LITHIUM BATTERY WORKSHOP

11-12 October 2016

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6TH LITHIUM BATTERY WORKSHOP

DAY 1

11 October 2016

IATA Competition Law Compliance

- Do not discuss:
  - Pricing, including fares, service charges, commissions, etc.
  - Bids on contracts or allocation of customers
  - Geographic/Product market allocations and marketing plans, including
  - Expanding or withdrawing from markets
  - Group boycotts
  - Your commercial relations with agents, airlines or other third parties
- Any discussion aimed at influencing the independent business decisions of your competitors
- You will be asked to leave the meeting, and the meeting may be terminated, if the above-mentioned discussions occur.

Remember: All discussions count, even informal ones outside the meeting room!

6TH LITHIUM BATTERY WORKSHOP

Chairman Opening Remarks

Geoff Leach

Director, DG Office UK

6TH LITHIUM BATTERY WORKSHOP

Keynote Address

Nathalie Dejace

Director General, Belgian CAA

Keynote Address
6th lithium battery workshop

Nathalie Dejace
Director General, Belgian Civil Aviation Authority

WELCOME

ONE SPEECH…

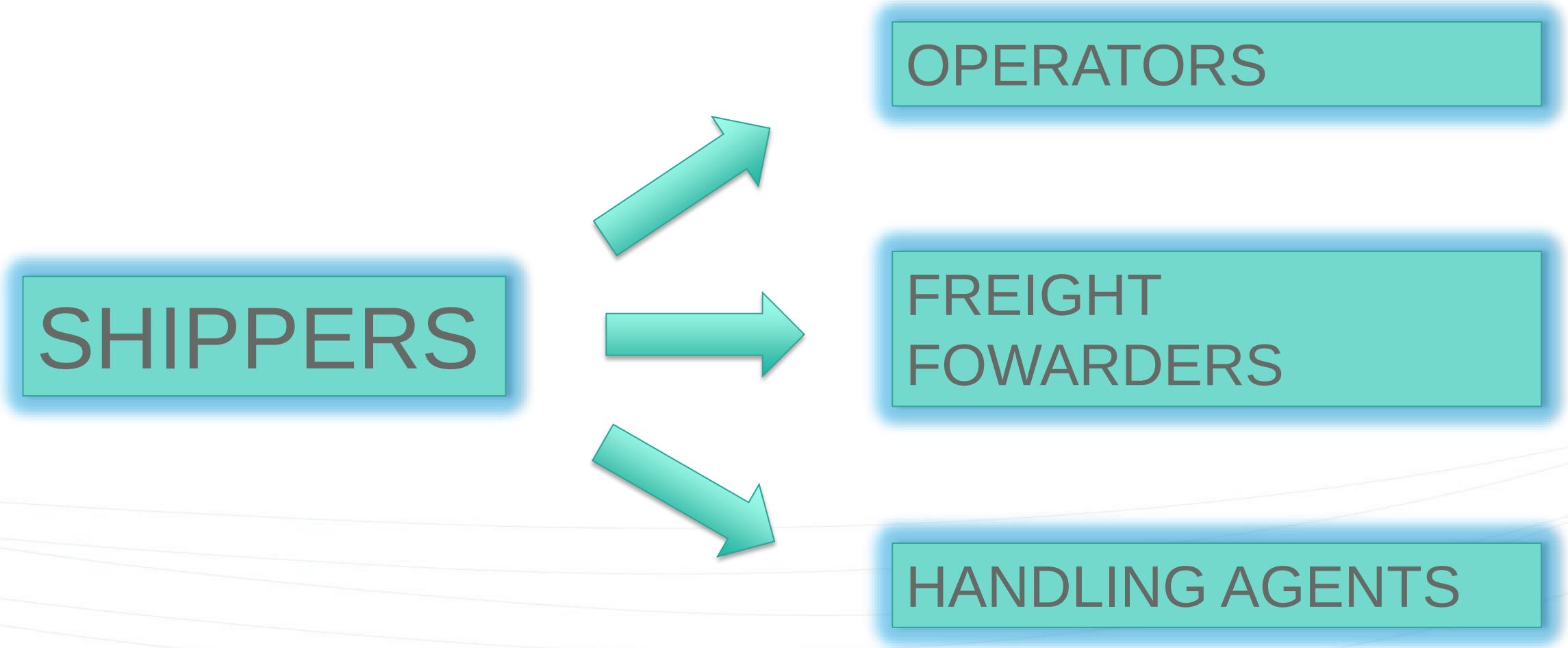
TAKING OVER THE WORLD

AIR TRANSPORT INCIDENTS

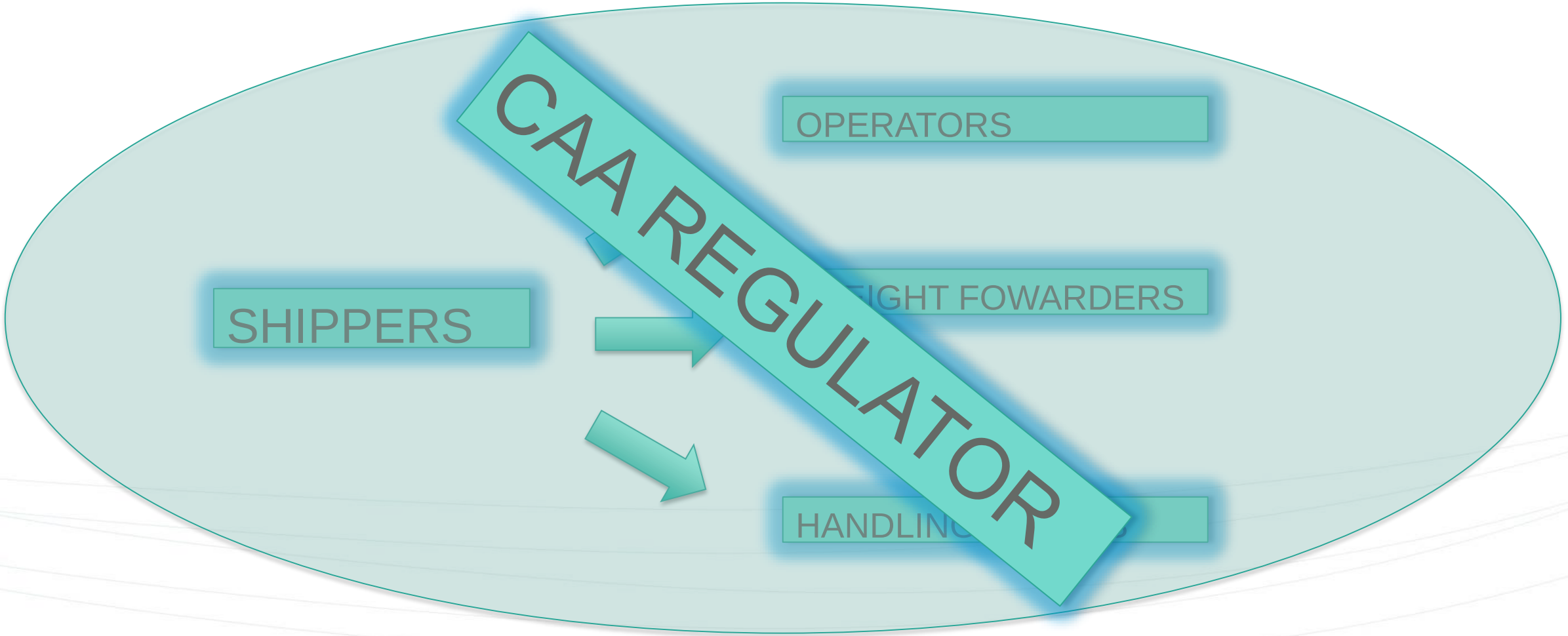
MITIGATION MEASURES

INDUSTRY  REGULATORS

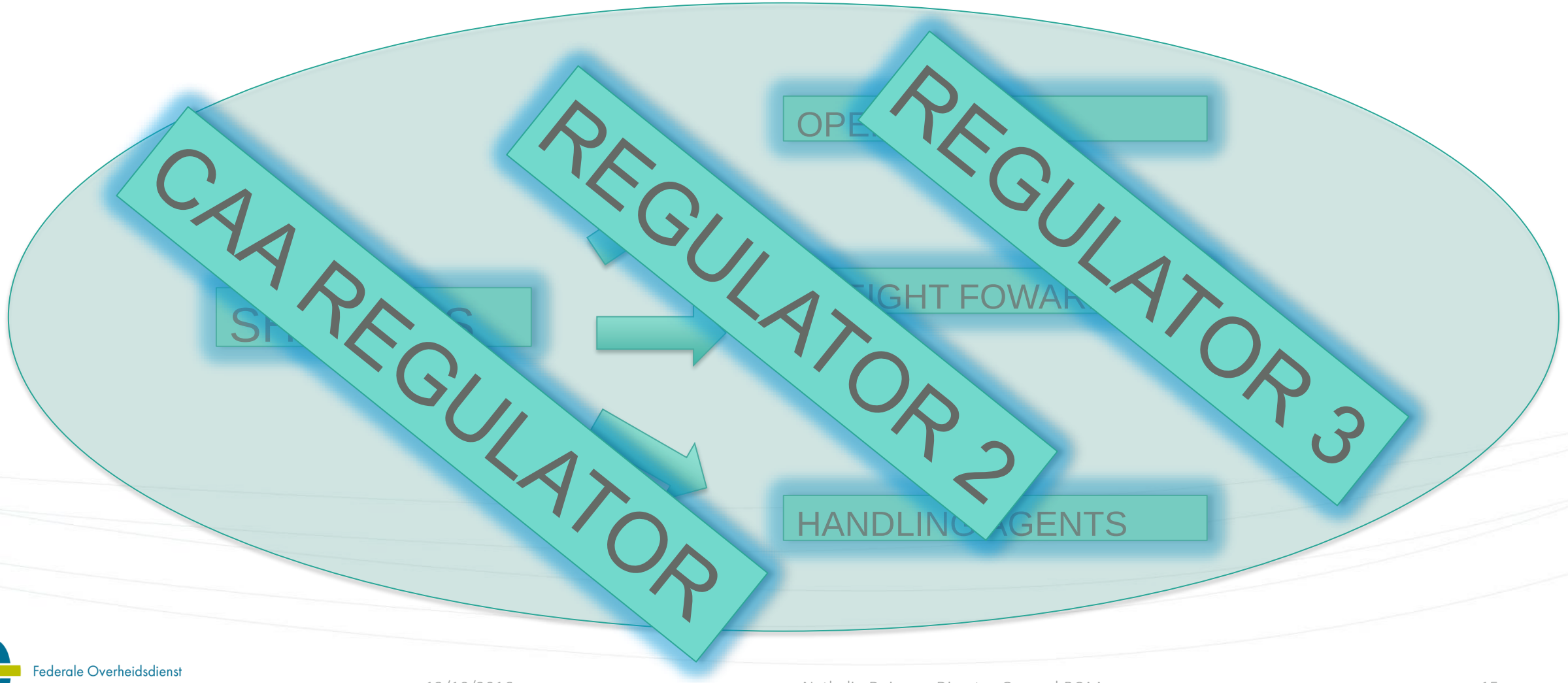
INDUSTRY



SAFETY OVERSIGHT



SAFETY OVERSIGHT

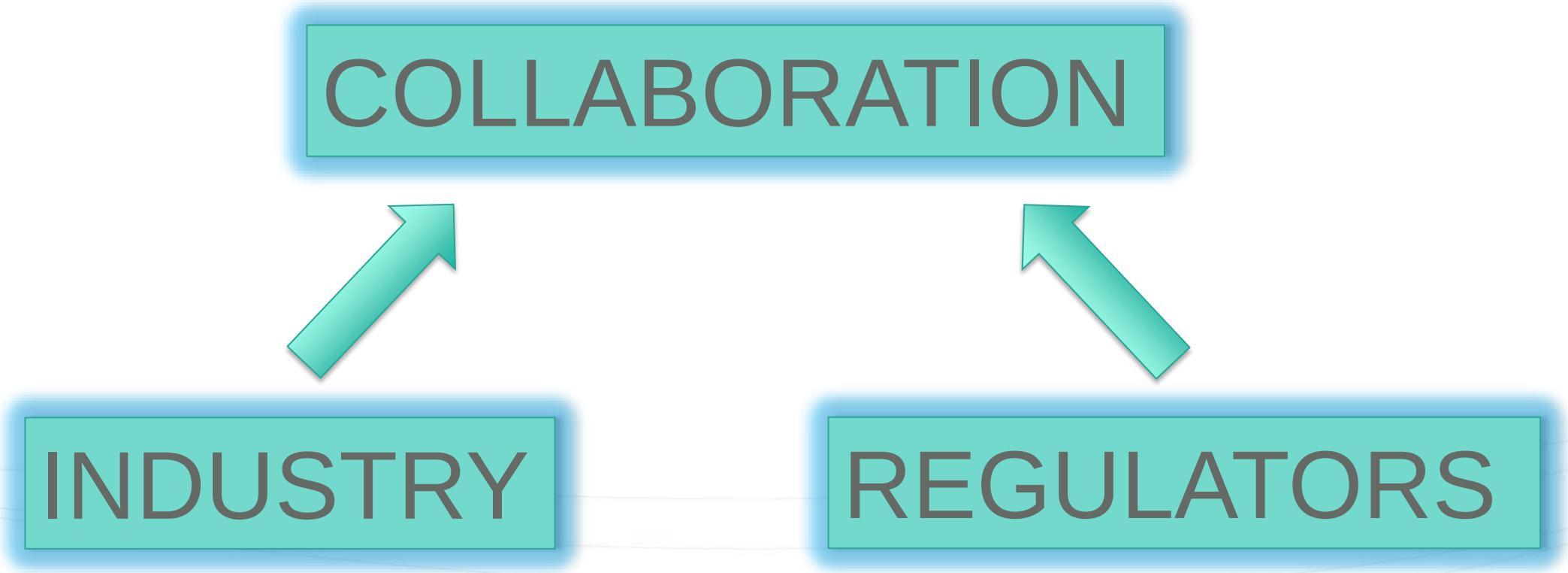


PASSENGERS

PASSENGERS

INFORMATION = PREVENTION

PERFORMANCE BASED STANDARDS



ALL ENTITIES ARE IMPORTANT

COMPLIANCE

SAFETY OVERSIGHT

SHARING INFORMATION

COLLABORATION

THANK YOU FOR YOUR ATTENTION!

6TH LITHIUM BATTERY WORKSHOP

Regulatory Update

David Brennan

Assistant Director Cargo Safety & Standards, IATA

11 - 12 October 2016 – Brussels, Belgium

2017 Regulatory Changes

6th Edition UN Manual of Tests and Criteria

- Revision to new type for shock test:
  - Small batteries (≤ 12 kg) change of mass
- Revisions to definitions
- Clarification on the applicability of tests for batteries assembled from tested batteries
- T.4 Shock test revised to address large batteries
- T.5 External short circuit test
- T.7 Overcharge test

Adequate Instruction

- Recommendations added to DGR 1.6
  - Which type(s) of battery(ies) / configuration;
  - Documented procedures / work instructions;
  - Review and understanding;
  - Records of when / who;
  - Periodic refresher;
  - Consideration for reverse logistics.

List of Dangerous Goods

- Lithium battery Class 9 hazard label (Section I/IA/IB)
  - List of Dangerous Goods shows “Miscellaneous lithium battery” in hazard label column
  - Special Provision A206 – transition period for “standard” Class 9 hazard label until 31 December 2018
  - Applies to all modes of transport

Special Provisions

- Special provision A88:
  - pre-production prototypes transported for testing; or
  - low production runs of cells or batteries (< 100 per year)
  - State of Origin approval still required
  - Packing instruction 910 added to Supplement to the Technical Instructions
  - special provision noted on Shipper’s Declaration

Special Provisions (cont.)

- Special Provision A181 – “packed with” and “contained in” in the same outer packaging revised:
  - Applicable parts of both PIs apply
  - Quantity limits for pax or CAO, as applicable
  - Declared as “packed with”
  - If both metal and ion both PSN must be shown
  - Also added into Section II.

Special Provisions (cont.)

- Special provision A331:
  - Allowance for UN 3480 to be shipped at greater than 30% SoC;
  - Approval of States of origin and of the operator;
  - Criteria for issuance of approval;
  - Must be shown on the Shipper’s Declaration when applied.

Packing Instructions

- Packing Instructions 965 to 970 – General:
  - Note clarifying that a single cell battery must be transported according to requirements for cells
  - Sections IB and II:
    - strong rigid outer packaging required
    - permitted outer packagings listed
    - need for additional accompanying document deleted
  - Section II:
    - package must be big enough to fit lithium battery mark

Packing Instructions (cont.)

- Packing Instructions 966 / 967 and 969 / 970 – General:
  - ICAO adopted text: “equipment” means the device or apparatus for which the lithium cells or batteries will provide electrical power for its operation
  - Provisionally adopted by UN for the 20th revised edition.

Packing Instructions (cont.)

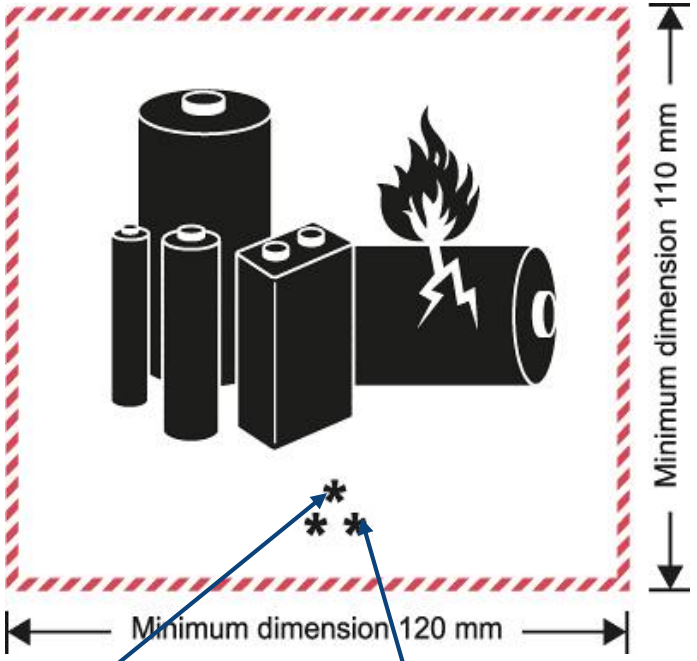
- Packing Instructions 967 and 970 – Section II. Application of lithium battery handling label. Exception for:
  - Packages where equipment contains only button cells; and
  - Consignments of ≤ 2 packages where ≤ 4 cells or ≤ 2 batteries in each package.

Marking & Labelling

- Lithium battery mark instead of label
  - must include UN number(s);
  - 120 mm x 110 mm (5 mm red hatching);
  - may be reduced to 105 mm x 74 mm if package size requires;
  - transition period for lithium battery handling label until 31 December 2018.


CAUTION!
IF DAMAGED
Lithium ion batteries
DO NOT LOAD OR TRANSPORT
PACKAGE IF DAMAGED
For more information, call xxx.xxx.xxxx
Minimum dimension 110 mm
Minimum dimension 120 mm


CAUTION!
IF DAMAGED
*
DO NOT LOAD OR TRANSPORT
PACKAGE IF DAMAGED
For more information, call xxx.xxx.xxxx
Minimum dimension 110 mm
Minimum dimension 120 mm


Minimum dimension 110 mm
Minimum dimension 120 mm
UN Number
Phone number

UN3171 Battery Powered Vehicle

- Special provision A21:
  - Additional examples:
    - trucks, locomotives, self-balancing vehicles, self-propelled farming/construction equipment




UN3171 Battery Powered Vehicle

- Packing Instruction 952
  - if vehicle could be handled other than in upright position:
    - Strong outer packaging required
    - Vehicle must be secured in packaging
  - batteries detached from vehicle must be classified separately as batteries on their own or packed with equipment



Q & A


Who
What
Where
How
Which
Why
FAQ
Exploration
Concepts
Problems
Inspiration
Uncertainty
Service
Ideas
Question
Hello

6TH LITHIUM BATTERY WORKSHOP

Networking Break

10:30 – 11:00

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6th LITHIUM BATTERY WORKSHOP

State of Charge - How and What?

Moderator:

Kristel Vermeersch, Managing Director, KVS & Partners

Panelists:

Kevin O'Leary, DGSA – Global Logistics, EMC Information Systems International

Colin Thirlaway, Director Global Compliance, Stanley Black & Decker Corp.

11 - 12 October 2016 – Brussels, Belgium

Background

- October 2015: The ICAO Dangerous Goods Panel agreed that lithium ion cells and batteries must be offered for transport at a State of Charge (SoC) not exceeding 30% of their rated capacity (*)

- Reason: test results did demonstrate that propagation of thermal runaway could be greatly reduced or eliminated at that level.

- Applicable to: Lithium ion cells and batteries shipped in accordance with Sections IA, IB and II of Packing Instructions 965

- Effective: Since 1 April 2016

(*) Cells and batteries may be shipped at a SoC greater than 30% with the approval of the State of Origin and the State of the Operator

Six Months later…

- How do shippers comply with the requirements ?
- Problems encountered !
- Solutions !
- Amendments / changes required ?
- Proposals ?

Dell EMC 30% State of Charge (SOC) Compliance Process

Kevin O' Leary
Dangerous Goods Safety Advisor

October 11, 2016

DELL EMC

Who is Dell EMC?

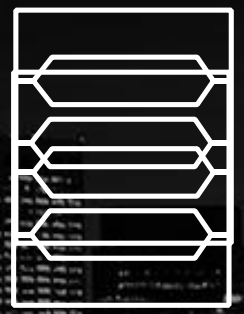
Dell EMC, a part of Dell Technologies, enables organizations to modernize, automate and transform their data center using industry-leading converged infrastructure, servers, storage and data protection technologies. This provides a trusted foundation for businesses to transform IT, through the creation of a hybrid cloud, and transform their business through the creation of cloud-native applications and big data solutions.

Dell Technologies:

- $74B revenue
- Serves 98% Fortune 500
- 140,000 employees
- 30,000 full-time customer services & support employees
- 180 countries
- 17 global research and development centres
- 25 manufacturing locations
- 40+ distribution and configuraiton centers

Dell Technologies is recognized as a market leader in

#1
CI



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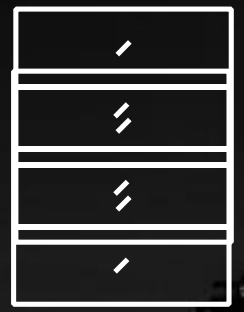
STORAGE



#1
DC AUTOMATION

#1
PCs

#1
CLOUD

#1
VIRTUALIZATION

DELL EMC

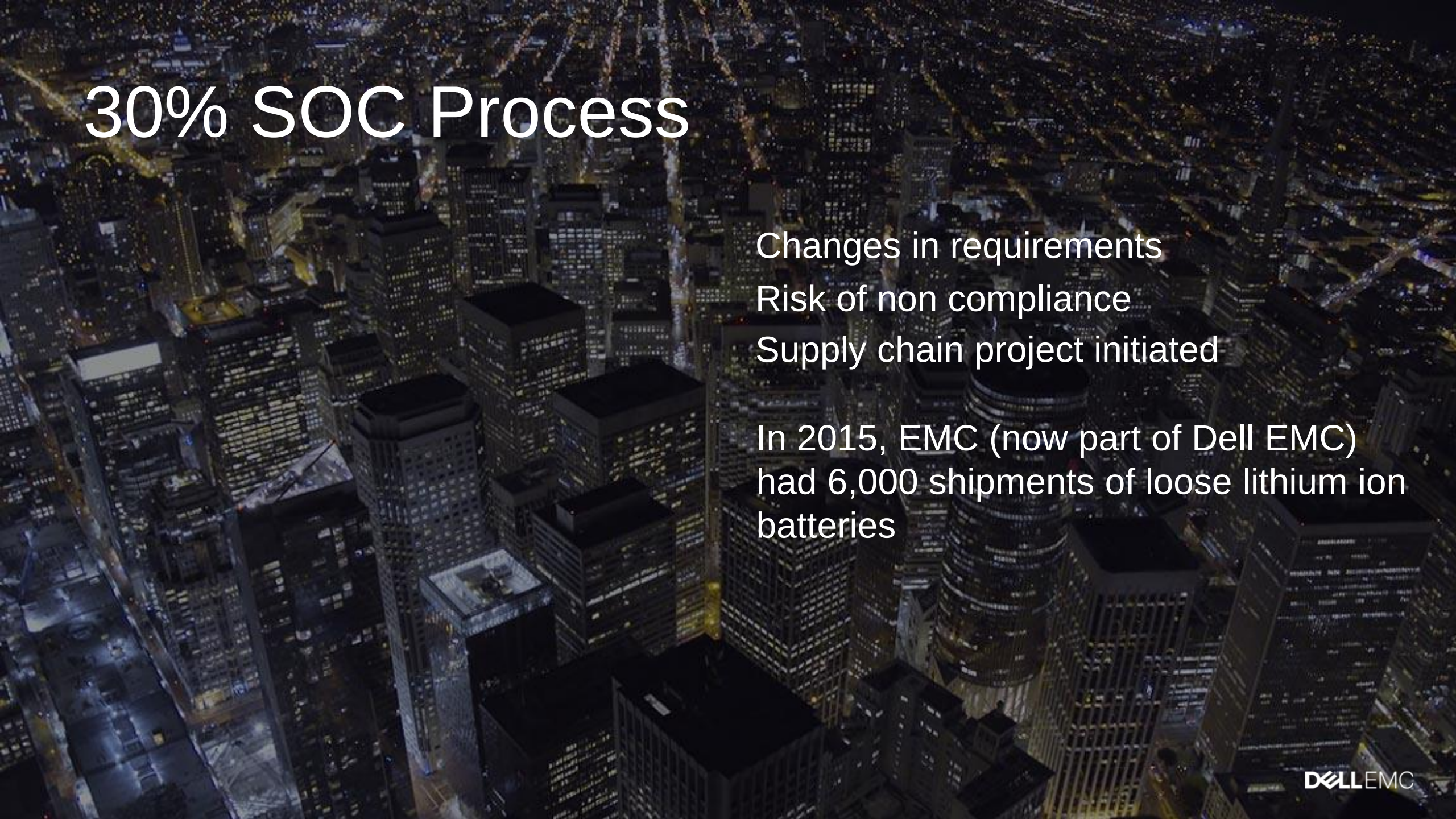
30% SOC Process

Changes in requirements

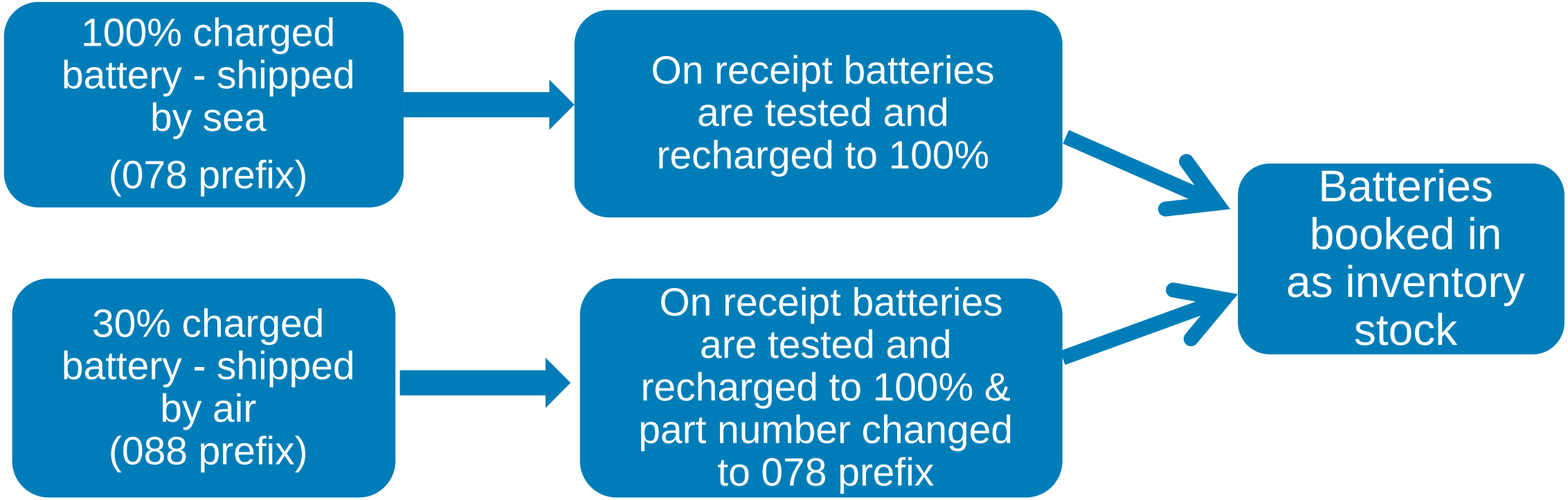
Risk of non compliance

Supply chain project initiated

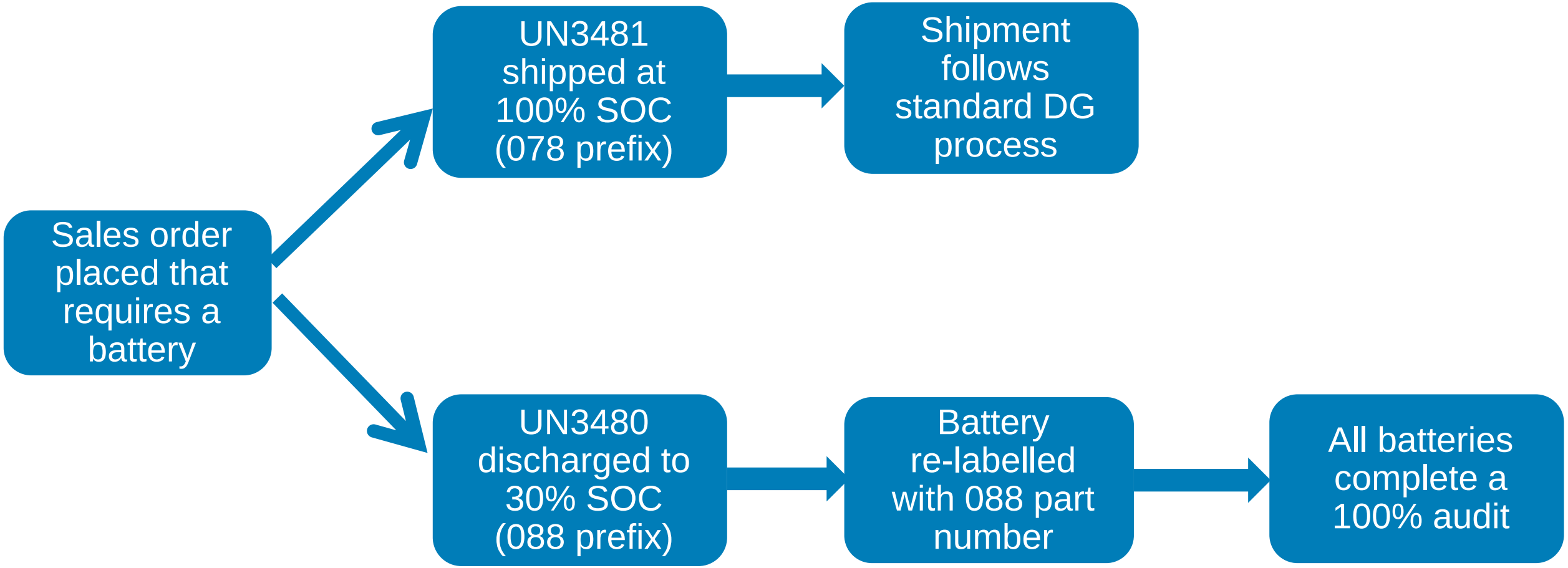
In 2015, EMC (now part of Dell EMC) had 6,000 shipments of loose lithium ion batteries



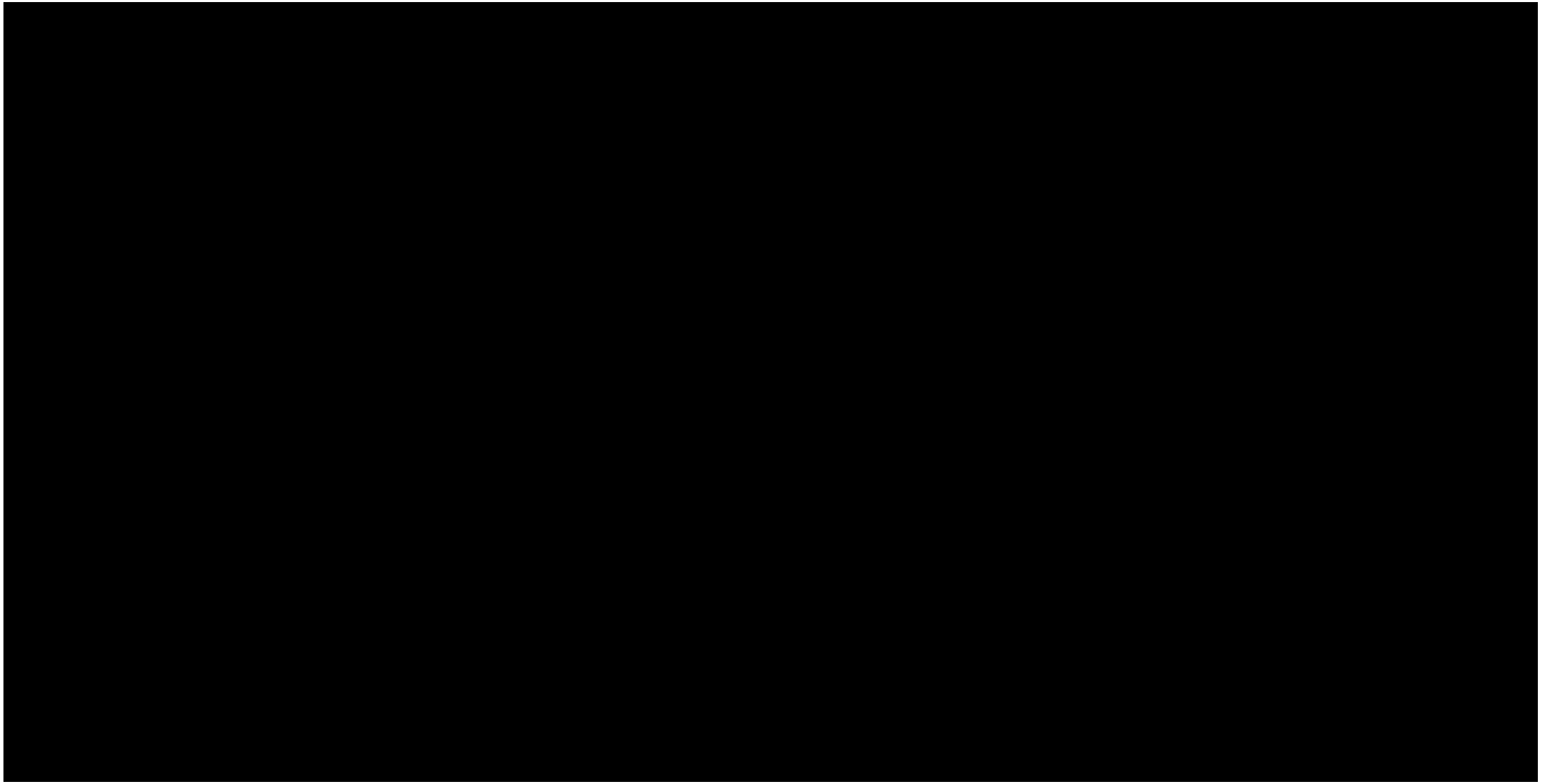
UN3480 Dual Part Number Overview – Inbound Materials



UN3480 Dual Part Number Overview – Outbound orders



UN3480 Process Overview



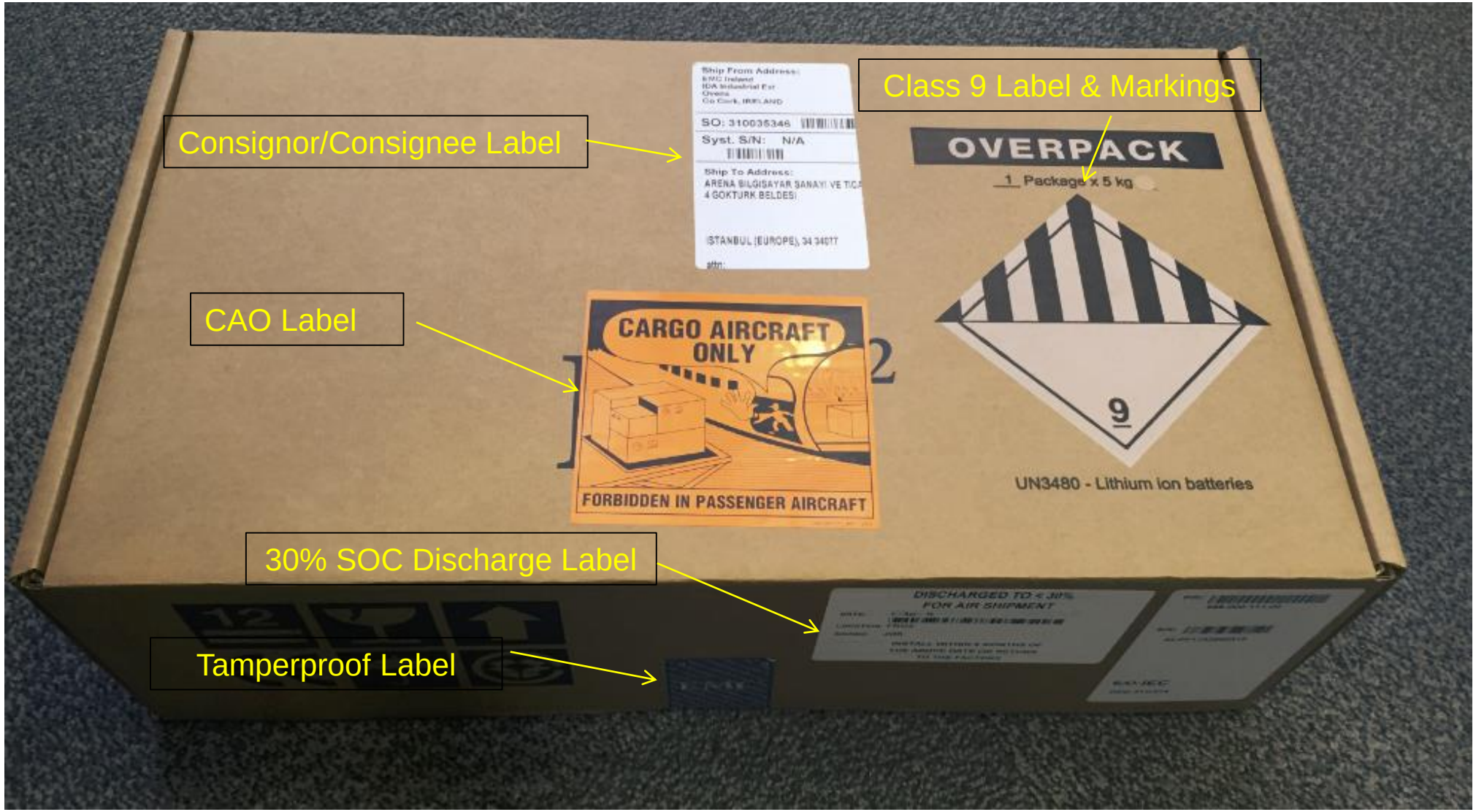
UN3480 Process Overview

All 30% SOC batteries are bagged and sealed

If the seal on the bag is broken the shipment is put on hold

Batteries are then retested and resealed, taken off hold and shipped

Packaging Overview



DG Auditing process

International - EMC's Dangerous Goods Shipping Tool

SystemModel: 088-000-111-00

EMC Part Detail

SystemModel: 088-000-111-00

SOC: 30

Possible Modals of Transport

Ground: Yes

Sea: Yes

Air: Yes

Additional Information

AWB Comment: Lithium ion batteries in compliance with PI 965 Section IA

Special Instruction: None

Documents Required: Yes

Labels

Label1	Label2	Label3	Label4	Label5
046-000-584 Class 9 UN3480 Label	Shipping Address Label	Discharge Label	046-005-157 CAO Label	

NONE

UN3480 Large battery by air

Required Shipping Documents

View/Print	EMC_Lead_Acid_Battery_Transport_Compliance	No
View/Print	300-000-017_Li Caution_Statement_UN3480_Rev	No
View/Print	300-015-393_Li_Caution_Statement_UN3481	No
View/Print	IATA_Shippers_Declaration_for_Dangerous_Goods	Yes
View/Print	Mag_Statement	No

DELL EMC

Traceability

All test discharge events are logged in by unique battery serial numbers

The test file history logs who and when the battery was discharged to 30% SOC

Home

Serial Number Inquiry

Site: CORK

Building: MANUFACTURING

Area:

Tla SN:

OR

Enter Serial, Tester Name or SO number#: ACPF1161900017 Submit

Test History Inquiry: ACPF1161900017

Site	Tester	Tester Function	Product Family	Run ID	Session ID	Sequence File	Start Date	End Date	Test Status	Restart Count	First Step	Step Name	Step #	Step Start Time	Step End Ti
Cork, Ireland	EMIARGEN001	Enclosure	Argonaut	8361614	10365151	LiSps.xml	8/8/2016 7:20:56 PM	8/8/2016 11:29:10 PM	Error	0	1	LiSPSLogin			
Cork, Ireland	EMIARGEN001	Enclosure	Argonaut	8361614	10365151	LiSps.xml	8/9/2016 12:07:21 PM	8/9/2016 12:07:23 PM	Error	1	9	DischargeToThirty			
Cork, Ireland	EMIARGEN001	Enclosure	Argonaut	8361614	10365151	LiSps.xml	8/9/2016 12:09:41 PM	8/9/2016 12:28:44 PM	Finished	2	9	DischargeToThirty			

Traceability

The log file can be extracted to get the details of the battery successful conversion to under 30%

LOG FILE EXTRACT:

8/9/2016 12:22:04 PM - Disabling SPS -> Target Discharging Seconds: 475

8/9/2016 12:22:04 PM - Disabling SPS -> Total Discharging Seconds: 480

8/9/2016 12:22:04 PM - Disabling SPS -> Reported Remaining Whr: 033

8/9/2016 12:22:04 PM - Disabling SPS -> Reported Percent Charged: **26%**

Message prompt

Test Completed Battery _ Charged _ Less _ Than 30%... Note : DO_NOT_POWER_BACK_ON... Apply the Battery 30% 088 PN label

Traceability

All sales orders contain the serial number for each part in SAP

We can see the serial number of the 078 battery (ACPF1161900017) has been converted to an 088 part number

Traceability

Fru Packaging Area: *** If required sections of this sheet are not completed notify Group-leader.

1. Verify all previous steps were signed off : ID: _____ Date: _____
2. Verify all 088 P/N, properly sealed poly bag with 046-007-205 label: ID: _____ Date: _____
3. Follow Procedure GMO-M1046 Pack Li-ION battery (for Inner and Overpack box)

Confirm Labelling as per Diagram (CAO, Discharge label, Ship to/from, Part#-S/n label) ID: _____ Date: _____

Manufacturing Product Assurance/Cork Audit Group: *** If required sections of this sheet are not completed notify Group-leader.

1. Verify GMO-M1046 Air (Cargo ONLY) shipment packaging and labels followed: ID: _____ Date: _____
2. Li-ION Battery meet the UN3480 Air transport Cargo ONLY shipping requirements are valid: **MPA Signature:** _____

DELL EMC

Implementation Challenges

Development costs

- IT development
- Additional test equipment
- Additional labelling

Manufacturing costs

- Increased testing
- Increased labelling and documentation

Project scope complexity

- 120 members on the project

Supplier and 3PL education


Questions ?
kevin.oleary@dell.com
DELL EMC


GRACIAS
ASANTE
TAK
SUWUN
धन्यवाद
TAKK
hvala
Salamat
HVALA
mersi
شكرا جزيلا
Ευχαριστώ
감사합니다
kiitos
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Рахмет
Thank You
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ARIGATO
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TAKK
ありがとう
DANKE
Благодарам
TAKK
ASANTE
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多謝
gra2ie
SALAMAT

SBD 30% SoC - Issues

- Working with our suppliers to ensure cells / packs were coming through at 30% SoC.
- Four month time window from April 1st 2016 to flush through
- Implementation of testing procedures to ensure batteries were at 30% SoC.
  - Every tester we have that tests voltage had to be updated
  - Every supplier specification had to be changed for our suppliers and our own documentation.
- Perceived reduced battery performance issues due to shipping at 30% SoC
  - Reduced shelf life etc.
  - Too early to tell
- Communicating changes effectively inside our organization and outside to customers.
- Managing inventory on products with less continuous demand
- Limited time to react

6TH LITHIUM BATTERY WORKSHOP

Networking Lunch

Nouveau Taste Restaurant - Ground Floor

12:30 - 14:00

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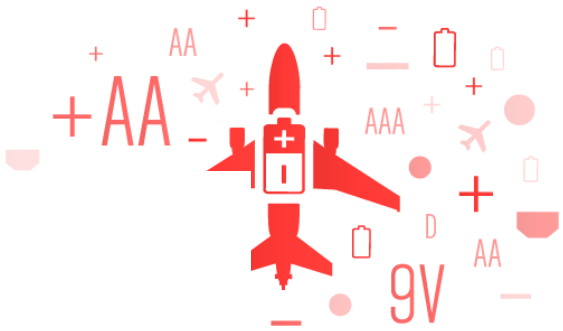
Interactive Q & A Session

Questions Answered



- The standard of the cylindrical lithium-ion cells will change in the near future. Currently the standard is the 18650, but may move to become the 21700. That will result in an increase in the Watt-hour rating.
  To address this has there been thought given to raising the 100 Wh limit for SP 188 / Section II?

- Is anybody thinking and making it obligatory to add to every shipment with batteries the SDS from the batteries, and further – to make it obligatory to have the UN test report inside the SDS, as proof that the battery is not a prototype?

- As shipper, we're pleased that the requirement for the additional document is deleted in DGR 58th, but are afraid some other optional requirement would come up. Any plans of such decisions?

- Definition of "Consignment" is always troublesome.
  PI967 Section II and PI970 Section II exclude consignments of two package or less where each package contains no more than 4 cells or 2 batteries installed from the application of the lithium battery handling label.
- Under circumstance of mass production, we need to have a standard to put LBH label for all consignments. As long as we understand, above article does not "prohibit" LBH attachment, but some airlines do this and stop our shipment.
- Any plans to clarify this? We're looking forward to have a clear guide line for this.

- Necessity of LBH label for Section IB?
  Packages of UN3480, PI965 Section IB and UN3090, PI968 Section IB requires many labels and marks. For this reason, we as a manufacturer require a larger package than needed for the ordered quantity.

- If labelling requirement is the same as IA, our logistics cost could be less. Why does a Section IB package require the additional label?

- Background colour description of lithium battery mark in DGR 58th? Report of UN Subcommittee meeting shows Black and White "OR SUITABLE CONTRASTING BACKGROUND“. The original said only "Black and White".
- As there is a need to order prints of the new mark on our product cartons, will this be included in the DGR 58th?

- Passenger provisions for “heat producing articles” give an example as diving lamps, but there is no reference to lithium batteries.

  Most diving lamps are now powered by lithium ion batteries with many exceeding 100 Wh.

  Is there any plan to change this entry or reference lithium batteries?

- What will be the regulatory changes in the next year or so?
- Will there be specific packaging requirements for UN 3480 to allow these on a passenger aircraft?
- How do you address shipping lithium batteries to a country where the airlines have an embargo?

6TH LITHIUM BATTERY WORKSHOP

Networking Break

15:30 – 16:00

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Joint Session with Air Pharma Conference on the use of Lithium Batteries in the Pharmaceutical Environment

Moderator:

David Brennan, Assistant Director, Cargo Safety and Standards, IATA

Panelists:

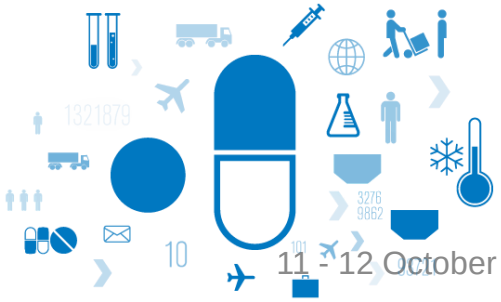
Kristel Vermeersch, Johnson & Johnson

John Masters, US Federal Aviation Administration

Martin Longobuco, DataLong16

Olivier Simonnot, Sensitech

Gerry Wheeler, IAG Cargo



IATA Lithium Battery Workshop

Use of Lithium Batteries in the Pharmaceutical Environment

Kristel Vermeersch
KVS & Partners
on behalf of Johnson & Johnson

Qfor | IATA Accredited School | Johnson & Johnson

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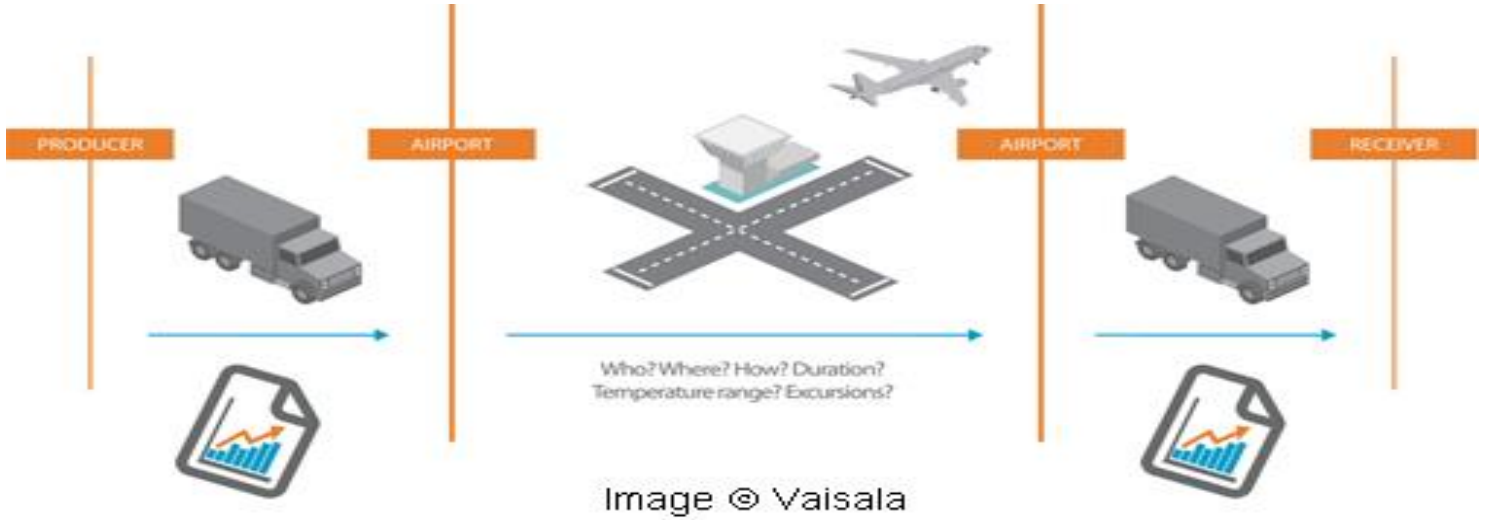
I. Supply chain of temperature sensitive pharmaceuticals

- Goal of supply chain
  - To transport from manufacturer to the consumer



- Success of supply chain
  - Ability to deliver products that can serve their ultimate purpose with end user

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I. Supply chain of temperature sensitive pharmaceuticals

- <u>Meaning in pharmaceutical supply chain</u>
  - Product must arrive unadulterated and fully intact

- Amongst other factors such as cleanliness, humidity, vibrations…

  a very important factor in the pharmaceutical supply chains: temperature control.

- The complete supply chain must happen within the “temperature profile” defined for each product (cold chain)

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II. Guidelines and Regulations

- Moving temperature-sensitive products: must be in compliance with federal and international regulations, guidelines and standards.

- Currently: no single standard, guidance or regulatory document with a final say on a compliant cold chain for a specific region.

- Growing list of legislation, documents and guidelines such as:
  - US Food and Drug Administration (FDA) guidelines
  - International Conference on Harmonisation of Technical Requirements for Registration of Pharmaceuticals for Human Use (ICH)
  - The EU Guide to Good Manufacturing Products (GHP)
  - The EU Guideline on Goods Distribution Practice (GDP) of Medicinal Products
  - The WHO Guidelines on the storage and transport of time – and temperature – sensitive pharmaceutical products.
  - Parental Drug Administration (PDA) Technical Report 39

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DANGEROUS GOODS CONSULTING

II. Guidelines and Regulations

- Several regulations but with a common requirement:

  “Continuous monitoring must be performed”

  ⇒ use of temperature, time, multi-use data loggers

  ⇒ interference with Dangerous Goods Regulations:

  may contain Lithium Batteries

KVS & PARTNERS
DANGEROUS GOODS CONSULTING

III. Dangerous Goods Topics

- The IATA DGR allows devices such as RFID tags & temperature loggers to be transported, when intentionally active.

- <u>Conditions</u>

  - Not capable of generating dangerous evolution of heat
  - Devices may not interfere with aircraft systems
    (must meet defined standards for electromagnetic radiation)
  - No emission of disturbing signals
    (such as buzzing alarms or strobe lights)

⇒ Obtain confirmation from logger manufacturers

KVS & PARTNERS
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III. Dangerous Goods Topics

- Loggers containing Lithium batteries

⇒ Obtain information that the batteries meet the requirements of each test of the UN Manual of Tests and Criteria, Part III, Subsection 38.3

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III. Dangerous Goods Topics

- Loggers containing button cell batteries

⇒ No problem: marking and documentation not required

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III. Dangerous Goods Topics

- Loggers containing other than button cell batteries

  - Regulations need to be clarified !

  - Question / Problem: can they be shipped under the same conditions as button cell batteries, or must the boxes/pallets be marked and documented in accordance with regulations if:

    – Packages/pallets contain more than 2 batteries installed in equipment (e.g. package containing 3 temperature loggers)

    – If consignment contains more than 2 packages, each containing not more than 2 batteries installed in equipment (e.g. temperature loggers)

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III. Dangerous Goods Topics

- Additional problem

- “Pharmaceutical products ready for use”, if classified as dangerous goods are subject to the regulations for the transport of dangerous goods by air !

⇒ No equivalent Special Provision as in ADR (SP 601) exists for air transport!

KVS & PARTNERS
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III. Dangerous Goods Topics

- Additional problem

  - SP 601: Pharmaceutical products (medicines) ready for use, which are substances manufactured and packaged for retail sale or distribution for personal or household consumption are not subject to the requirements of ADR

⇒ compliance with Dangerous Goods Regulations for air transport in addition to above mentioned regulations: additional implications in warehouses. More difficulties in handling and operations

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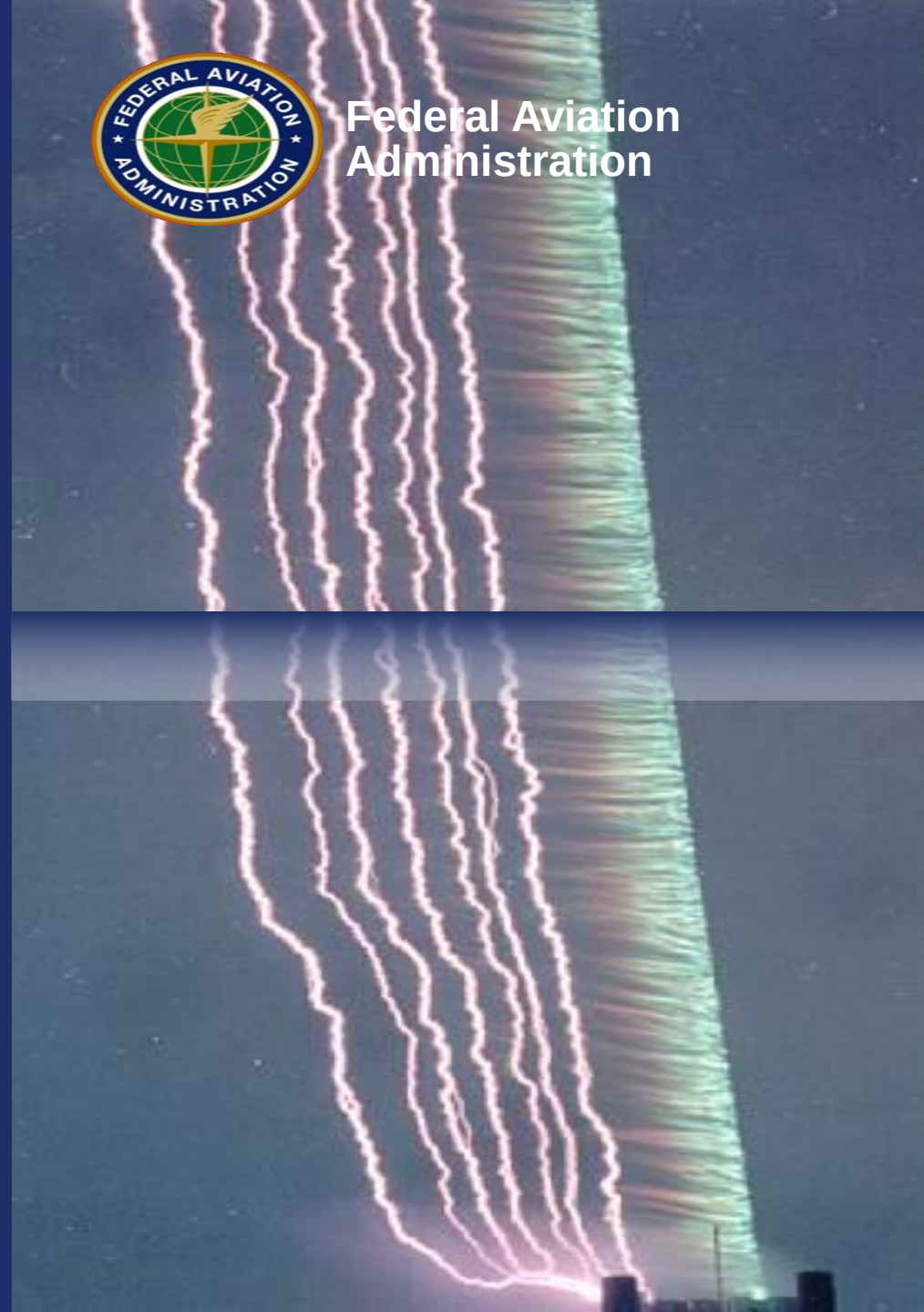
A Review of FAA's Portable Electronic Device (PED) Regulations, Policy, and Guidance

John Masters
FAA Flight Standards Coordinator for European Affairs

11 October 2016

Federal Aviation Administration



Regulations

- **Aircraft operators must comply with applicable operating regulations governing the use of PEDs.**
  - **United States Code of Federal Regulations Title 14, Parts 91, 121, 125, and 135**
- **The *aircraft operator* required to determine when PEDs can and cannot be used safely while an aircraft is being operated.**

Policy

31 October 2013 - FAA announced new policy to expand PED use.

- **Uses risk-based approach**
- **Assesses aircraft PED tolerance to intentional transmitters (back-door) and spurious (front-door) emissions**

Guidance (1 of 3)

Advisory Circular (AC) 91.21-1C, *Use of Portable Electronic Devices Aboard Aircraft*, (7 May 2015)

- **Adopts the 2013 FAA Policy**
- **Added a section for PEDs used in aircraft locations that are *inaccessible* during flight**
- **If followed, must be used in its entirety**
- ***PED manufacturers and aircraft operators* must ensure certain design and operational considerations are addressed**

Guidance (2 of 3)

- **PED meets RF radiated emissions limits**
- **PED designed with a minimum of *two independent* means to**
  - **Turn off completely,**
  - **Turn off cellular or mobile functions, or**
  - **Combination of both**

  ***when airborne*.**
- **PED *manufacturer* substantiated data includes lithium battery usage and its qualification standard**

Guidance (3 of 3)

- **PED must *not* be capable of generating a dangerous evolution of heat or emitting disturbing signals during transport**
- **The PED *battery* must be compliant with the requirements of 49 CFR parts 171–180 and meet the size exceptions**
- **FAA recommended limitations for *batteries* of devices attached to the *outside* of cargo:**
  - **0.3 grams per lithium metal cell**
  - **2.7 Watt-hours per lithium ion cell.**

EASA Regulations and Guidance

- **Regulation (EU) No 965/2012 (Air Operations), Part-CAT**
  - ***CAT.GEN.MPA.140 Portable electronic devices***
- **AMC1 CAT.GEN.MPA.140**

  Technical prerequisites for the use of PEDs, including the EMI assessment of cargo tracking devices
- **AMC2 CAT.GEN.MPA.140**

  Procedures for the use of PEDs, including for PEDs not accessible during the flight
- **GM1 CAT.GEN.MPA.140**

  Definitions
- **GM3 CAT.GEN.MPA.140**

  Guidance on cargo tracking devices evaluation

QUESTIONS?

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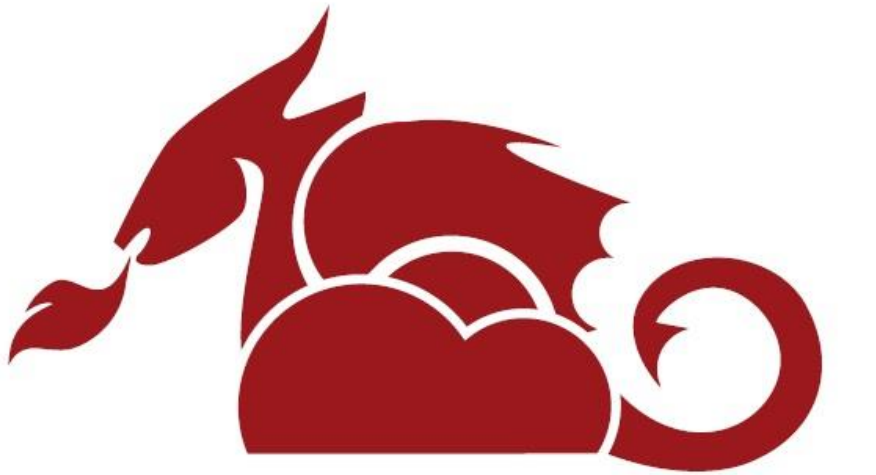

DataLong16

Martin Longobuco
CEO Datalong16

Lithium Battery Workshop

BRUSSELS, BELGIUM 11-13 OCTOBER 2016

Batteries Types Data-Loggers

	Battery Life	Power	Danger Level		
Lithium Metal	+	+	+		
Ion-Lithium *	−	+	+		
Alkaline	−	−	−		

(*) Rechargeable

Data-Loggers Types

	Energy need	Battery Life	Demand Tendency
On Line	+	- ?	+
Off Line	-	+	-

The **Future** is **On Line!!**

On Line Wan Communications

	Energy need	Battery Life	Frequencies
GSM/GPRS	+	−	Hi
Narrow Band-IoT	−	+	Low

GSM
GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS

SIGFOX
One network A billion dreams
WEIGHTLESS™
LoRa™ Alliance

3GPP™
A GLOBAL INITIATIVE

WHY NB-IoT?

BECAUSE:

- ✓ Improve life battery. Low radiation, less energy.
- ✓ Reduce size.
- ✓ Many other logistic applications:
  - Embedded tracking devices in shipments box.
  - International coverture, to track world wide shipments.
- ✓ **We can USE ALKALINES batteries or batteries with low**

THANK YOU VERY MUCH...

Use of PED’s/T-PED’s in Cargo - Airline Perspective

IAG Cargo

Use of PED's/T-PED's in Cargo - Airline Perspective

Legislation and Operator Responsibilities

- The responsibility for permitting the use of T-PED's/PED's lies solely with the operator. (As per regulations published by regulatory bodies e.g. EASA/FAA)
- The operator is responsible for the evaluation and approval of each individual PED submitted
- The requirement to complete actual live testing is time consuming and costly
- The number of PEDs available on the market makes this task near impractical for the individual airline/operator

Use of PED's/T-PED's in Cargo - Airline Perspective

- Availability of the local expertise ie. engineering to evaluate all relevant data is crucial

- The determination can be made by data certification, PED testing, risk assessments and mitigations if required

- The issuance of a "No Technical Objection" (NTO) from a regulator may support the process, but does not negate the operators responsibility to evaluate and approve the device for use

Use of PED's/T-PED's in Cargo - Airline Perspective

Types of PED Devices

- The most common types of PED's used and transported on board aircraft are music reproducers, games machines and personal computing devices.

- Intentionally active transmitting devices (T– PED) are usually in the form of mobile phones, laptops, tablets and EPOS (Electronic Point of Sale) units and the RF (Radio Frequency) transmissions (Wi-Fi, Bluetooth, GSM radios) in general are not permitted to be used while an aircraft is in operation.

Use of PED's/T-PED's in Cargo - Airline Perspective

Industry Response

- In an effort to track and monitor the state of cargo, customers are applying to have electronic devices attached to their cargo shipments. These devices are portable, battery powered and may have the capability to transmit and receive information by radio and store data locally on the device

- The industries requirements have evolved from the classical basic PED data storage device to a more technically advanced device with tracking capability and wireless data transfer ,T-PED devices

- These devices(T-PED's) are used by shippers to record/transmit environmental data during shipment and present operators with legislative and approval challenges

Use of PED's/T-PED's in Cargo-Airline Perspective

Approval Process

- For an electronic device to be considered for approval for use on board an aircraft it must have no RF transmissions either intentional or otherwise capable of interfering with any aircraft systems/equipment or failing that the RF transmitter is not active while on board the aircraft

- The devices to be approved must clearly demonstrate that they failsafe and that they can clearly identify when on board an aircraft so as to disable the RF systems

- Batteries fitted must be compliant with the relevant IATA Dangerous Goods Regulations

Use of PED's/T-PED's in Cargo - Airline Perspective

- Legislation documents from the relevant Regulatory Authorities are used to set the validation criteria

- This information would be used in conjunction with the manufacturers own test data. Further information can also be gleaned from technical documents and any regulatory authorities NTO's related to the use of these devices

Use of PED's/T-PED's in Cargo - Airline Perspective

Approval Summary

- Aircraft testing by either the manufacturer and/or the operator
- Devices must be approved by a qualified person appointed by the operator prior to acceptance and use on board an aircraft
- Internal Processes/Procedures developed by operator to allow use of approved devices on-board
- Liaise with National Authority on the approval process and procedures

Use of PED's/T-PED's in Cargo - Airline Perspective

Challenges

- Industry innovation, technology advances
- Industry engagement, Aircraft manufacturers, Device Manufacturers
- Compliance by all participants in the chain, Manufacturers, Shippers , Freight Forwarders ,Ground Handlers and Operators
- Unknown/Unapproved devices being carried at present

Use of PED's/T-PED's in Cargo - Airline Perspective

What would help improve the present situation ?

- There needs to be a consistent approval process to allow the industry to progress and the airlines to operate safely

- An approval process that brings together Aircraft manufacturers, device manufacturers and regulatory authorities to approve the devices, and then make the data available to the carriers so that they can use that as part of a decision making process and risk assessment

END

6TH LITHIUM BATTERY WORKSHOP

Chairman Closing Remarks

6TH LITHIUM BATTERY WORKSHOP

Welcome Reception

Clarity Room, 8th Floor, 18:00 – 19:30

Kindly sponsored by

SAFRAN Morpho

11 - 12 October 2016 – Brussels, Belgium

6TH LITHIUM BATTERY WORKSHOP

DAY 2

12 October 2016

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6TH LITHIUM BATTERY WORKSHOP

Chairman Recap of Day 1

Geoff Leach

Director, DG Office UK

6th LITHIUM BATTERY WORKSHOP

Risk Assessment Mitigation Strategies

Moderator:

Paul Horner, Manager, Dangerous Goods Standards, IATA

Panelists:

Phil Greetham, Airline Director of Ground Operations, DHL Air Ltd

Ed Boon, Manager Dangerous Goods & Cargo Compliance, KLM

Remko Dardenne, Dangerous Goods Coordinator, Belgian CAA

11 - 12 October 2016 – Brussels, Belgium

Cargo Fire
Risk Assessment - Mitigation Strategies

Phil Greetham - DHL AIR UK Ltd

Brussels 12th October 2016

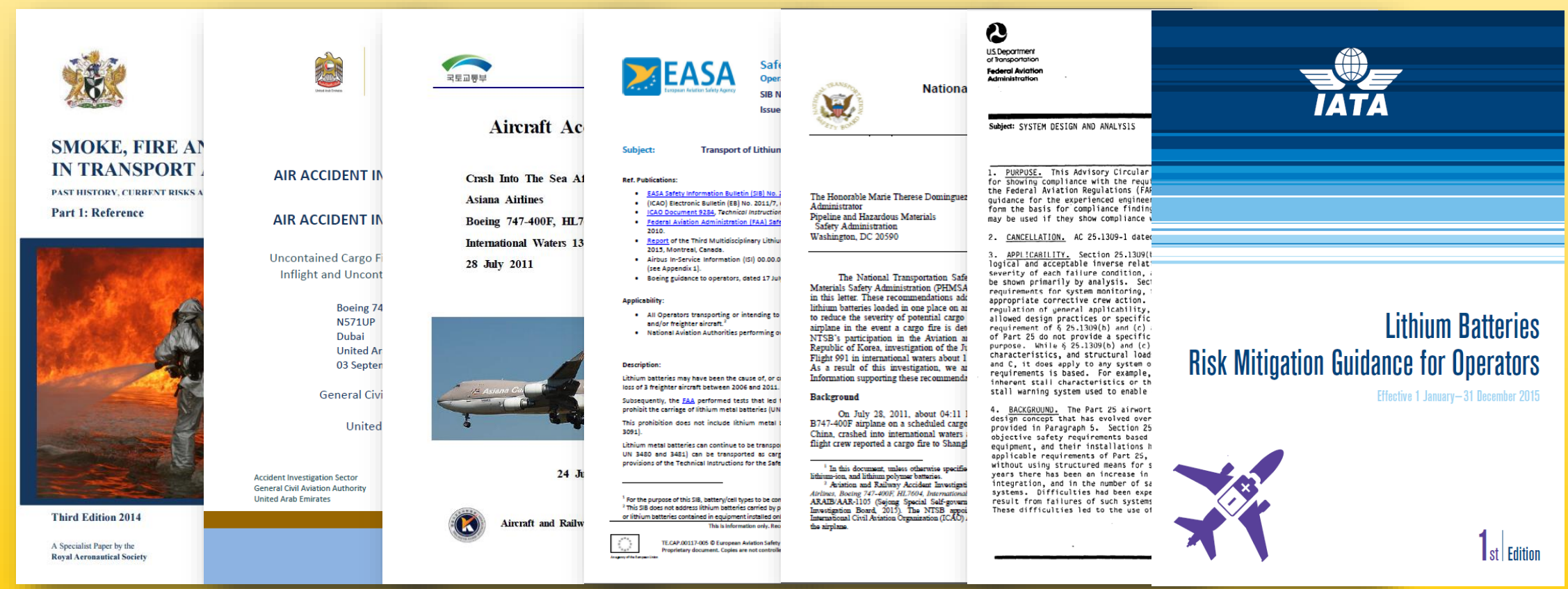
1 Million Shipments contain an Energy Storage Device

Two Fundamental Risk Assessment Questions

1. Can Regulation alone, mitigate the risk of Cargo Fire originating from ‘Energy Storage Devices’ to an acceptable level ?

2. Can ‘All-cargo’ Operators safely deal with fire events involving ‘Energy Storage Devices’ ?

Risk Advice (Regulatory & Safety Groups)



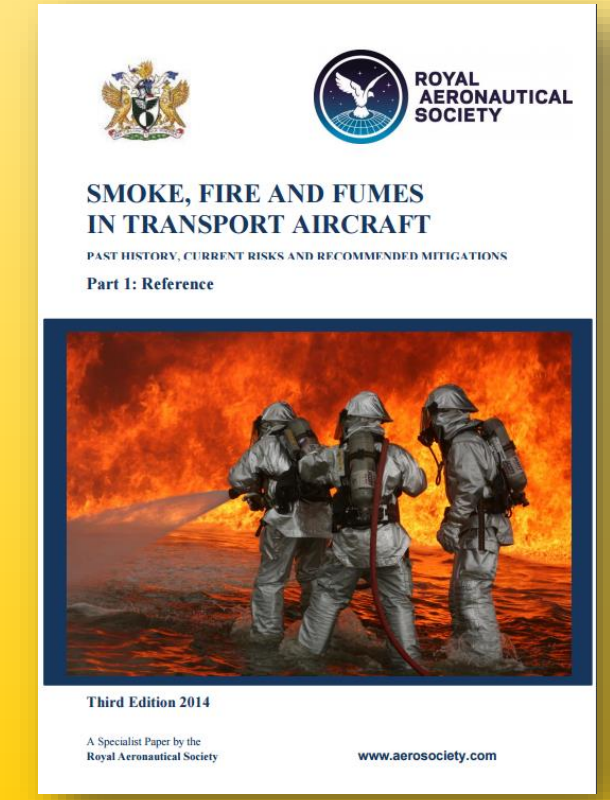
Comprehensive Risk Advice Available Today

Key Risk Advice Statements from the NTSB

- Batteries **will** continue the trend of increasing energy density
- The proliferation of portable electronic devices **will** increase the number of battery failure incidents

Key Risk Advice Statements from the Royal Aeronautical Society

- '**All** Lithium Batteries Present a Potential Fire Hazard'
- 'Aircrew have no means to determine the presence of 'Grey Market' batteries'
- 'Prevention of fire, while desirable, is not possible in all cases. Consequently, consideration of detecting and fighting fire must be included in the mitigations'

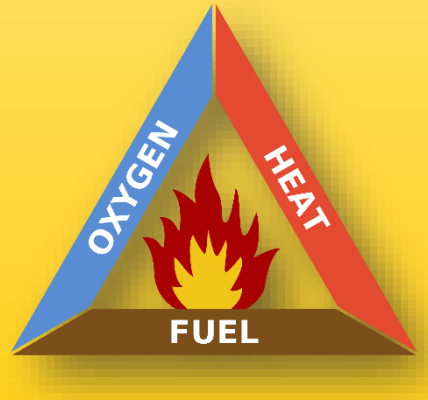


Desired Conditions of Acceptable Risk

1. Prevention of Cargo Fire Event
2. Continued Safe Flight and Landing During Cargo Fire Event

1996 'Class E' In-Flight Fire Event

2006 'Class E' In-Flight Fire Event



Where are the Potential Risks ? (All-Cargo Operator)

1. Loose & Bulk Li Battery Shipments (Known)
2. Li Batteries in / with Equipment (Known)
3. Hidden & Misdeclared Li Batteries (Known Unknowns)
4. Ability to Control Fire in Class E Cargo Compartments (?)
5. Ability to Control Fire in Class C Cargo Compartments (?)

Is There Any Evidence of an Increasing Risk ‘Probability’ ?

‘*A mature Safety Management System must be able to capture and evaluate*

Near-Miss Events’

Near-Miss Events List 2014 & 2015 (Cargo Smoke, Fire or Fumes)

	Date	Event Location	Origin	AWB	Event Description
1.	25.02.14	Hub (Sort)	HKG		Incorrectly Packed Shipped as Section II
2.	10.08.14	Hub (Sort)	HKG		Incorrectly Packed Shipped as Section II
3.	13.01.15	Hub (Sort)	HKG		Incorrectly Packed & Misdeclared Shipment
4.	07.05.15	Hub (Ramp)	HKG		Incorrectly Packed Shipped as Section II

Near-Miss Event 1

- **Feb 2014**
  Sortation Facility
  Incorrectly Packed
  Shipment of
- **e-cigarettes (UN3481)**

Near-Miss Event 2

- **Aug 2014**
  Sortation Facility
  Incorrectly Packed
  Shipment of
- **GPS Trackers (UN3481)**

Near-Miss Event 3

- **Jan 2015 Sortation Facility**
- **Misdeclared & Incorrectly Packed Shipment of**
- **‘Power Banks’ Described as ‘Toy Games’**

Near-Miss Event 4

- **May 2015**
  During Aircraft Offload
  Incorrectly Packed Shipment
  Loose Lithium Ion Batteries (UN3480)

Accepted as a Section II Shipment, the NOTOC Indicated ‘No DG’s On-board’

Progressive Mitigation – Bow Tie Diagram

Threat	Prevention	Hazard	Recovery	Consequence
Incorrectly Accepted Batteries	DG Technical Instructions	Cargo fire	Emergency Vision Assurance Systems	Possible Fatality
	Staff Training & Awareness		Full Face Oxygen Masks	
Hidden / Misdeclared Batteries	Only Approved Li Shipper Accounts		Crew Emergency Training	Possible Hull Damage
Mishandled Batteries	Improved Security Screening for Hidden Li Detection		Li Segregation From Flammables	Possible Cargo Loss
			Section II Included on the NOTOC	

Progressive Mitigation – Bow Tie Diagram Con't

Threat	Prevention	Hazard	Recovery	Consequence
Incorrectly Accepted Batteries		Cargo fire	Use of 'Class C' compartments when available	Possible Fatality
Hidden / Misdeclared Batteries			*Not yet Actioned;* FCC & FRC deployment	Possible Hull Damage
Mishandled Batteries			Definition of Bulk & Volume	Possible Cargo Loss

Pre 2006 (Philadelphia Event) Severity / Probability Matrix

Catastrophic	**5**	5 Medium	10 High	15 High	**20** **Severe**	**25** **Severe**
Major	**4**	4 Low	8 Medium	12 High	16 High	**20** **Severe**
Moderate	**3**	3 Low	6 Medium	9 Medium	12 High	15 High
Minor	**2**	2 Low	4 Low	6 Medium	8 Medium	10 High
Insignificant	**1**	1 Low	2 Low	3 Low	4 Low	5 Medium
		1 **Exceptional**	**2** **Improbable**	**3** **Remote**	**4** **Occasional**	**5** **Frequent**

‘Current’ Severity / Probability Matrix

Catastrophic	**5**	5 Medium	10 High	15 High	**20** **Severe**	**25** **Severe**
Major	**4**	4 Low	8 Medium	12 High	16 High	**20** **Severe**
Moderate	**3**	3 Low	6 Medium	9 Medium	12 High	15 High
Minor	**2**	2 Low	4 Low	6 Medium	8 Medium	10 High
Insignificant	**1**	1 Low	2 Low	3 Low	4 Low	5 Medium
		1 **Exceptional**	**2** **Improbable**	**3** **Remote**	**4** **Occasional**	**5** **Frequent**

‘Future’ ? Severity / Probability Matrix

		1 Exceptional	2 Improbable	3 Remote	4 Occasional	5 Frequent
Catastrophic	**5**	5 Medium	10 High	15 High	**20** **Severe**	**25** **Severe**
Major	**4**	4 Low	8 Medium	12 High	16 High	**20** **Severe**
Moderate	**3**	3 Low	6 Medium	9 Medium	12 High	15 High
Minor	**2**	2 Low	4 Low	6 Medium	8 Medium	10 High
Insignificant	**1**	1 Low	2 Low	3 Low	4 Low	5 Medium

Progressive Mitigation – FCC's & FRC's

'Passive' Fire Suppression will Become Fundamental to Effective Mitigation

Final Thought - Smart luggage that can charge PED’s !!!


THANK YOU

MITIGATION STRATEGIES BY THE REGULATOR

Remko Dardenne
BCAA Dangerous Goods Coordinator

INTRODUCTION

- 5 main airports
- 11 AOC holders
- 5 DG-approved operators
- 2 freight forwarders
- 1 designated postal operator

OUTLINE

- Introduction
- Operators and handling activities
- Shippers
- Designated postal operator
- Passengers and electronic devices

OUTLINE

- Introduction
- Operators and handling activities
- Shippers
- Designated postal operator
- Passengers and electronic devices

OPERATORS AND HANDLING ACTIVITIES

- Communication
  - Regulator – operator
  - Operator – handling agents

- Emphasize regulatory requirements during inspections:
  - Carry-on baggage removed from gate and put in hold
  - E-cigarette policy
  - Portable Electronic Devices used by the operator

- Safety risk assessment before transporting lithium batteries as cargo
  - IATA guidance document for operator
  - ICAO guidance for States?

OPERATORS AND HANDLING ACTIVITIES

- Dangerous Goods must be integrated in the Safety Management System
- Reporting (information, amount, frequency)
- Evaluation (objective criteria, evidences, common sense)
- Developed mitigating measures
  - Acceptable level of risk?
  - (Cost) - Effectiveness?

OUTLINE

- Introduction
- Operators and handling activities
- Shippers
- Designated postal operator
- Passengers and electronic devices

SHIPPERS

- First entity in transport chain
  - Mistakes propagate
  - How to identify non-compliance?
- Biggest risk
  - Undeclared (hidden) and misdeclared lithium batteries
  - Counterfeit lithium batteries
- Difficult to perform risk assessment by operator
- Regulator responsible for oversight!

SHIPPERS

- Proactive mitigation strategy
  - Provide information
  - Map shippers
  - Evaluate group
  - Organize audits
  - Approved shipper system?

- Reactive mitigation strategy
  - Evaluate information received (screening / incidents)
    - Size of company, kind of shipments, amount of shipments
    - Activities, commercial or non-commercial
    - Intentional or unintentional

OUTLINE

- Introduction
- Operators and handling activities
- Shippers
- Designated postal operator
- Passengers and electronic devices

DESIGNATED POSTAL OPERATOR

- Approved to transport lithium batteries in equipment
  - Approved training program
  - Procedures to prevent dangerous goods being introduced into air mail

- Regulator role
  - Introduction
  - Provide information
  - Give advice
  - Support initiatives


bpost

Lithium cells
batteries

Definition

What is the difference between a lithium cell and a lithium battery?

A lithium cell is a single encased electrochemical unit consisting of one positive and one negative electrode that exhibits a voltage differential across the two terminals.

A lithium battery is one or more cells electrically connected. A single cell battery is considered to be a cell and not a battery.

Acceptable

Can be accepted by bpost under certain **conditions** only

1. Always installed (contained) in equipment
2. Conditions about cells and batteries (watt-hour rating does not exceed the specified value, maximum of four lithium cells or two lithium batteries installed in equipment, non-damaged cells, …)
3. Conditions about installing and packaging: Lithium batteries shall be adequately packed to prevent accidental activation leading to heat, fire or short circuits during transport
4. Conditions specified by destination countries: some destination countries might not accept equipment containing lithium batteries sent by the post

Lithium batteries packed alone or those packed with equipment are not acceptable in international mail! For details: see Dangerous Goods Guide.

In practice

THE FOLLOWING EQUIPMENT IS IN GENERAL ACCEPTABLE

- Video camera
- Walkie talkies
- GPS
- Radio controlled toys
- Digital camera
- Scanner
- Mobile phone/MP3 player
- Bluetooth headset
- Smart phone
- Laptop computer
- Shaver
- Power drill
- Measuring equipment
- Tablet computer
- Portable DVD player
- Measuring equipment

(*) This is a representative listing of common electronic equipment containing 4 or less lithium cells or 2 or less lithium batteries therefore complying with postal requirements. Acceptance for lodgment as post is not exclusive to these items.


produits dangereux

contrôle plus strict des paquets internationaux

L'envoi de produits dangereux par la poste a toujours été interdit. Depuis le 1er avril, le contrôle de l'envoi de ces produits sous forme de paquet à l'étranger est également devenu plus strict. La raison : la sécurité. texto en a parlé avec Remko Dardenne, le responsable national du transport de biens dangereux par voie aérienne du Service public fédéral Mobilité et Transports.

Quelles sont les règles pour l'expédition internationale de courrier ?

Remko : "Il s'agit essentiellement de l'expédition de produits dangereux par voie aérienne. Une réglementation internationale existe depuis longtemps dans ce domaine. Chaque pays doit également veiller à faire respecter cette réglementation. Ce qui est nouveau, c'est qu'il existe aussi maintenant des consignes spécifiques concernant l'expédition de piles ou de batteries au lithium. En résumé, cela revient à dire que les piles ou batteries au lithium ne peuvent pas être envoyées, sauf si elles se trouvent dans un appareil."

Quels autres produits sont considérés comme dangereux ?

Remko : "Les choses évidentes telles que les feux d'artifice, les armes ou les produits chimiques. Mais le parfum, la peinture, les boissons alcoolisées et les briquets sont aussi interdits. Nous profitons de l'occasion pour encore une fois souligner ce point."

Ces produits sont-ils si dangereux ?

Remko : "C'est surtout la combinaison de produits qui peut être dangereuse. Les changements de température, les vibrations ou les changements de pression durant le transport en avion peuvent faire couler ou s'échapper certains produits. En combinaison avec d'autres produits, cela peut provoquer des réactions qui mettraient en péril la sécurité."

Quel est le rôle des collaborateurs de bpost pour garantir la sécurité ?

Remko : "Chaque collaborateur qui réceptionne des paquets, doit avoir le réflexe de poser quelques questions à l'expéditeur concernant le contenu du paquet. Bien que des contrôles soient encore opérés par la suite pour éviter la présence de produits dangereux dans un avion, il reste important de les bloquer à la source !"

"En posant les bonnes questions, les collaborateurs de bpost évitent que des produits dangereux ne se retrouvent dans un avion."

Remko Dardenne

Plus d'infos ?
Consultez l'intranet : http://oss-pr.natpost/fr/Pages/dangerousgoods.aspx

DESIGNATED POSTAL OPERATOR

- Difficulties
  - New logistic process
  - Postal offices and “postal points”
  - Screening
  - Reporting (monthly listing)
  - Organising oversight

- Opportunities
  - Interceptance of dangerous goods in air mail
  - Screening developments

OUTLINE

- Introduction
- Operators and handling activities
- Shippers
- Designated postal operator
- Passengers and electronic devices

PASSENGERS AND ELECTRONIC DEVICES

- Passenger awareness
  - Operators – airports – regulators
  - Reporting of items intercepted
- Mobility aids
  - Differences in interpretation
- Personal Transportation Devices
  - Operator variations causing confusion
  - Common approach at airport

PASSENGERS AND ELECTRONIC DEVICES

- Power banks
  - Considered as spare batteries
  - Carried in carry-on baggage

- Portable electronic devices
  - Recommendation to put in carry-on baggage
  - Malfunctioning – recalled device
  - Drones

CONCLUSION

- All entities involved in lithium battery transport have responsibilities
- Regulatory safety oversight of the complete transport chain
- Regulators need information to act proactive and to react
- Evaluation of information through risk assessment
- Enforcement… but first collaboration!

THE END

THANK YOU FOR YOUR ATTENTION!

6TH LITHIUM BATTERY WORKSHOP

Networking Break

10:30 – 11:00

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6th LITHIUM BATTERY WORKSHOP

What Part do FRC / FCC Play in Risk Mitigation?

Moderator:

Alexandra Jimenez,

Manager Cargo Standards, IATA

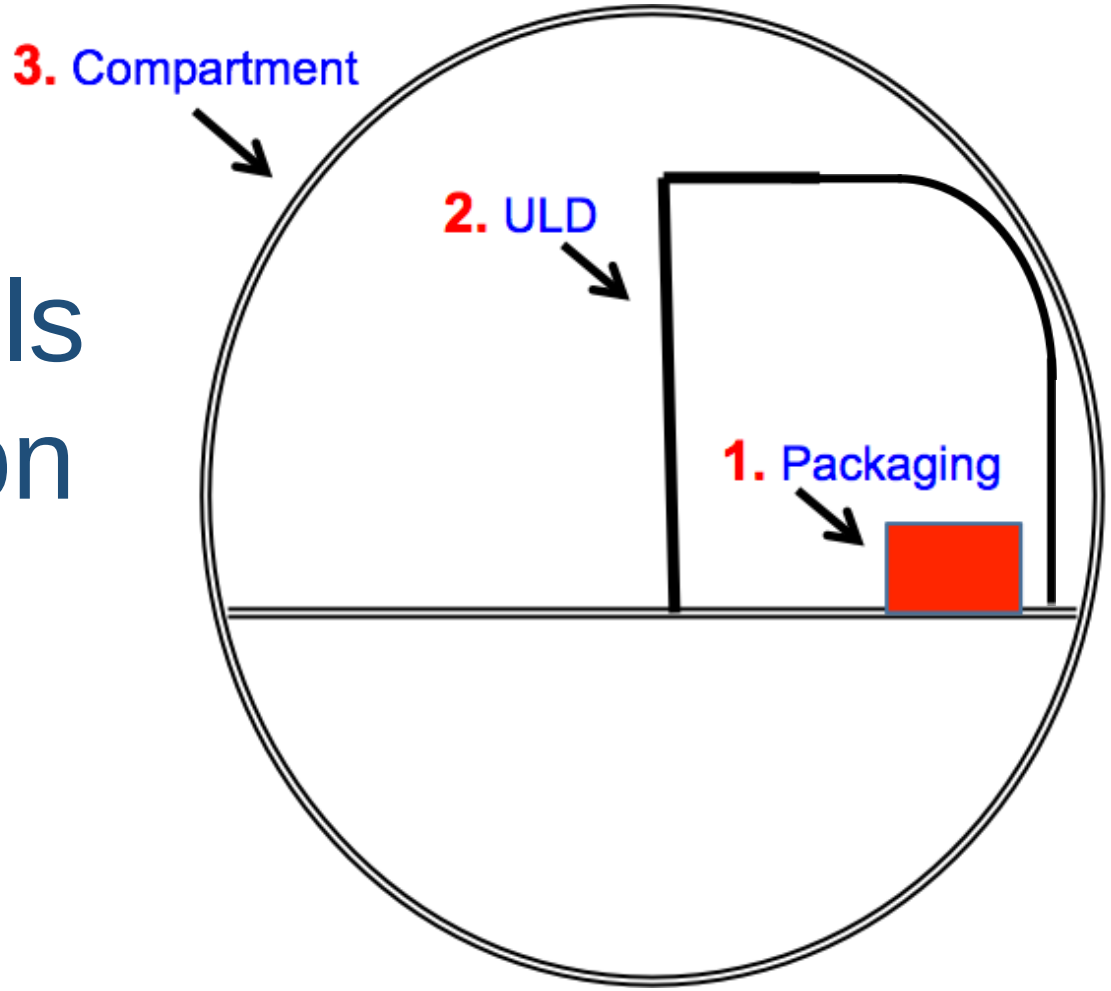
Panelists:

Phil Greetham, Airline Director of Ground Operations, DHL Air Ltd

Alex McCulloch, International Dangerous Goods Manager, UPS

Andy Davies, Engineering Director, Global, AmsafeBridport

Three Levels of Protection

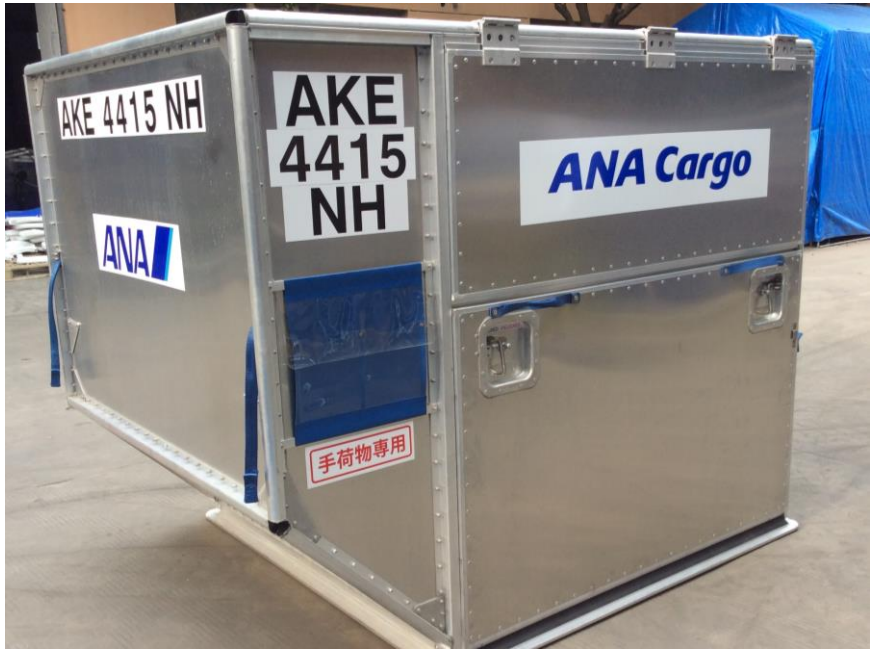


Recovery Strategies:

Threat → Risk Mitigation consideration

Implementation challenges vr opportunities

Current conventional ULD design



FRC – Fire Resistant Containers

FCC - Fire Containment Covers

International standards:

- 2008 initiation
- 2013 for **ISO 14186** on FCCs;
- 2015 for **ISO 19281** on FRCs;
- 2013 **SAE AS 6453** for Fire Containment Covers;
- In progress **SAE AS 6278** for Fire Resistant Containers.

6TH LITHIUM BATTERY WORKSHOP

Outreach and Engagement

11 - 12 October 2016 – Brussels, Belgium

An open discussion on how the industry can better address non-compliance through better outreach with e-commerce buyers and sellers and others in the supply chain.

Objective:

Find key initiatives to be deployed over the next 2 years. Identify the potential stakeholder driving the initiatives.

What is the 1st thing you do when you are sitting on the plane?

Why the seat-belt?

https://www.youtube.com/watch?v=ji65WI5QLZI

Nudge – Seat-belt sign on / Safety Video / Final check by flight crew

Individual Responsibility - fasten your seatbelt

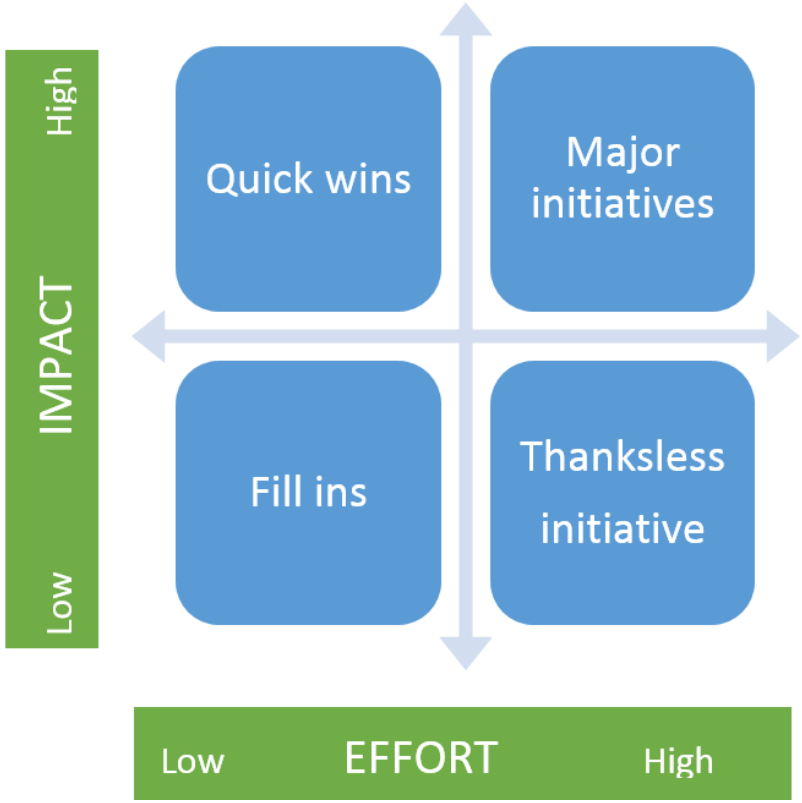
What can we do to get to this point?

- Manufacturers
- Sellers
- Retailer, e-tailer
- Postal operators
- Freight forwarders

- Traditional customers
- e-commerce customers (buyers)
- Airlines/operators
- Ground handlers
- Regulators

5 min

20 min



15 min

#1

- Summary Table

Target	Key initiative	Initiative details	Priority	Stakeholder driver

6TH LITHIUM BATTERY WORKSHOP

Networking Lunch

Nouveau Taste Restaurant - Ground Floor

12:30 - 14:00

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6TH LITHIUM BATTERY WORKSHOP

Update on the Development of Performance-Based Standard

Claude Chanson
General Manager, Recharge Batteries and Co-Chairman,
SAE G27 Committee

11 - 12 October 2016 – Brussels, Belgium

The Advanced Rechargeable & Lithium Batteries Association

SAE G-27 Lithium Battery Packaging Standard

IATA Workshop– Brussels

Claude Chanson

Content

1. Why a standard for Lithium Batteries ?
2. What are the hazards to keep under control ?
3. Why a packaging standard ?
4. What should the standard contain ?
5. The standard practical implementation issues
6. The performance criteria and assessment issues
7. Application of the standard

1. Why a standard for Lithium Batteries ?

1. The root cause of the issue:
   - Lithium batteries specific safety characteristic: potential for reaction and self ignition risk.
   - According the battery and packaging design, risk of reaction propagation.

2. Usual fire control means in the airplane (i.e. halon gas extinguisher) have been shown inefficient in some cases.

3. Li Batteries are one among other Dangerous Goods transported by air, but quantities are much higher.

1. Why a standard for Lithium Batteries ?

- Some fire incidents identified where Li batteries are involved, and may be the root cause.
- Perception of an increasing risk linked to the increase in quantities transported by air.
- Identification of non compliant products (UN qualification tests of the batteries and packaging conditions) or undeclared products.

→ Required specific action for the Lithium batteries

2. What are the hazards to keep under control ?

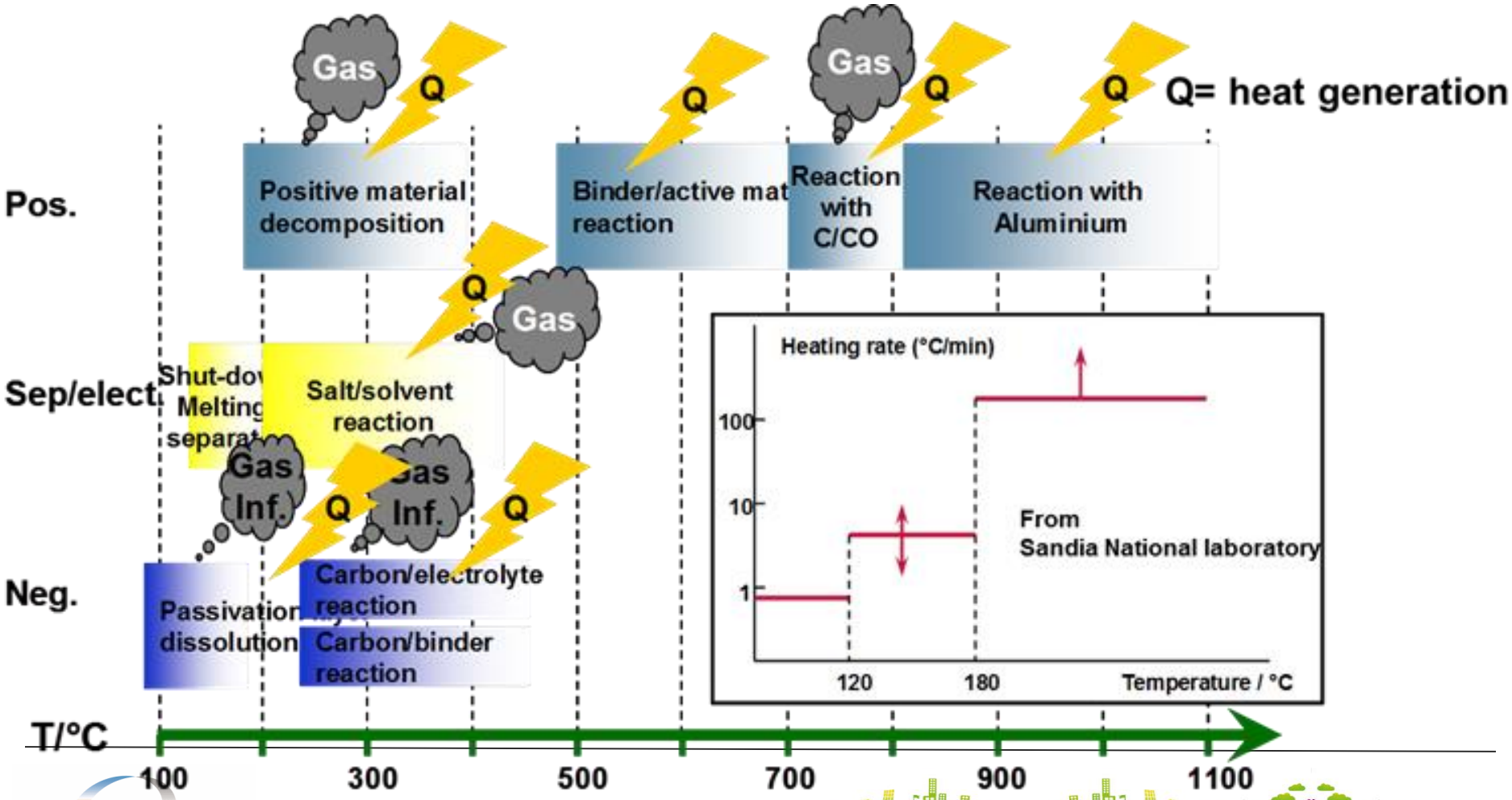
Potential hazards of Lithium batteries

- ✓ **The potential hazards of batteries**
  - The Chemical hazard
  - The Electrical hazard (and the case of high voltage)
  - Cumulative Electrical and Chemical hazards : can lead to thermal run-away

- ✓ **The three major possible consequences in case of thermal runaway:**
  - Flammable/toxic gas emission (possibly bursting)
  - Flame ignition, and possible flame propagation in the cells or batteries casing and packaging.
  - Heat emission and Thermal Runaway Propagation (TRAP) from cell to cell or battery to battery, in absence of flames.

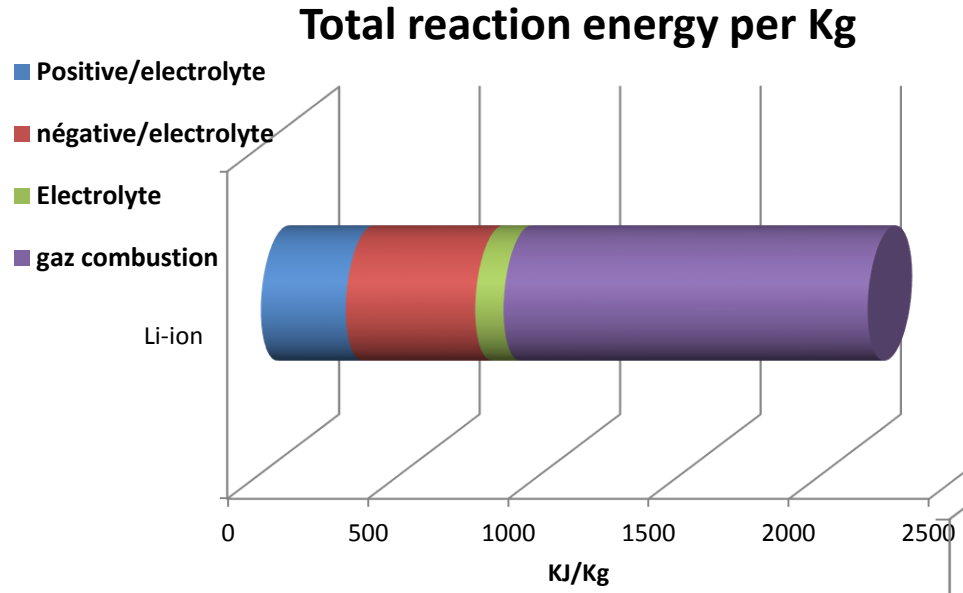
2. What are the hazards to keep under control ?

Thermal run-away: a chain of chemical reactions

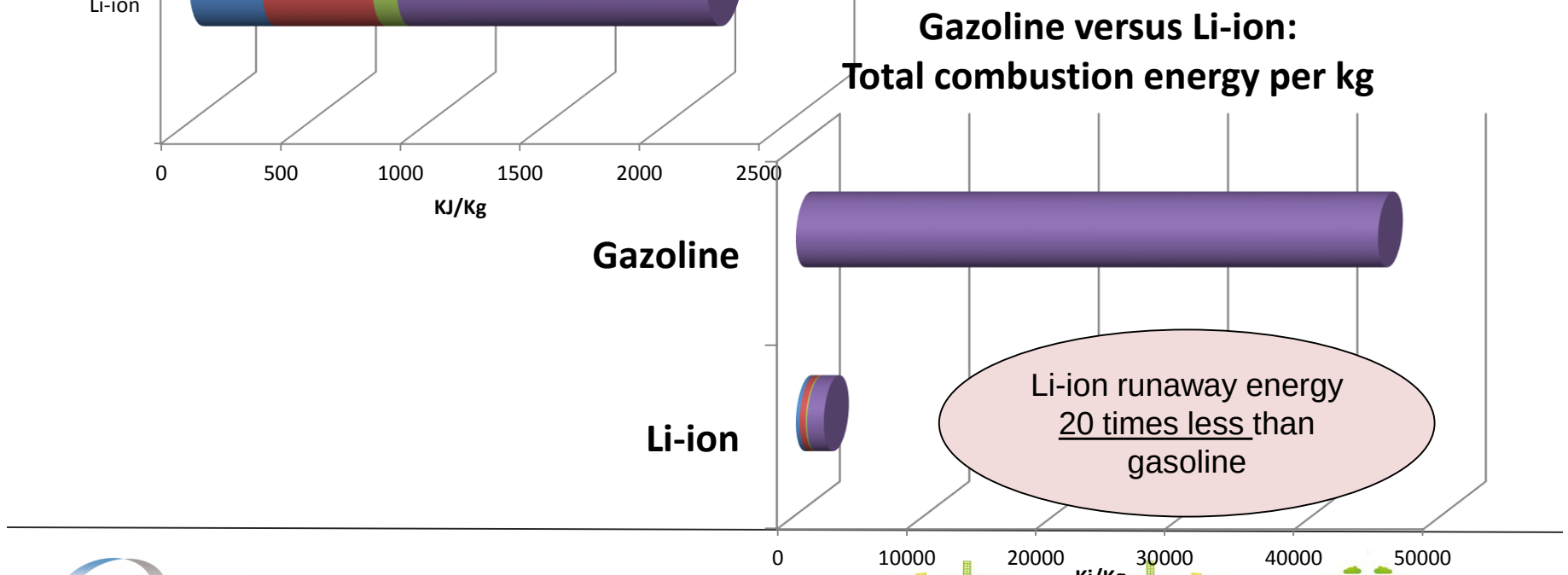


2. What are the hazards to keep under control ?

Thermal run-away: reaction energy of Li-ion cells



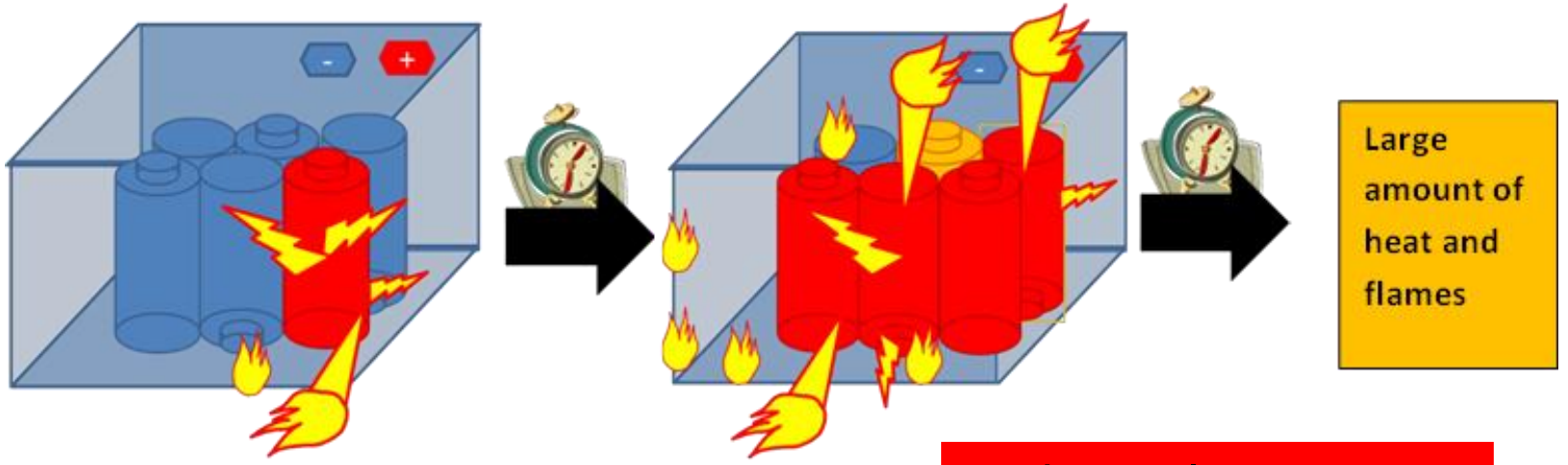
The gas combustion represents 50% of the total



Li-ion runaway energy 20 times less than gasoline

2. What are the hazards to keep under control ?

Thermal run-away: how can it propagate ?



Ignition of one cell in a battery or in a box

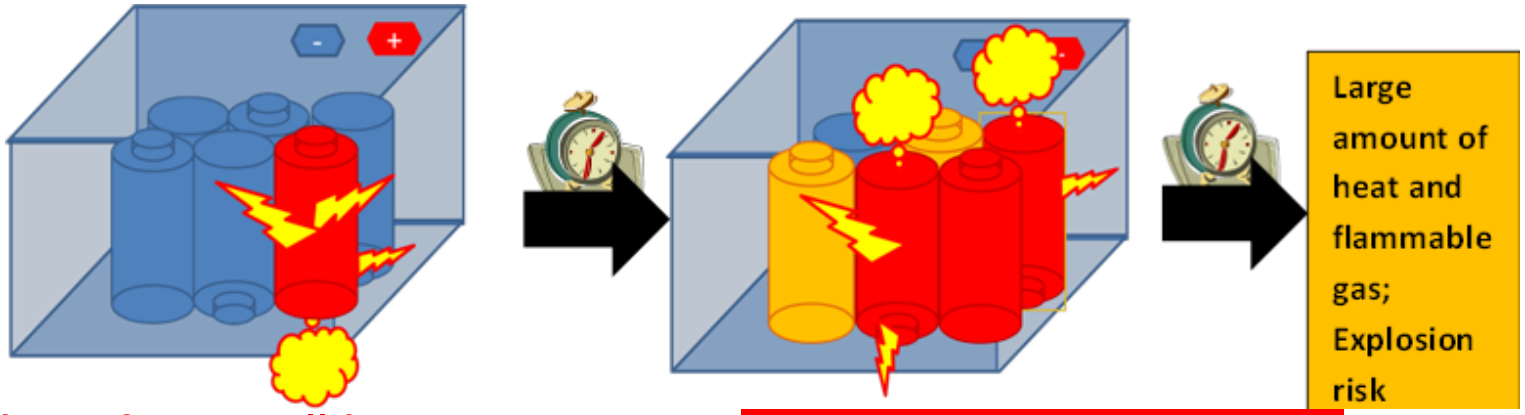
Thermal run-away propagation

Heat, flames, flammable/toxic gases can contribute to the propagation

All possible consequences have to be controlled

2. What are the hazards to keep under control ?

Thermal run-away propagation by heat transfer



Ignition of one cell in a battery or in a box

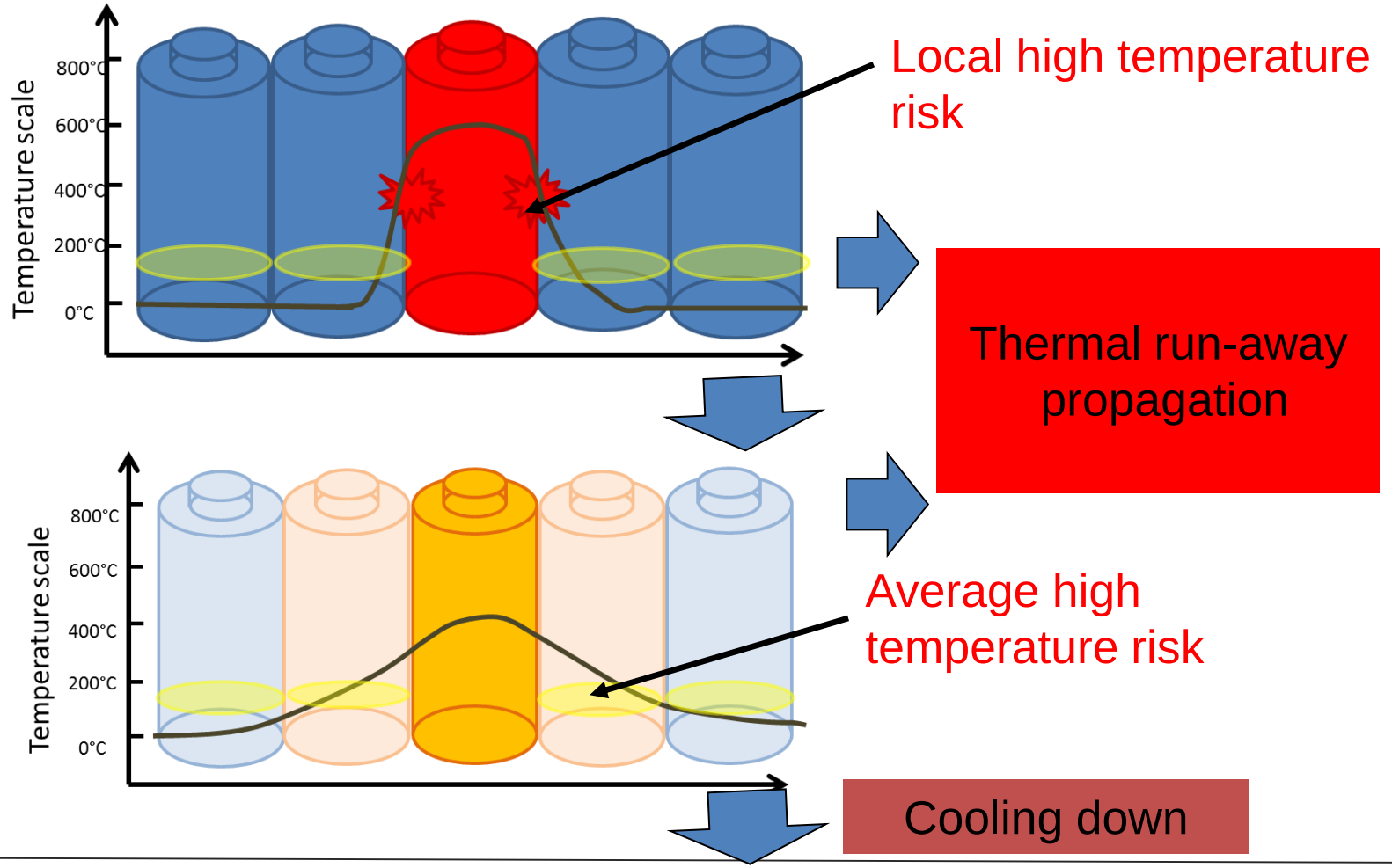
Thermal run-away propagation

- ✓ Flames extinguishing may not be sufficient in case of « High density » packaging.

- ✓ In case of flame extinguishing systems, the gas flammability risk has to be taken in account.

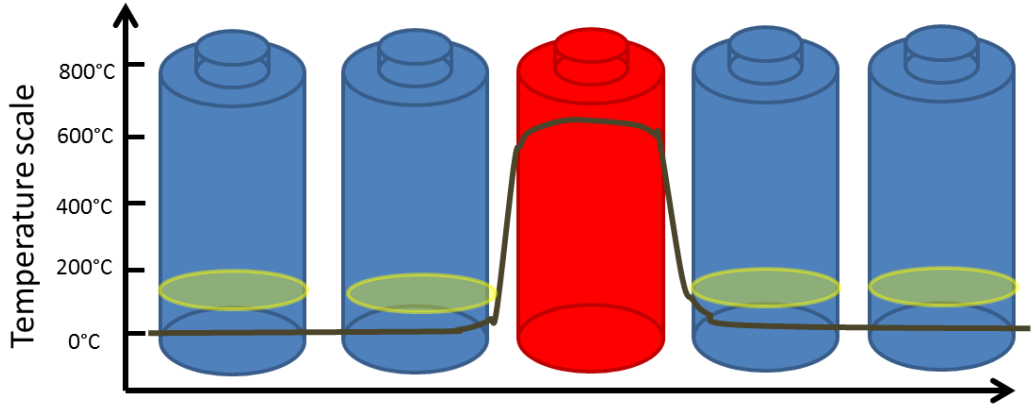
2. What are the hazards to keep under control ?

Thermal profile in case of 1 cell/battery run-away, high density packaged



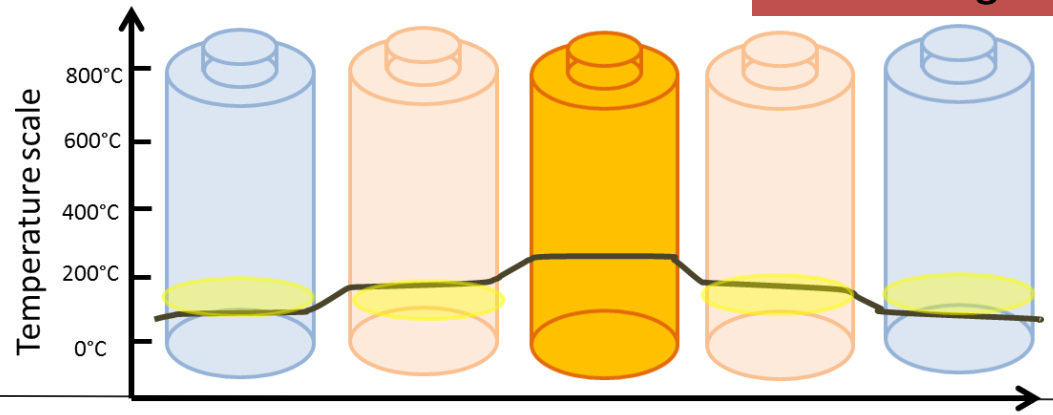
2. What are the hazards to keep under control ?

Thermal profile in case of 1 cell/battery run-away, low density package



Local high temperature risk mitigated by distance/thermal insulation

Cooling down



Temperature homogeneity improved during cooling

2. What are the hazards to keep under control ?

- Hazards to control can be a combination of complex and multiple phenomena and conditions.
  Not only flame, but heat can propagate and extend the hazard, specific risks may be linked to the gas flammability,…

- Main fire control systems in airplane are based on flame extinguishing: halon or oxygen starvation. But halon is not a cooling system. In case of thermal run-away propagation, their efficiency may be insufficient.

3. Why a packaging standard ?

1. A multi-layered approach has to be considered when looking for mitigation means at cell, battery, packaging, palette, cargo compartment and aircraft level.
2. Multiple solutions could be applied at these various levels.
3. Considering the shipper responsibility, the package (including battery and packaging) represents a key unit for the containment of the risk.

→ ICAO decision to require a containment at package level, based on a testing technical standard proving the efficiency. The decision was made to mandate SAE for writing the standard.

3. Standardisation with SAE G-27 working group

- G-27 is the SAE committee for the “lithium battery packaging performance standard, mandated by ICAO.
- It is co-chaired by Doug Fergusson (Boeing) and Claude Chanson (RECHARGE General Manager)
- ICAO mandate to SAE to establish such committee:

ICAO therefore urges SAE to establish a committee to propose a packaging performance standard for lithium batteries, using the high-level standards developed during the third multidisciplinary lithium battery transport coordination meeting as the basis for this work. ICAO will work closely with SAE, industry and authorities to support this important effort.

If you have any questions or require assistance, please contact Katherine Rooney, Chief, Cargo Safety Section at +1 514-954-8099 or krooney@icao.int.

Yours sincerely,

Stephen P. Creamer
Director
Air Navigation Bureau

4. What should the standard contain ?

The safety testing requirements:

When considering an approval, the following criteria at the cell/battery or package level should be considered:

- No hazardous amount of flame is allowed outside the package;
- The external surface temperature of the package cannot exceed the amount that would ignite adjacent packing material or cause batteries or cells in adjacent packages to go into thermal runaway;
- No hazardous fragments can exit the package and the package must maintain structural integrity; and
- The quantity of flammable vapor must be less than the amount of gas that when mixed with air and ignited could cause a pressure pulse that could dislodge the overpressure panels of the compartment or damage the cargo liner.

4. What should the standard contain ?

Principle of the solution discussed:

- a test at package level, allowing to verify the safety behavior of the cells or batteries and the packaging as proposed for transport.

- The simulation of the self ignition is obtained with the controlled abuse of a single cell or battery within the package.

- The hazards control is verified at package level.

4. What should the standard contain ?

Draft Purpose of the standard:

This standard provides a test method to demonstrate and document the control of the potential hazards from Lithium metal batteries (UN 3090) and Lithium ion batteries (UN 3480) when transported as cargo on aircraft. It addresses the need to control the hazards which might arise from a failure of an individual cell by containing the hazards within the package. Controlling the consequences of a failure within the package is intended to prevent uncontrolled fire and critical overpressure pressure pulses that may compromise current fire suppression systems within the cargo compartment.

5 . The standard practical implementation issues

5.1 : the simulation of the self ignition for cells:
it is aimed at triggering the potential thermal run-away of a single cell, with negligible influence on the rest of the cells, batteries and packaging.

- For cells the abuse method selected is the heating at 200°C .
  The heating system can be a cartridge, a tape or similar devices, with suitable thermal insulation.

  One issue under discussion is the selection of the cell in the package: according its surrounding (number of cells and/or package material), heat dissipation can be different.

  ▲ Possible divergence observed in the test result.

5 . The standard practical implementation issues

5.2: the simulation of the self ignition for batteries:
the goal is to use the same methodology applied to a single cell within the battery, but specific issues can be expected due to the battery various designs.

- For testing batteries: other abuse methods are allowed. Methods as described in IEC 62619 may be considered as alternative methods for initiating thermal runaway

- **One issue under discussion**: how to prove that an alternative triggering method is equivalent to the heating at 200°C ?
  Proposal: demonstrate that the alternate method will put an individual cell into thermal runaway giving the same results as if the cell had been thermally induced.

5 . The standard practical implementation issues

5.3: the heating protocol details:
It is proposed to heat up at 5 to 10°C per minute, and maintain at 200°C

- **One issue under discussion**: how to control and measure the heating rate ?
  - The heater power and control system may be a limiting feasibility factor (very different behavior of button cells compared to large batteries
  - The place where the thermocouple measuring the temperature is placed can induce variability in the test results

5 . The standard practical implementation issues

5.4: the testing of large batteries:
It is proposed to test modules or sub-parts in order to represent the large batteries (for feasibility and cost reasons)

- **One issue under discussion**: how to verify it is equivalent to the complete battery?

- **Proposal**: document the sub-system that in a complete battery assembly and packaging are thermally, mechanically and/or electrically connected such that the sub-system behavior accurately replicates the complete assembled battery behavior for the specific test.

5 . The standard practical implementation issues

5.5: the testing of equivalent products:
Due to the high number of cells and batteries “versions” which are of a similar type, it is a major cost question to define appropriate cells and batteries type, for which cells and batteries could be transported based on the same test result.

- It is proposed to define cells, battery and packaging types, and define “equivalent test” qualification.

- **One issue under discussion**: how to verify it is equivalent to the original battery? How to manage the complexity of the identification.
  - **Proposal under discussion**

5 . The standard practical implementation issues

5.6: the testing of cells or batteries which do not produce the identified hazards, independently of the packaging (called C0 cells and B0 batteries).

It is important that such type of cells can be qualified for transport in any type of usual UN packaging.

- It is proposed to define some specific additional conditions to the standard test, in order to prove the safety performance of the cells or batteries: for example, test in a high density package configuration, with a minimum packaging (single layer cardboard box).

- **Text under discussion.**

6 . The performance criteria & assessment issues

The definition of what should be the “controlled hazard” at the package level is raising a lot of concerns.

6.1 Discussions about “hazardous flame”, “hazardous fragments”

The principles retained for the criteria definition are:

- The control should be possible (visibility of the flame and fragments).
- The resulting hazard should not represent any risk to the surrounding packaging.

6 . The performance criteria & assessment issues

6.2 Discussions about the maximum temperature:

Practical questions have been raised:
What is the maximum acceptable, possibility of a peak transition, of which duration?
-> it is expected that real tests results may help defining relevant criteria for this parameter.

Where should the temperature be controlled (risks of packages heterogeneity thermal heterogeneity, dependence on the situation of the triggering event,…?)
-> test results also may clarify the potential importance of this question.

6 . The performance criteria & assessment issues

6.3 Discussions about the gas explosion risk

Due to the variety of flammable properties of the gas obtained in thermal runaway of the lithium batteries, it has been decided to concentrate:

- T, gas: aggregation of volume and explosivity in one test (explosive has become flammable due to progressive).
- Limit volume calculation link to aircrafts cargo size and liner properties.

6 . The performance criteria & assessment issues

A test chamber with transparent sides that is used to test a package containing lithium batteries. The test chamber shall have a free volume of 0.3 m^3 ± .015 m^3 (see Appendix A for rationale of free space volume)after accounting for the volume of the package to be tested. The test chamber shall be capable of containing the gases generated from thermal runaway of the cells or batteries within the package. The test chamber shall be fitted with a pressure relief device that is capable of relieving excess pressure to protect the chamber.

The chamber may achieve .3 m^3 volume with the use of an adjustable floor/ceiling/sides or filler material placed in the bottom of the chamber. The length, width and height measurements of the chamber must be within 40% of each other.

6 . The performance criteria & assessment issues

6.3 Discussions about the gas explosion risk

Due to the variety of quantities and flammable properties of the gas obtained in thermal runaway of the lithium batteries, it has been decided to concentrate on the global result of an explosion in a chamber:

- a spark ignitor is used to check if the gas emitted during the test has reach the limit of flammability in a fixed volume chamber.
- The volume of the chamber has been determined based on the explosion test of a similar volume of gas in an aircraft cargo compartment.

6 . The performance criteria & assessment issues

6.3 Discussions about the gas explosion risk

The derivation of the .3 cubic meter Test Chamber Size.
The size of the Test Chamber, with two adjustments, is based on the volume of lithium ion battery gas that if collected and ignited in an aircraft class C cargo compartment could over pressure the compartment and dislodge the decompression panels. From testing that volume was determined to be 57 liters (see chapters 9 & 10 of reference 1).

Adjustment 1: The 57 liter volume is based on a stoichiometric mix of battery gas. It is much easier to determine the lower flammability limit. The size of the chamber was adjusted based on the ratio of the stoichiometric concentration (21.47) to the lower flammability limit (8):

21.47/8 = 2.684

Therefore 57 X 2.684 = 152.9 Liters

The volume was rounded off to 150 liters, or .15 cubic meters.

6 . The performance criteria & assessment issues

6.3 Discussions about the gas explosion risk

The derivation of the .3 cubic meter Test Chamber Size.
Adjustment 2: It was suggested that it is too conservative to consider all of the gas collecting in one location without some loss. A 50% loss was considered reasonable, therefore the size of the box was doubled.

.15 X 2 = .3 cubic meters.

Reference 1. " Summary of FAA Studies Related to the Hazards Produced by Lithium Cells in Thermal Runaway in Aircraft Cargo Compartments" DOT/FAA/TC – 16/37, June 2016, Harry Webster et al.

Questions can be raised about the representativity of this test, and the probability of real events simulated by this method.

6 . The performance criteria & assessment issues

6.3 Discussions about the gas explosion risk

Issues identified with the testing apparatus:

- The fixed volume rule generate some complexity when testing packaging of various sizes.

- The test chamber may fill with smoke, thus limiting the capacity to check the flame and particle risk.

Issue under discussion

6 . The performance criteria & assessment issues

6.4 Discussions about the reproducibility and the minimum number of tests

Because this standard is checking properties of batteries in case of abuse, and depending on a complex chain of events, it is expected that some lack of reproducibility is observed.

The requirement proposed is the successful completion of three consecutive tests verifying each non-hazardous result.

7 . Application of the Standard

- **The standard addresses the risk of self-ignition**

- **Question is raised about the way to address the external fire risk.**

Preliminary technical approach indicates that a different test method should be required, but:

- The reference conditions have not been clearly described and agreed.
- The need to request additive protection properties at the package level, in addition to the benefit of the “non-propagation”, has also to be clarified (other mitigations mean could be much efficient)

7. Application of the Standard: move to regulation?

The objectives as provided by the G-27 Committee are:

- Develop Aerospace Standards (AS) for minimum performance packaging requirements to safely ship lithium batteries as cargo on aircraft. The standard may include packaging design, qualification, test procedures and any other related tasks. **Upon completion of the standard, ICAO will reference the standard in ICAO's Technical Instructions for the Safe Transport of Dangerous Goods by Air (TIs) Packing Instructions for Lithium Batteries.**

- Provide a forum for the exchange of technical information related to lithium battery packaging for transportation by air.

Thank you for your kind attention !

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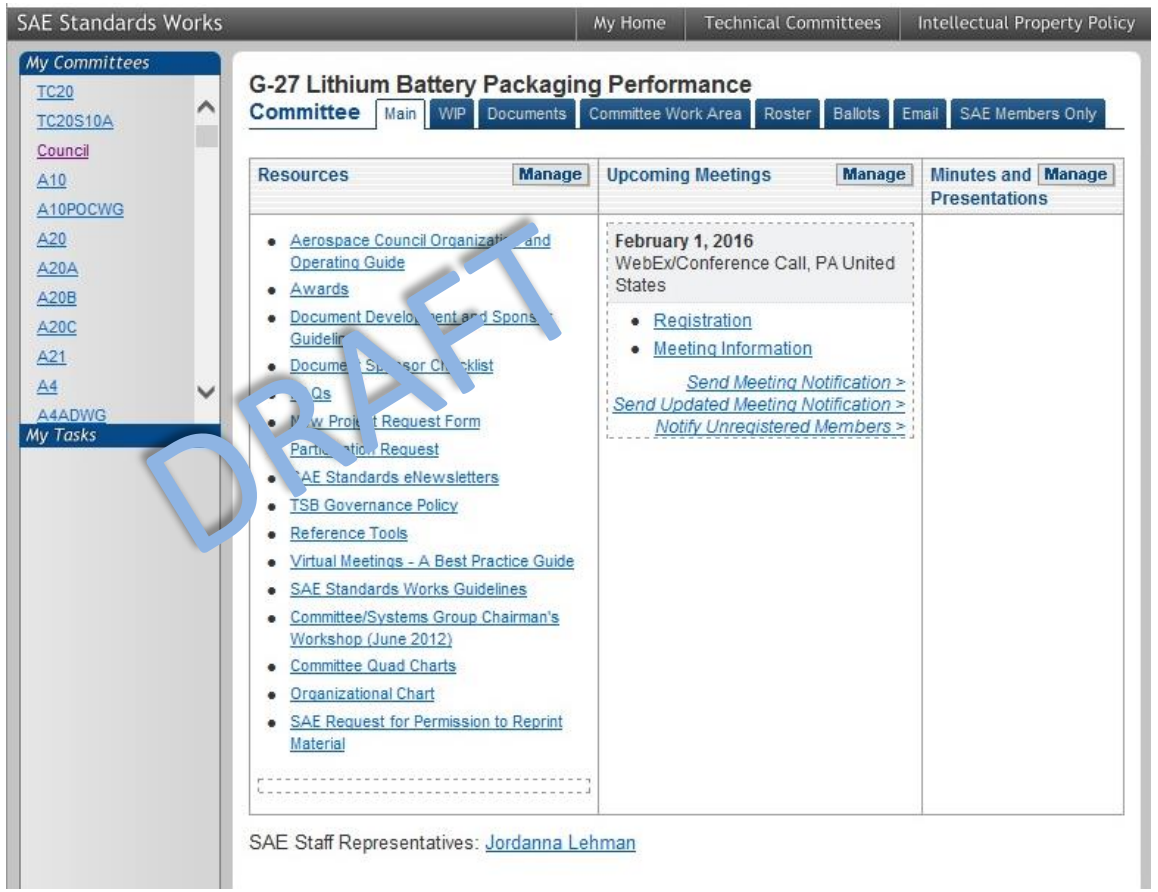
SAE Committee Membership

- SAE Technical Committee Members:
- Function as individuals and not as agents or representatives of any organization with which they may be associated.
- Governmental employees participate in accordance with government regulations.
- Maintain balance among various interest groups (user, producer, general interest)

Committee Charter

- Draft posted under Committee Work Area of G-27 website, http://www.sae.org/servlets/works/committeeHome.do?comtID=TEAG27



MPS Development and Writing Team

- Standards Development Process
  - **Writing Team develops strawman (~20 people)**
  - **Draft standard circulated to entire G-27 committee (over 160 people) for review**
  - **Balloting process involves all stakeholders with opportunity to comment on draft**

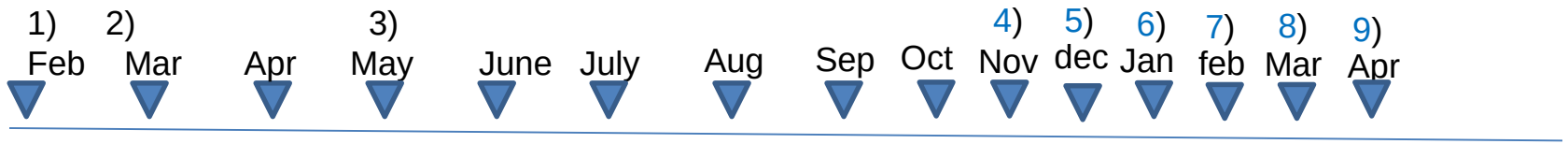
MPS Development and Writing Team

- Standards Development Process
  - One telephone conference meeting/month since February
  - Draft standard writing team of ~20 people met for one week face-to-face in March.
  - Preliminary draft of AS6413 on SAE G-27 website for comments
  - Face to face meeting of G-27 committee May 19-20 in Toulouse, France
  - Writing team meeting in June at FAA Tech Center to finalize draft with incorporation of G-27 comments and lessons learned from Tech Center testing.
  - Next face to face meeting in November in Huntington Beach in California for he writing team and the global G-27.

MPS Development and Writing Team

- Writing Team
- Approximately 20 individuals with standards and test experience balanced with geographic representation from the following stakeholders:
  - **Aircraft cargo fire protection specialists**
  - **Regulatory authorities**
  - **Operators**
  - **Pilots**
  - **Packaging manufacturers**
  - **Battery manufacturers**
  - **Test houses**

Optimistic Projected Timeline



1) Initial G-27 meeting

2) Document Development
(face to face followed by virtual)

3a) Tests feasibility verification

3b) Document Review
(face to face and virtual)

4) Document finalization

5) Committee Balloting

6) Resolve Comments

7) Affirmation Balloting

8) Council Balloting

9) Publication

QUESTIONS?

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6TH LITHIUM BATTERY WORKSHOP

Networking Break

15:30 – 16:00

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6th LITHIUM BATTERY WORKSHOP

What are the Practical Considerations to Implement the Performance-Based Standard?

Moderator:

Claude Chanson, General Manager, Recharge Batteries and Co-Chairman, SAE G27 Committee

Panelists:

Keith White, Principal Consultant and Office Manager, VCA

James Jones, President, PA2

Alex McCulloch, International Dangerous Goods Manager, UPS

11 - 12 October 2016 – Brussels, Belgium

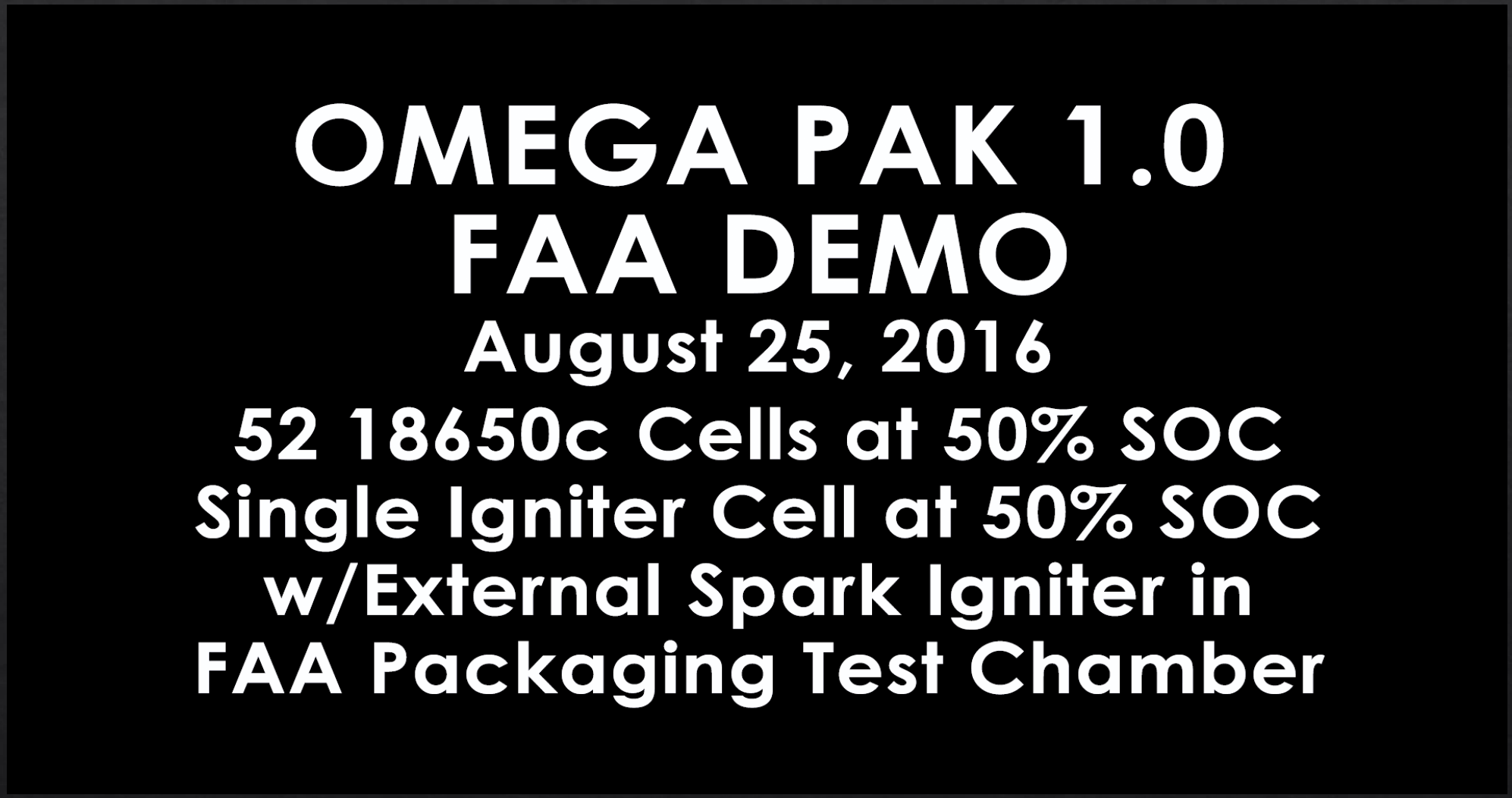
Achieving the Draft ICAO G-27 Standards: A Practical Implementation

PA² Product Demonstrations at the FAA Technical Center on 25 August 2016

- The Omega Box 1.1 is a metal container that was packed with 230 18650 lithium-ion cells at 50% SOC. The 230 lithium-ion cells were placed in 115 standard chipboard boxes that had been treated with a fire resistant solution. The standard Styrofoam separator in each 2-cell box was replaced with a corrugated cell separator that was also treated with a fire resistant solution.
  - Two layers of risk mitigation
- The Omega Pak 1.0 is a corrugated box that was packed with 52 18650 lithium-ion cells at 50% SOC. The 52 lithium-ion cells were placed in individual slots in the internal corrugation. The corrugation was treated with a fire resistant solution.
  - One layer of risk mitigation

The ICAO SAE G-27 Preliminary Draft Standards are Achievable

The ICAO SAE G-27 Preliminary Draft Standards are Achievable



What are Practical Design Criteria?

- Enhanced lithium-ion battery packaging will be a safety system
  - Risk mitigation technologies & risk mitigation processes.
- Must design for high growth, high volume market
  - Millions of packages annually
  - Global production doubling every 3.6 years (20% CAGR 2004 – 2014)
    - 2014 – 5.4 billion cells – 1.62 billion shipped by air
    - 2017 – 11.0 billion cells – 3.3 billion shipped by air (if still 30%)
- Safety first – contain thermal runaway & effects within package
- Passive systems, not active systems
  - Minimize critical failure points
  - Minimize need for inspection & maintenance

What are Practical Design Criteria?

- Engineer for rough handling in transit
- Must function successfully in all packaging orientations during transit
  - Right side up, flipped on side, upside down, canted
  - Important safety issue
    - Package that is successful in laboratory could fail in real world conditions
- Minimize impact on packagers & shippers
  - Ease of use & ease of training
  - Assist shippers in identification & tracking
- Scalability & cost-effectiveness
  - Must support bulk shipping as well as specialty shipping

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Chairman Closing Remarks

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