FREIGHTER FIRE PROTECTION DURING SMOKE/FIRE/FUME EVENTS

Captain Bob Brown

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

1988

2014

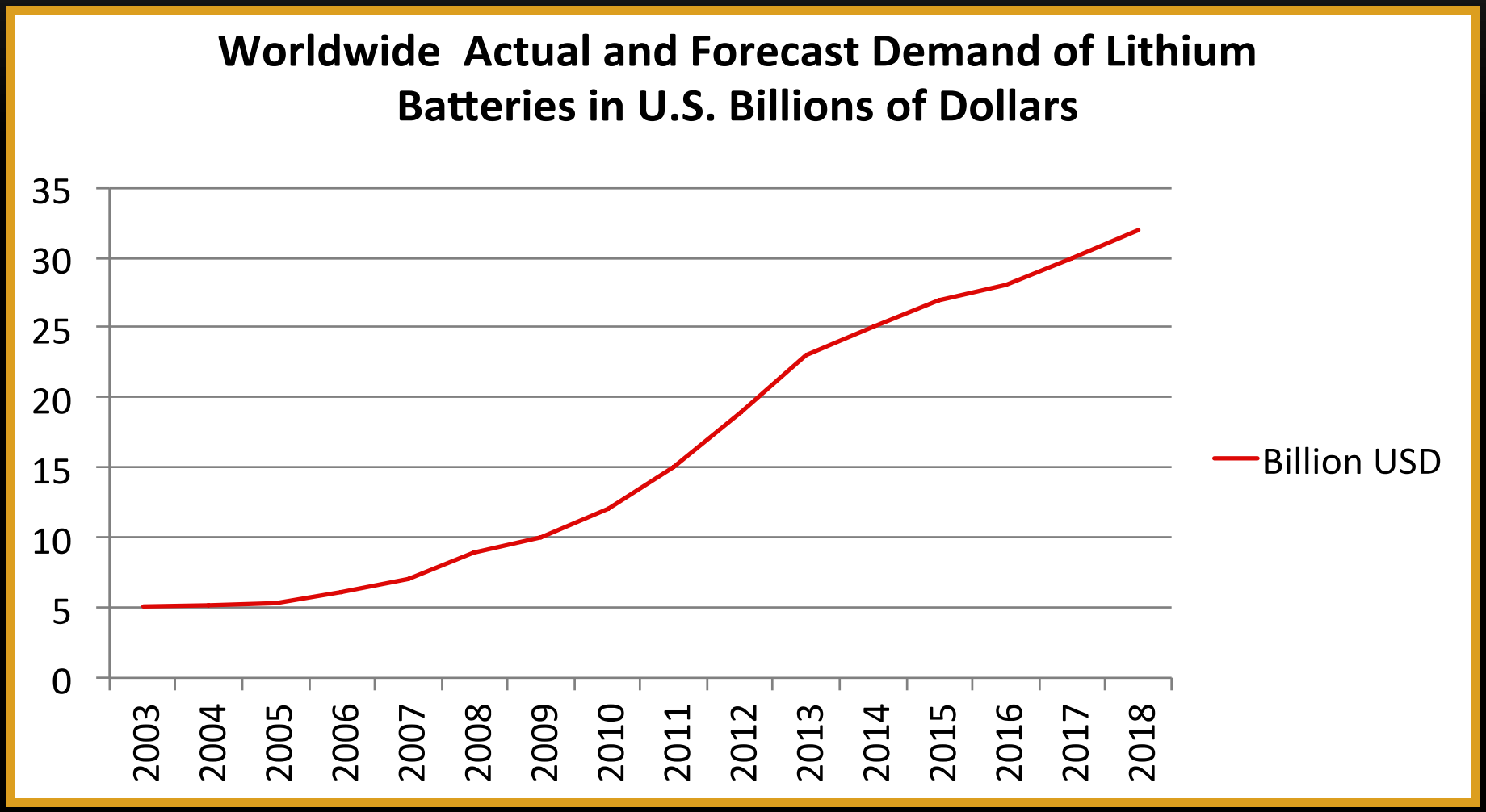
THE BATTERY MARKET IS GROWING

- 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

FROST AND SULLIVAN REPORT FOR NAATB

NATIONAL ALLIANCE FOR ADVANCED TECHNOLOGY BATTERIES

GLOBAL LITHIUM BATTERY MARKET IN ($US) BILLIONS

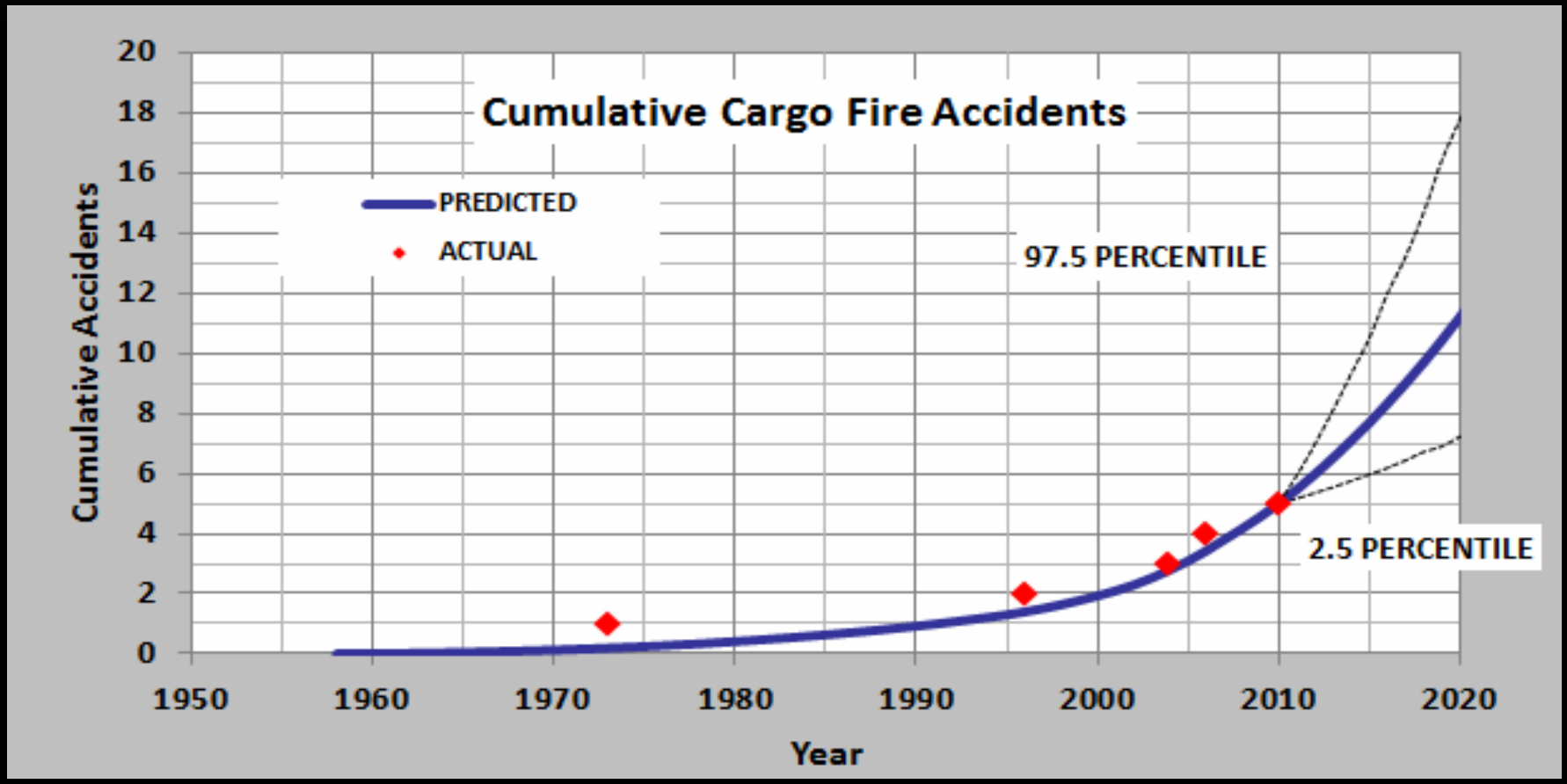


SOURCE: INSTITUTE OF INFORMATION TECHNOLOGY

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



DOT/FAA/AR-11/18 FREIGHTER AIRPLANE RISK MODEL, APRIL 2013

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)*

Flight Deck

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.

Training

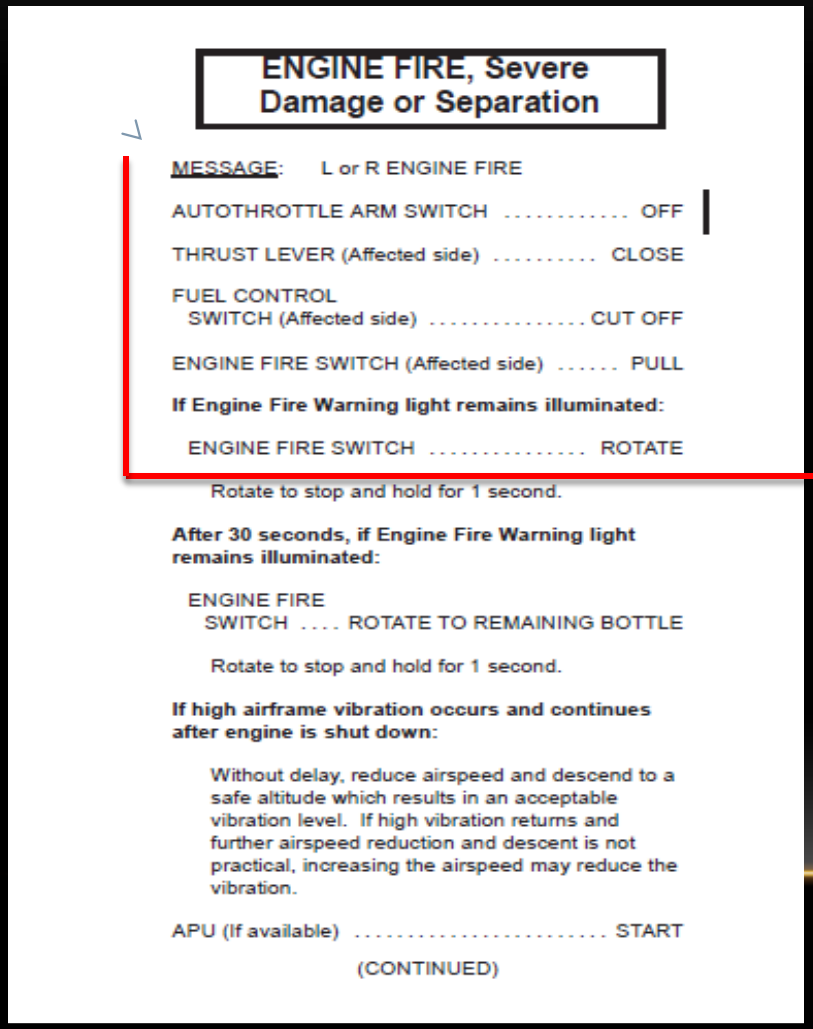
PILOT TRAINING

Improving the Process

Training

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

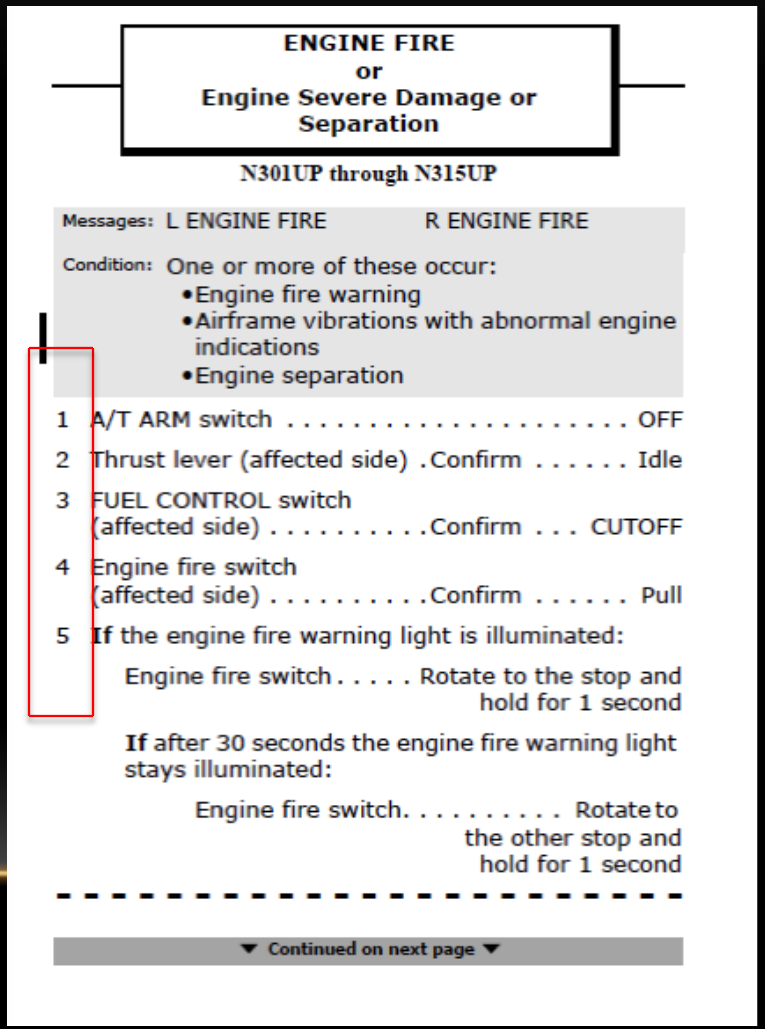
Rotate to stop and hold for 1 second.

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)



ENGINE FIRE or Engine Severe Damage or Separation

N301UP through N315UP

Messages: L ENGINE FIRE R ENGINE FIRE

Condition: One or more of these occur:
- Engine fire warning
- Airframe vibrations with abnormal engine indications
- Engine separation

1 A/T ARM switch ..... OFF

2 Thrust lever (affected side) .Confirm ..... Idle

3 FUEL CONTROL switch (affected side) .....Confirm ... CUTOFF

4 Engine fire switch (affected side) .....Confirm ..... Pull

5 **If** the engine fire warning light is illuminated:

Engine fire switch..... Rotate to the stop and hold for 1 second

If after 30 seconds the engine fire warning light stays illuminated:

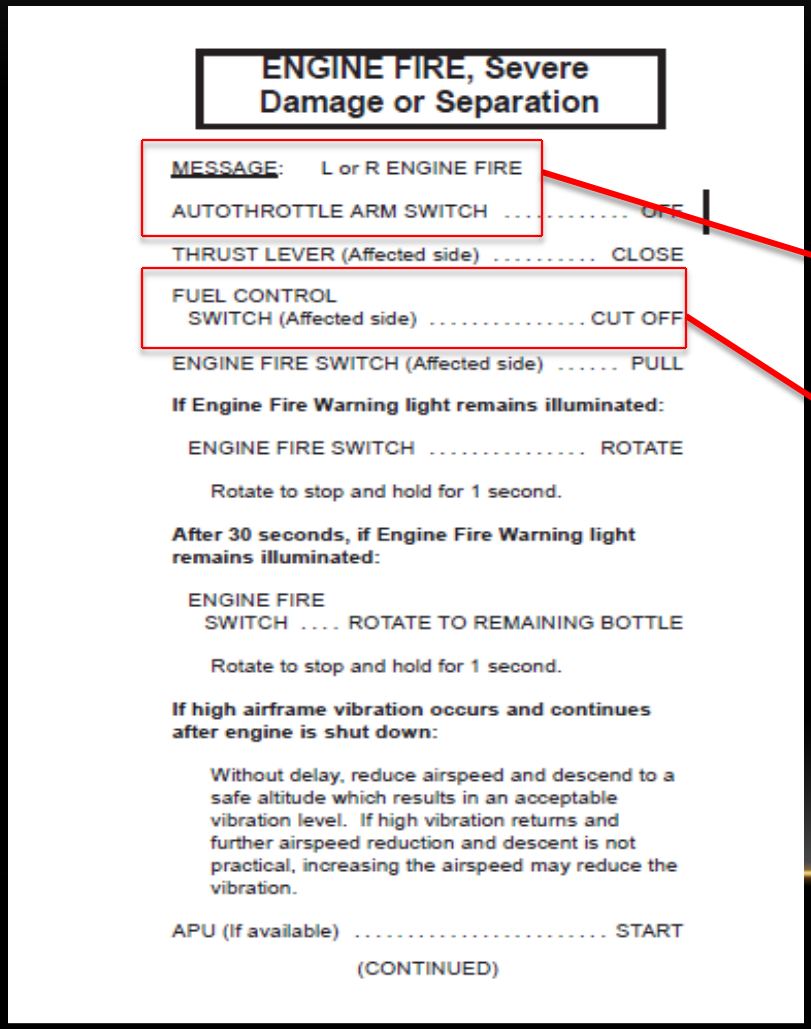
Engine fire switch..... Rotate to the other stop and hold for 1 second

▼ Continued on next page ▼

Training

CHECKLIST DESIGN

HUMAN FACTORS EXAMPLE: CONDITION AND CONFIRMATION STEPS



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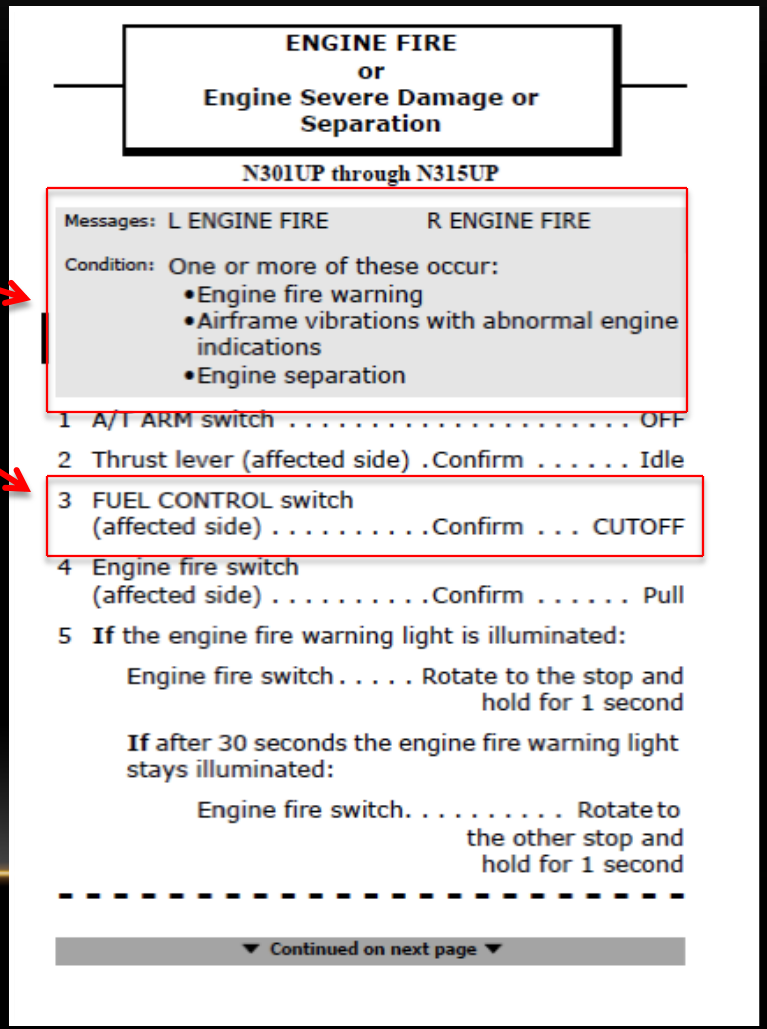

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Training

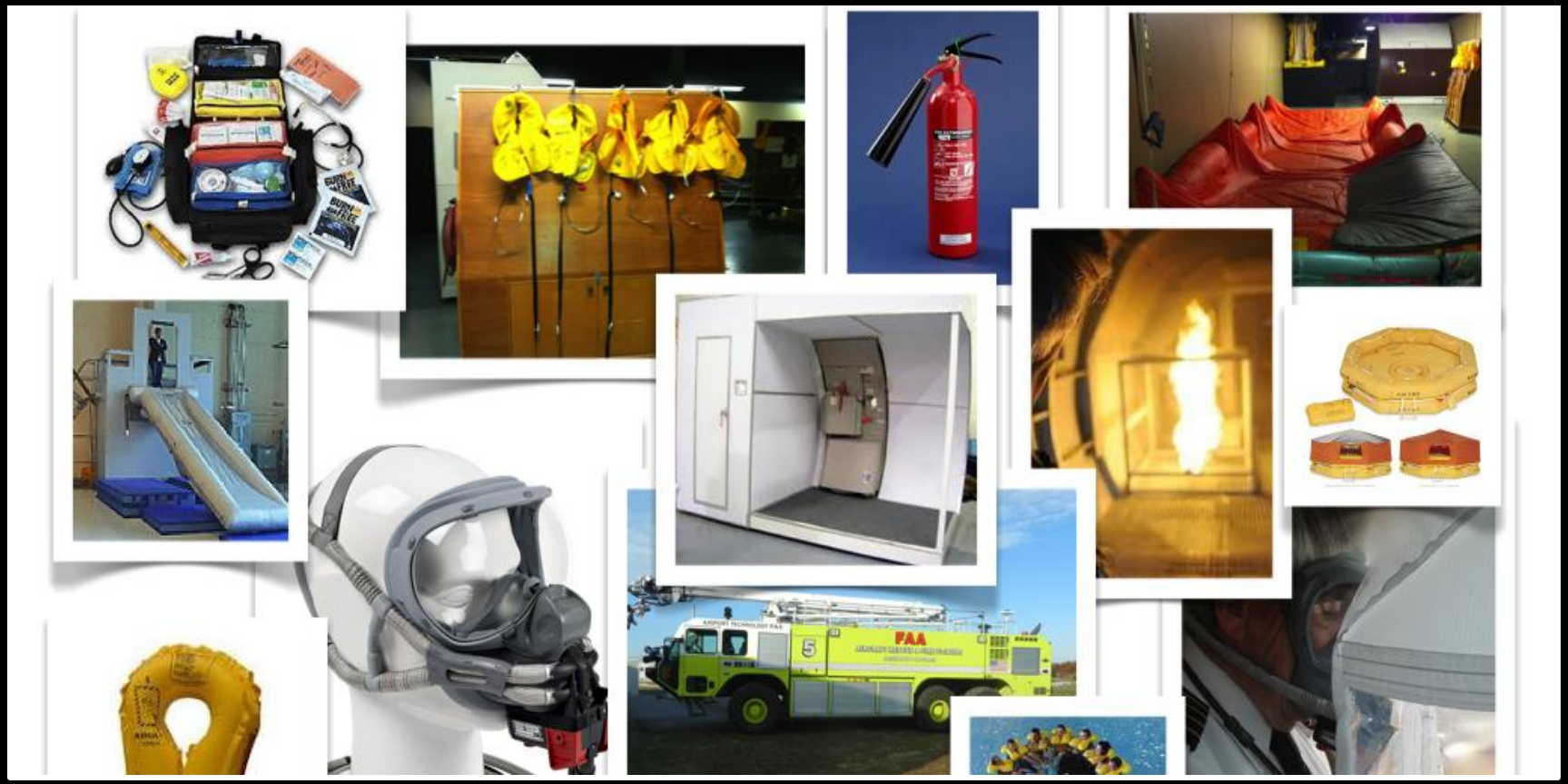
TRAINING CENTER

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."

"Sequence learning". *Trends in Cognitive Sciences* **2** (8): 275–81

COMBINE TEACHING INDIVIDUAL MODULES



INTO A SEQUENCE BASED LEARNING EXPERIENCE…





Inflight Smoke/Fire





PROTECTING THE AIRCRAFT

New Materials and Designs are making a Difference

FIRE CONTAINMENT COVERS (FCC)

Containers

- 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

Containers

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

UNIT LOAD DEVICE (ULD)

Containers

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)

Containers

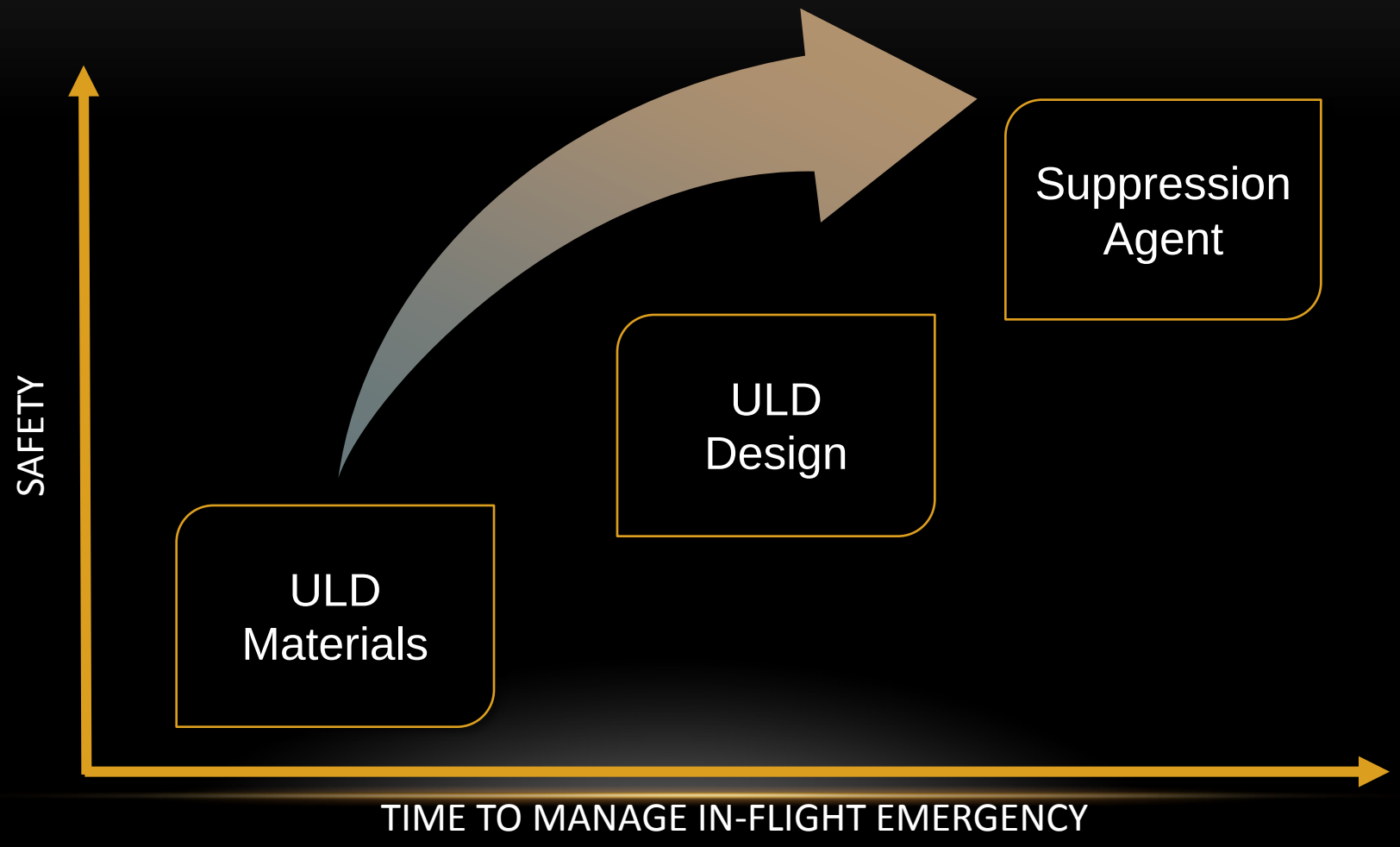
UPS has done extensive research and testing on ULD materials and door designs

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

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

Certification

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

B727 at 10 Minutes

B727 at 14 Minutes

REAL WORLD STANDARDS

Certification

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)

REAL WORLD STANDARDS

Certification

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…

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