FREIGHTER FIRE PROTECTION DURING SMOKE/FIRE/FUME EVENTS

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UPS/IPA Safety Task Force
PRESENTATION OBJECTIVES

- Describe the Changing Nature of Air Shipments
- Discuss 4 Areas for Improving Freighter Fire Protection
- Provide Thoughts for the Industry to Consider
THE AIR BUSINESS MODEL HAS CHANGED

- A growing percentage of our payload involves technology
- Evolving high-energy technologies
- Battery energy costs have dropped from $3.17/watt hour in 1991 to $0.12/watt hour in 2014

Bottom Line – Transportation of Batteries and Energy is Increasing
The battery market is growing

- The global lithium-ion market in 2012 was $11.7 billion
- That market is expected to **double** by 2016
- Today 64% of the lithium-ion battery market is in consumer batteries
THE ISSUE IS SAFELY TRANSPORTING HIGH ENERGY SHIPMENTS BY AIR
FAA STUDY ON CARGO FIRE ACCIDENTS

FAA Safety Analysis of U.S. domestic freighters predicts approximately six (6) accidents likely to occur from now to 2021.
4 AREAS FOR IMPROVING FREIGHTER FIRE PROTECTION

- Flight Deck
- Training
- Containers
- Certification
PILOTS AND THE FLIGHT DECK

The Last Line of Defense
IMPORTANT FACTS ABOUT COCKPIT SMOKE

"Smoke is the leading defined cause of emergency landings for ETOPS" (Air Safety Week)

"The time from first indication of smoke to an out-of-control situation may be very short." (Boeing Aero 14)

In-flight smoke events on transport jets are twice as likely as in-flight engine failures (ALPA Safety Report)
THE COMBINATION OF TWO TECHNOLOGIES GREATLY IMPROVES SAFETY
EMERGENCY VISION ASSURANCE SYSTEM

Emergency Vision Assurance System (EVAS) is being installed on all UPS aircraft.

When a crewmember deploys EVAS, it inflates in about 1 minute to provide a clear view of primary flight instruments and outside front windshield.

Testing conducted by UPS demonstrated pilots using EVAS could still safely fly an aircraft in a densely smoke-filled cockpit.
EMERGENCY VISION ASSURANCE SYSTEM
FULL-FACE OXYGEN MASKS

Flight crews must be protected not only from smoke, but also from toxic fumes.

Smoke goggles have been found to be ill-fitting for some eyeglass wearers.

Full-Face Masks don quicker, reduce operational complexity and allow a better fit and more effective mask purging.
PILOT TRAINING

Improving the Process
CHECKLIST DESIGN
HUMAN FACTORS EXAMPLE:
CHECKLIST NUMBERING SYSTEM

ENGINE FIRE, Severe Damage or Separation

MESSAGE: L or R ENGINE FIRE
AUTOTHROTTLE ARM SWITCH .......... OFF
THRUST LEVER (Affected side) .......... CLOSE
FUEL CONTROL SWITCH (Affected side) ......... CUT OFF
ENGINE FIRE SWITCH (Affected side) ........... PULL
If Engine Fire Warning light remains illuminated:
ENGINE FIRE SWITCH ................. ROTATE
  Rotate to stop and hold for 1 second.
After 30 seconds, if Engine Fire Warning light remains illuminated:
ENGINE FIRE SWITCH .... ROTATE TO REMAINING BOTTLE
  Rotate to stop and hold for 1 second.
If high airframe vibration occurs and continues after engine is shut down:
Without delay, reduce airspeed and descend to a safe altitude which results in an acceptable vibration level. If high vibration returns and further airspeed reduction and descent is not practical, increasing the airspeed may reduce the vibration.
APU (If available) ..................... START
(CONTINUED)
CHECKLIST DESIGN

HUMAN FACTORS EXAMPLE:

CONDITION AND CONFIRMATION STEPS

**ENGINE FIRE, Severe Damage or Separation**

**MESSAGE:**
- L or R ENGINE FIRE
- AUTO THROTTLE ARM SWITCH
  - OFF
- THRUST LEVER (Affected side) CLOSE
- FUEL CONTROL SWITCH (Affected side) CUT OFF
- ENGINE FIRE SWITCH (Affected side) PULL

If Engine Fire Warning light remains illuminated:
- ENGINE FIRE SWITCH
  - ROTATE
  - Rotate to stop and hold for 1 second.
- If high airframe vibration occurs and continues after engine is shut down:
  - Without delay, reduce airspeed and descend to a safe altitude which results in an acceptable vibration level. If high vibration returns and further airspeed reduction and descent is not practical, increasing the airspeed may reduce the vibration.

**APU (If available)**
- START

(Continued)
Incorporate Sequence Based Instruction into Smoke/Fire/Fumes Emergency Training

“The order in which material is presented can strongly influence what is learned, how fast performance increases, and sometimes even whether the material is learned at all.”

COMBINE TEACHING INDIVIDUAL MODULES
INTO A SEQUENCE BASED LEARNING EXPERIENCE...
PROTECTING THE AIRCRAFT

New Materials and Designs are making a Difference
FIRE CONTAINMENT COVERS (FCC)

- 17 UPS Asian gateways are covering high-energy shipments and unknown palletized freight from origin to final destination.

- Program is being expanded to more UPS gateways.

- Covers are quickly returned to origin gateways for reuse.

- It requires no additional time to place an FCC on a pallet then a cargo net.
FCC BATTERY TESTS

- FCC Fire test with 5000 lithium-ion batteries conducted March 18, 2014
  - Test duration of 4 hours was obtained with a peak temperature of 1500F

- FCC test with 4800 lithium metal batteries performed March 25, 2014
  - Test limited to 15 minutes with peak temperature of 3000F
The initial goal of the ULD project was:

- Contain a Class-A fire in a ULD for 4 hours

- Testing by UPS has repeatedly shown that 4 hour containment can be achieved with Class-A fires in a ULD
UNIT LOAD DEVICE (ULD)

UPS has done extensive research and testing on ULD materials and door designs.

MACROlite material has proven to be lighter weight, more durable and exhibited tremendous fire resistant properties.

UPS has approximately 2000 MACROlite ULDs in service and recently placed an order for 975 additional MACROlite ULDs.
SEEKING A SOLUTION FOR BATTERY FIRE CONTAINMENT

ULD Materials

ULD Design

Suppression Agent

TIME TO MANAGE IN-FLIGHT EMERGENCY

SAFETY

Containers
ULD WITH SUPPRESSION

UPS has applied for an STC and is in the process of certificating a ULD suppression system.

Both FedEx and UPS fire suppression systems recognize the fire must be fought in the container.

More certification testing planned.
CERTIFICATION

Incorporating Real World Standards
REAL WORLD STANDARDS

From 1990 to 2010 there have been 18 major accidents involving in-flight fire. These accidents resulted in 423 fatalities (Flight Safety Foundation).

Recent full-scale testing by the FAA Technical Center (Feb 26, 2013) using a Boeing 727 proved that even with “air conditioning packs on” and manufacturer procedures followed, smoke enters the cockpit.
REAL WORLD STANDARDS

FAA’s Part 25 aircraft advisory materials AC25-9a (last updated 20 years ago) recommend all aircraft be tested during continuous smoke to prove systems can protect crewmembers during a smoke event.

Historically, smoke has entered the cockpit numerous times due to fire onboard an aircraft and remained a continuous threat. (UPS 6, Asiana 991, Express Jet 5912)
The evidence is overwhelming that fire onboard a cargo aircraft can produce a continuous source of smoke unless the fire can be contained or extinguished.

The published and voluntary standards are not consistent with real-world experience.
FINAL THOUGHTS...
A greater level of aviation safety is possible

New materials and design for ULD construction show great promise

New technology in the area of fire suppression has proven very effective

Industry and regulators need to work together to develop fire-safety certification rules and standards reflecting current (and future) technologies
FINAL THOUGHTS...

• If we do our jobs well, Aviation safety will be greatly enhanced and more aircraft cargo fires will become survivable events.
QUESTIONS