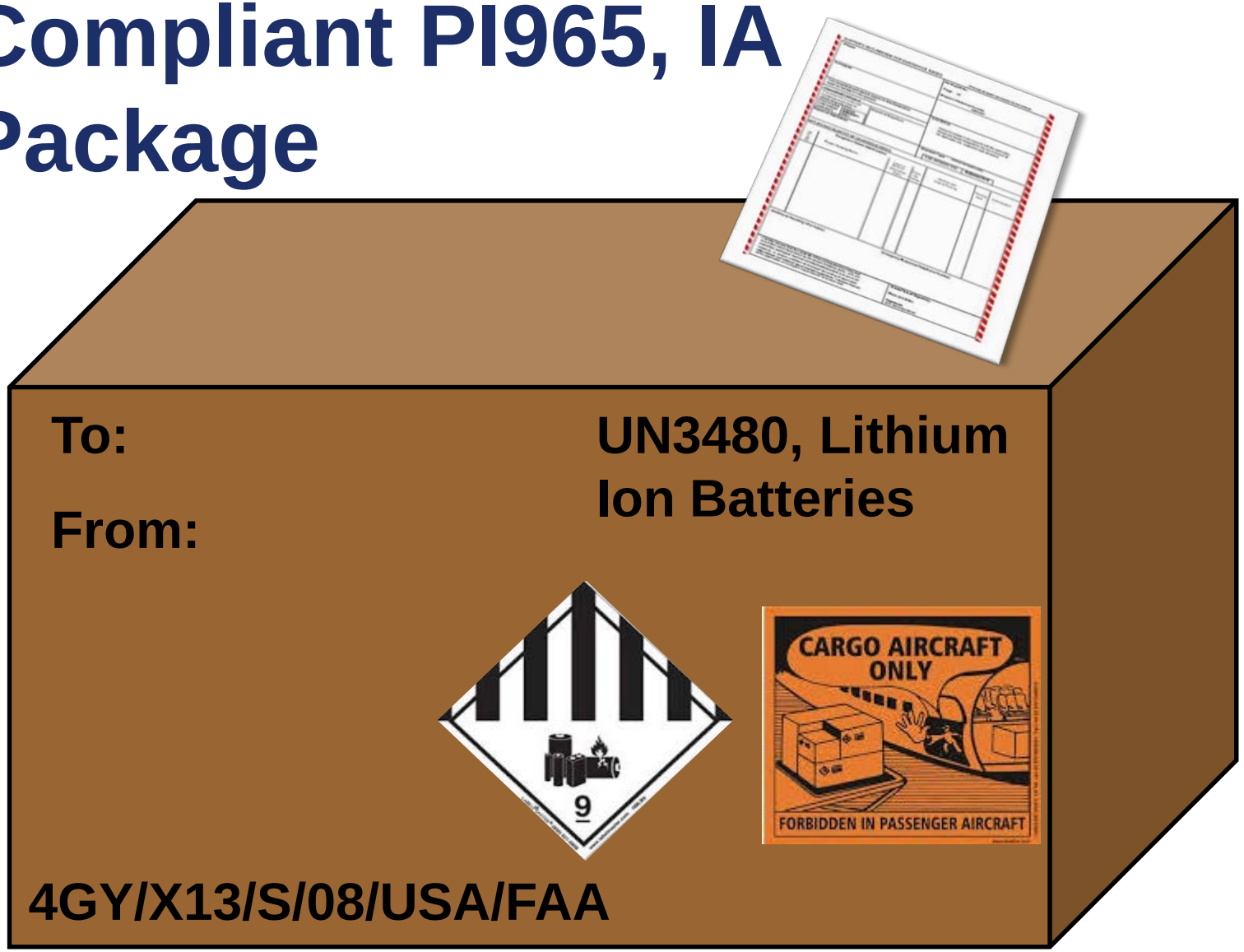
- Properly classifying the material;
- Selecting the appropriate packaging;
- Communicating the hazard;
- Limiting the quantity of the hazardous material being transported;
- Mode of transportation; and
- Segregation requirements.

Packing Instruction 965, Section 1A

Packing Instruction	UN #, Proper Shipping Name	Watt-hr Rating (Batteries)	Allowable Net Mass Per Package
PI 965, Section IA	UN3480, Lithium ion batteries	**>100 Wh**	(PAX) Forbidden 35kg (CAO)

Shippers Dec?	Labels	UN Spec Required?	Additional?
YES	9 + CAO Label	Y (PGII)	SOC <30%

Compliant PI965, IA Package



Special Permits Explained

Special permits are documents issued to ensure the safe transportation of hazardous materials (hazmat) when not otherwise permitted in the Hazardous Materials Regulations.

- **DOT-issued variances from HMR regulations;**
- **Achieve a level of safety at least equal to the safety level required under Federal hazmat law;**
- **Or are consistent with the public interest if a required safety level does not exist;**

Special Permits Cont...

- **Provide safe alternatives to the HMR;**
- **Another entity can apply for party status to any existing special permit;**
- **A hazmat employee MUST RECEIVE TRAINING on the requirements and conditions of the special permit;**
- **Special Permits expire.**

Applying for Special Permits

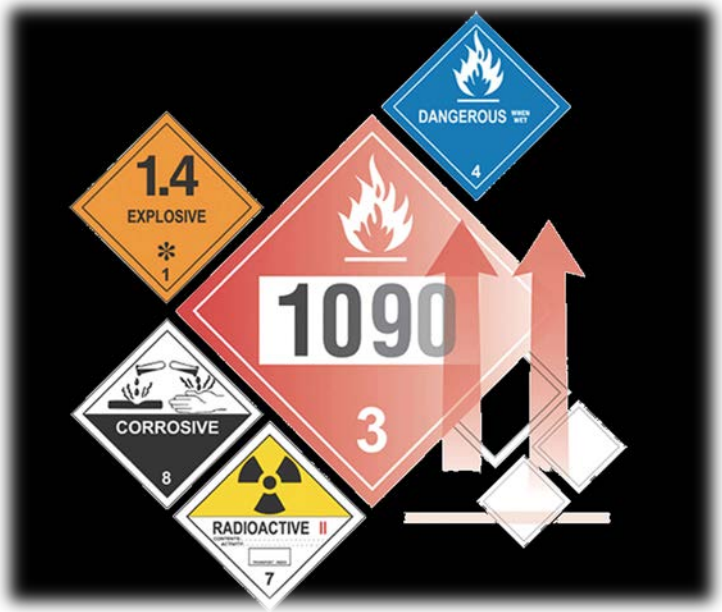
- Must be written in English and submitted at least 120 days before the requested effective date.
- Applications can be submitted by fax to (202) 366-3753 or (202) 366-3308 or email at specialpermits@dot.gov
- Or submitted using PHMSA's online system at: http://www.phmsa.dot.gov/hazmat/regs/sp-a
- Requirements are found in 49 CFR 107.105.

Special Permit Fitness Process

Inspections are geared toward safety and overall compliance.

Observations

- Processes and Procedures
- Testing Equipment
- Manufacturing Equipment
- Packaging
- Marking and Labeling
- *Registration
- *Security Plan



Document Review

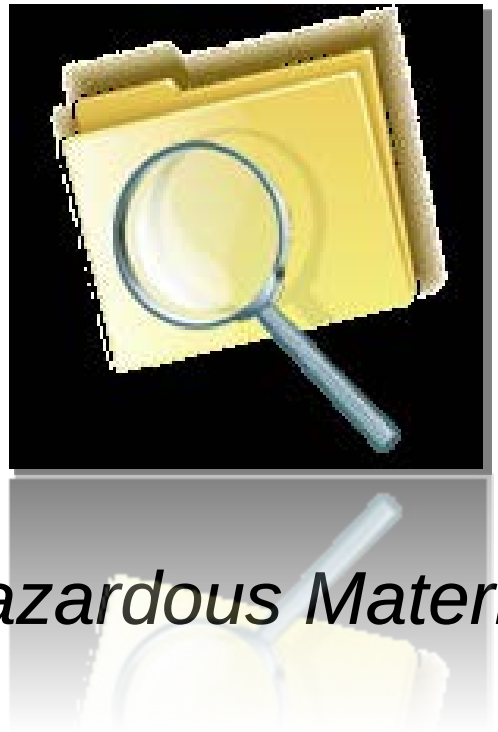
- ❑ Package Certifications
- ❑ Shippers Declarations

(Two-year retention)

- ❑ Closure Instructions
- ❑ Training Records

(Security if applicable and Hazardous Materials)

- ❑ Registration
- ❑ Invoices/Receiving Records
- ❑ Material Safety Data Sheets



Dangerous Goods Panel Working Paper 48

Document proposes to add the new UN entry UN 3536, “Lithium batteries installed in a cargo transport unit” to Table 3-1 in Part 3 of the Technical Instructions.

- **Applicable to containerized energy storage systems.**
- **Based on need in disaster areas and remote islands / mining sites.**
- **Special provision “A2XX” is proposed to be assigned to this entry.**
- **No quantity limitation due to size potential.**

WP 48 Cont...

Name	UN No.	Class or division	Subsidiary risk	Labels	State variations	Special provisions	UN packing group	Excepted quantity	Passenger aircraft		Cargo aircraft	
									Packing instruction	Max. net quantity per package	Packing instruction	Max. net quantity per package
1	2	3	4	5	6	7	8	9	10	11	12	13
Lithium batteries installed in cargo transport unit lithium ion batteries or lithium metal batteries	3536	9				A2 A3XX		E0	FORBIDDEN		See Special Provision A3XX	(No Limit)
. . .												

. . .

A2XX This entry only applies to lithium ion batteries (including lithium polymer batteries) or lithium metal batteries installed in a cargo transport unit and designed only to provide power external to the cargo transport unit. The lithium batteries must meet the requirements of 2;9.3.1 a) to e).

http://www.unece.org/trans/danger/danger.html

Lithium Battery Safety Concerns

- Lithium batteries provide a clear example of a hazardous material whose risks to aviation safety are both high and evolving.

- For example, regulations specify the size of the package and do not evaluate the effect of unlimited packages or one package in relation to the capabilities of aircraft and operator equipment.

As Of May 22, 2017, 160 Air/Airport Incidents Involving Lithium Batteries

LITHIUM BATTERIES & LITHIUM BATTERY-POWERED DEVICES

Aviation Cargo and Passenger Baggage Events Involving Smoke, Fire, Extreme Heat or Explosion Involving Lithium Batteries or Unknown Battery Types

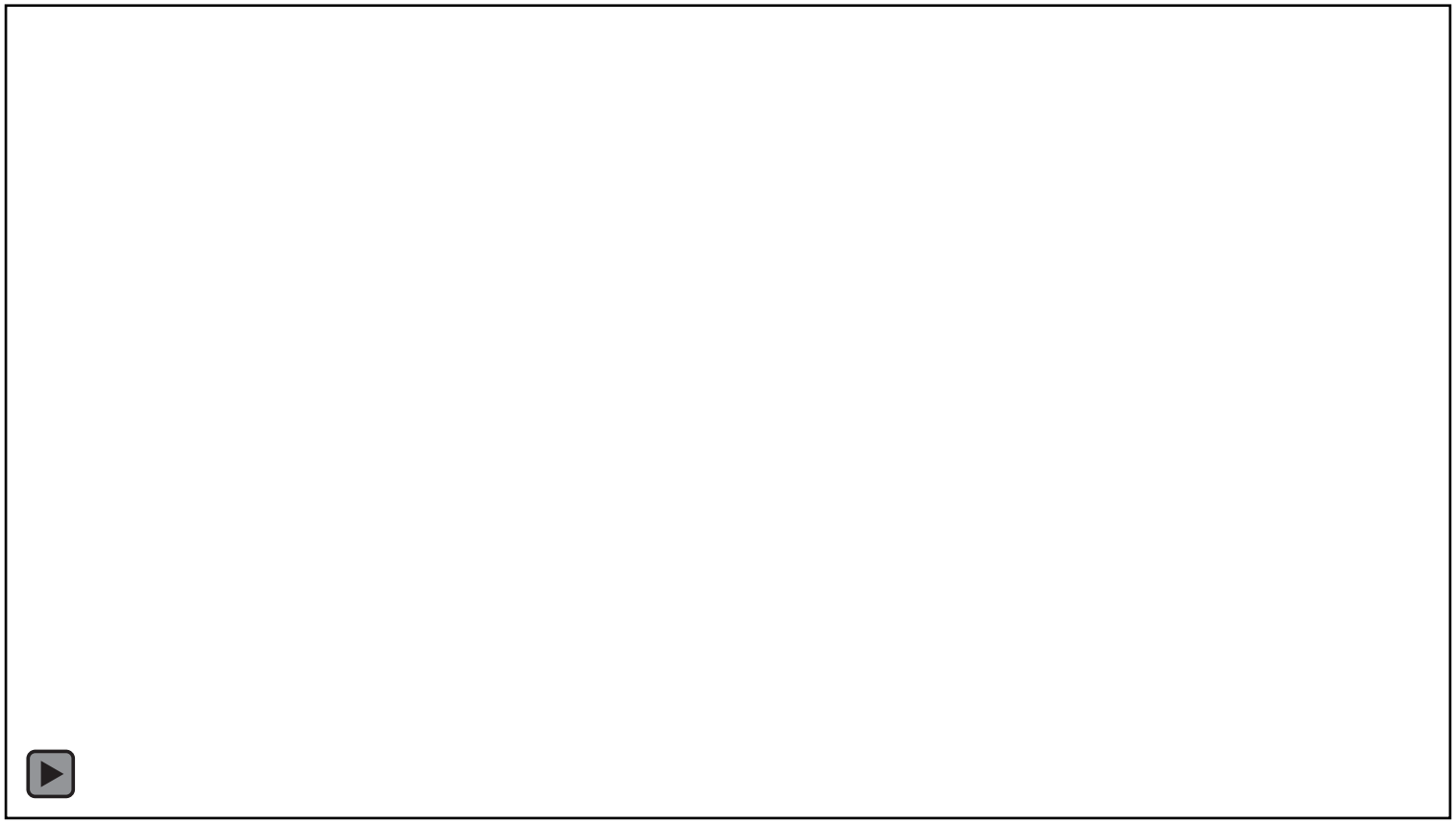
In an effort to more closely focus on lithium battery events, this list has been revised to include events involving lithium or unknown battery types.

As of May 22, 2017, 160 air/airport incidents involving lithium batteries carried as cargo or baggage that have been recorded since March 20, 1991

Note: These are recent cargo and baggage incidents that the FAA is aware of. This should not be considered as a complete listing of all such incidents. The incident summaries included here are intended to be brief and objective. They do not represent all information the FAA has collected, nor do they include all investigative or enforcement actions taken. This list does not include three major aircraft accidents where lithium battery cargo shipments were implicated but not proven to be the source of the fire: An Asiana Airlines 747 near South Korea on July 28, 2011, a UPS 747 in Dubai, UAE on September 3, 2010 and a UPS DC-8 in Philadelphia, PA on February 7, 2006

Date	Source	Type of Battery	Device (if applicable)	Carrier	Aircraft Type (Passenger or Cargo)	Incident Summary
5/14/2017	Airport Authority	Li-ion	E-cig	N/A	N/A	Information, including video footage, from the Seattle Airport Authority and witness statements show an individual's e-cig exploding, resulting in burning of his shirt and backpack. An investigation of this incident is ongoing.

Denver Airport



United Parcel Service, Flight 1307 Cargo Fire

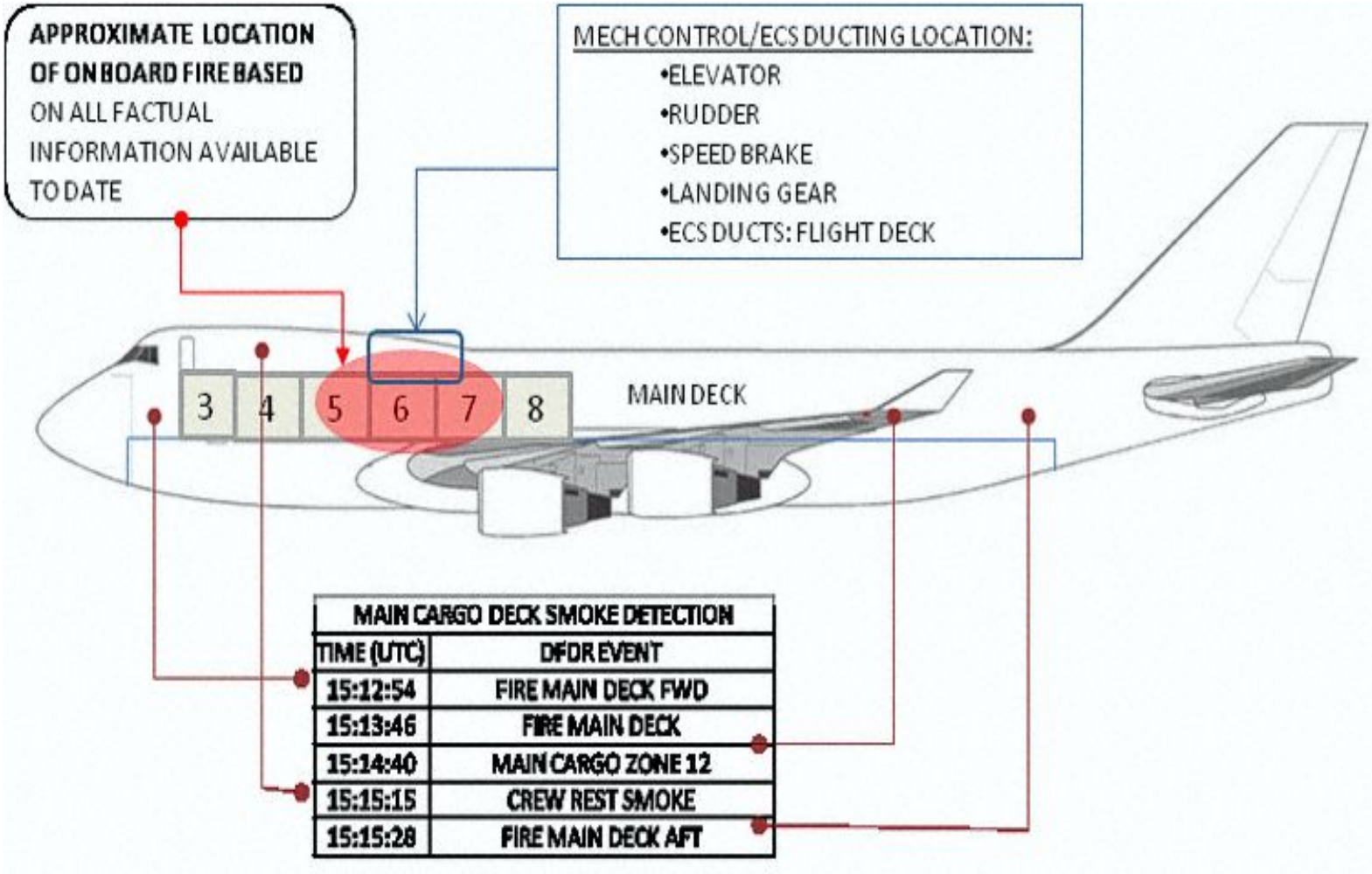
The National Transportation Safety Board determined that the probable cause of this accident was an ***in-flight cargo fire***, which was most likely located within **cargo container 12, 13, or 14**.

Federal Aviation Administration

September 3rd, 2010, United Parcel Service (UPS) Flight 6

*Obtained from UAE General Civil Aviation Authority (GCAA) report
AAIS Case Reference: 13/2010

The UAE GCAA's report states that the fire began in the section of the cargo that included "a significant number of lithium type batteries and other combustible materials" and added that "the fire escalated rapidly into a catastrophic uncontained fire."


APPROXIMATE LOCATION OF ONBOARD FIRE BASED ON ALL FACTUAL INFORMATION AVAILABLE TO DATE
MECH CONTROL/ECS DUCTING LOCATION:
•ELEVATOR
•RUDDER
•SPEED BRAKE
•LANDING GEAR
•ECS DUCTS: FLIGHT DECK
3
4
5
6
7
8
MAIN DECK
MAIN CARGO DECK SMOKE DETECTION
TIME (UTC) | DFDR EVENT
15:12:54 | FIRE MAIN DECK FWD
15:13:46 | FIRE MAIN DECK
15:14:40 | MAIN CARGO ZONE 12
15:15:15 | CREW REST SMOKE
15:15:28 | FIRE MAIN DECK AFT

Obtained from UAE General Civil Aviation Authority (GCAA) report

AAIS Case Reference: 13/2010

ACCIDENT SITE AND DEBRIS FIELD – VIEW LOOKING EAST

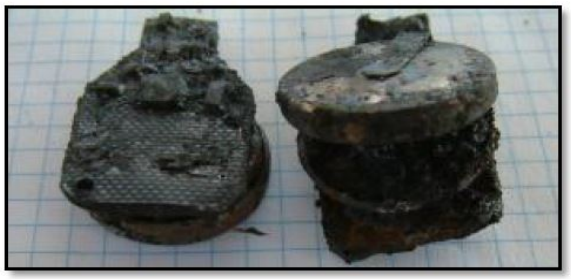
Federal Aviation Administration

Obtained from UAE General Civil Aviation Authority (GCAA) report

AAIS Case Reference: 13/2010

Fire damaged remains of battery pack with a fractured cell

Additional battery pack remains [LH]/D-Cell size lithium primary batteries. Photo shows fire damaged and undamaged batteries [RH]



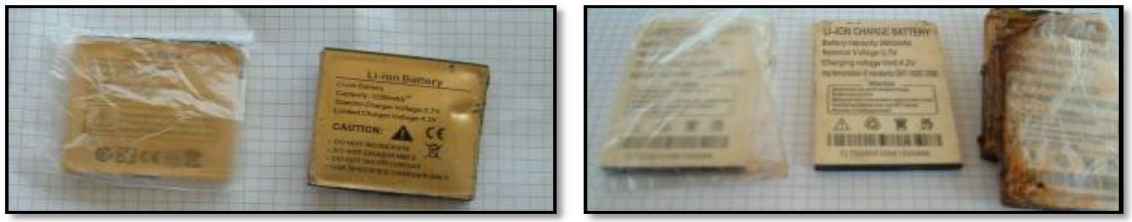
Lithium primary button sized flat cell batteries (watch style) with small circuit board

Obtained from UAE General Civil Aviation Authority (GCAA) report

AAIS Case Reference: 13/2010

36-cell lithium-ion battery pack with thermal damage.

36-cell lithium-ion battery pack with multiple vented cells



Lithium-ion, mobile phone type battery

Crash site in daylight (Photo: APA/EPA/Ali Haider):

Asiana Cargo B744, July 28, 2011

Picture by AviationNewsToday.com

The flight to Shanghai was loaded with 58 tons (57 long tons; 64 short tons) of cargo; 90% of the freight was standard cargo, semi-conductors, mobile phones, liquid crystal displays, and light-emitting diodes. The remainder included 400 kg (880 lbs.) of lithium batteries, paint, resin solutions and other liquids.

The Aviation Herald (avherald.com)

By Simon Hradecky, created Thursday, Jul 28th 2011 05:33Z

Burnt through skin panel (Photo: ARAIB)

One package containing 12 Lithium-Ion battery cells (Photo: ARAIB):

Debris floating off Jeju Island (Photo: AP):

Summary

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Questions?

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