FedEx Fire Suppression System

The Fire Suppression Organization

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FedEx Fire Suppression System

Timeline of Fire Events

- **9/5/1996: FedEx DC-10-10 destroyed at Newburgh after in-flight non-declared hazmat fire.**

  Loss $27.4M

- **July 1998: Strategic Projects tasked to explore possible solutions to preclude loosing another aircraft to Class E compartment fire.**

- **October 2000: The Fire Suppression Team was formed.**

- **4/27/2004: FedEx F-27 was destroyed in Brazil after in-flight non-declared hazmat fire.**

  Loss $2.1M

- **2/7/2006: UPS DC-8 was destroyed in Philadelphia after what appears to be an in-flight non-declared hazmat fire.**

- **8/4/2006: STC ST01874LA issued to Federal Express for the Fire Suppression System (for the MD10-10 aircraft).**

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40 packages have produced smoke and/or fire in the past 9 years.

- **ALL shipped as undeclared Hazardous Materials**
  - In the last 35 years FedEx has had only one hazmat container incident “classified” as a fire (Nitric Acid Spill 1985 but, in fact, was not a fire).
  - Only three of the 40 events took place on an aircraft.
- **In the past 9 years FedEx Express has delivered 10,641,092,000 packages!** The 40 events makes up only .000000038% of this freight, and the 3 events that happened on aircraft makes up only.000000003%.
- **Like airline travel what we do is relatively safe,** however like the passenger business, we must manage the errant event.

FedEx Fire Suppression System

This Briefing

- The FedEx Fire Suppression System

  Since October 2000, FedEx Strategic Projects has developed technology that meets the technical, operational and economical thresholds required by FedEx.

- Container requirements

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Increasing Regulatory Activity

- NTSB requested fire suppression after the FedEx DC-10 loss in Newburgh.
- RTCA battery special committee formed to address Lithium battery design and handling.
- NTSB hearing following the UPS fire focused on the need for a fire suppression system. Shipment of batteries appears to be the primary focus of the investigation.
- The FAA has proposed ADs to address passenger aircraft fire detection/suppression.
- Two recent ETOPS rule changes affect transport category aircraft
  - ETOPS + 15 minute Final Rule
  - Bomb containment NPRM
- Future rulemaking could impact cargo aircraft – e.g., AC 25.795
  - Flight deck smoke and fumes
  - Fire suppression cargo compartment
  - Least risk location
  - Redundant systems

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Current Fire Detection/Suppression on FedEx Aircraft

- Smoke Detectors certified for main cargo deck
- Flight Crew procedures
  - Depressurize aircraft and maintain 25,000 ft cabin altitude until descent.
  - Use of Halon® in remote and/or walk-around fire extinguishers.
  - Land aircraft ASAP.
- FAA regulations require access to certain hazmat
  - FedEx crew procedures do not encourage access into containers to fight fire.
- Aircraft container/pallet configurations do not allow access to non-hazmat freight.

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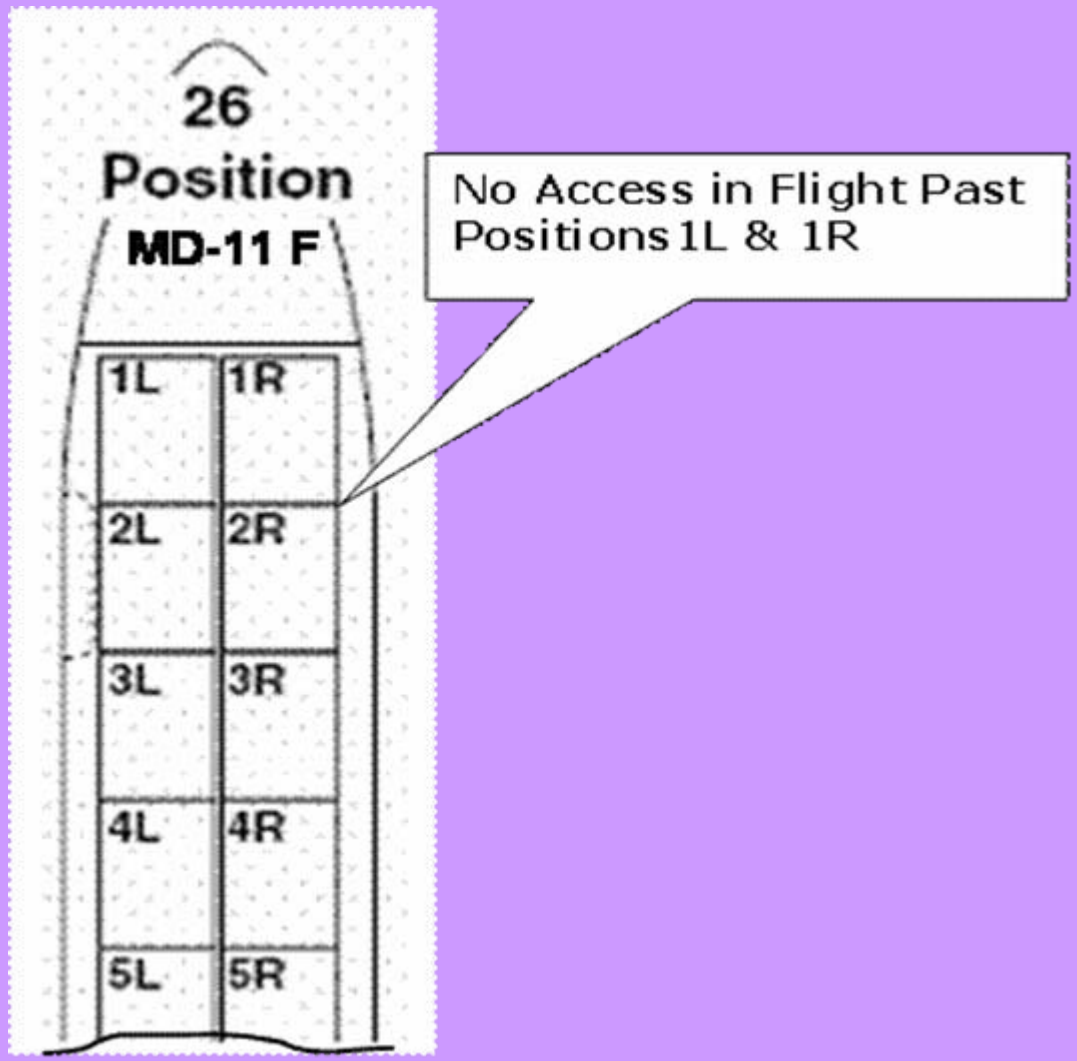

FedEx Fire Suppression System

Our Existing Hazardous Extinguishing System

- Existing remote system designed to allow the accessible hazardous freight to be connected to a extinguishing system.
- This system is designed to support up to 3 hazmat containers and can be triggered from forward of the smoke barrier.
- Limitations include:
  - Only available to the forward hazardous containers.
  - Not economically practical to expand to remaining container position which contain non-hazmat freight.
  - Containers are not sealed well and will not maintain a useful Halon® concentration for more than 10 to 15 minutes.
- While not optimal, this system permits the crew to apply Halon® to the inside of a burning container without having to open the container, thus preventing a fresh oxygen source, and exposing the flight crew to the danger within.

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The need for a better Fire extinguishing agent

- Halon® has a high ozone depletion index
  - While use is allowed, its manufacture is now prohibited by the 1994 Montréal protocol and the Clean Air Act of 1990.
  - Halon® is harmful to the environment and will be banned at some point in the future.
- Halon® must reach a concentration of 5% to knock a fire down and must maintain 3% to suppress a fire. The best replacement agents today are only half as effective as Halon®
- While Halon® is still one of the best agents, Halon® and halogen based agents are contraindicated for metal fires, including lithium battery fires.

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Halon® Reaction, Class “D” fire

- Gumdrop sized piece of sodium set ablaze
- Second pane, application of Halon®

Warning: I am a professional, don't try this at home!

FedEx Fire Suppression System
The Reaction is Remarkable!

- Fluorine is a better oxidizer than oxygen, the Halon® molecule contains 3 fluorine Atoms, when exposed to the high heat of a metal fire are liberated and rapidity oxidize the metal to create a very hot fire!
- Most of replacement agents are fluorocarbon based, all can be expected to react with equal vigor, for example FM 200 a proposed replacement agent has 7 fluorine atoms in it's structure!

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Fire Suppression System Design Considerations

- Provide fire suppression for ALL containers
- Rapidly detect a fire based on heat signature rather than visible smoke at any cargo position
  - Current smoke detectors cannot pinpoint the location of a fire.
- FedEx FSS automatically punctures the hot container, dispenses fire agent to the hot container, extinguishes the fire, and simultaneously alerts crew.

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Fire Suppression System Design Considerations

- No flight crew action is required to dispense extinguishing agent.
- The fire suppression system must be reliable with limited preventative or scheduled maintenance.
- No loading crew or aircraft maintenance personnel are required for loading or unloading aircraft.
- The system must contain enough fire agent to extinguish (or suppress) a fire for the largest size container (AMJ) for a minimum of four hours.

FedEx Fire Suppression System

Description of the FedEx FSS

- The Infrared Fire Sensor FedEx Design
  - Can pinpoint location of actual fire
  - Redundancy X4 (8 sensors per ULD position)

- The “Smart Electronics” Micro Processor
  - Reprogrammed as need dictates
  - Distinguish actual fire events from false fire events
  - Provides BIT capability (monitors system)

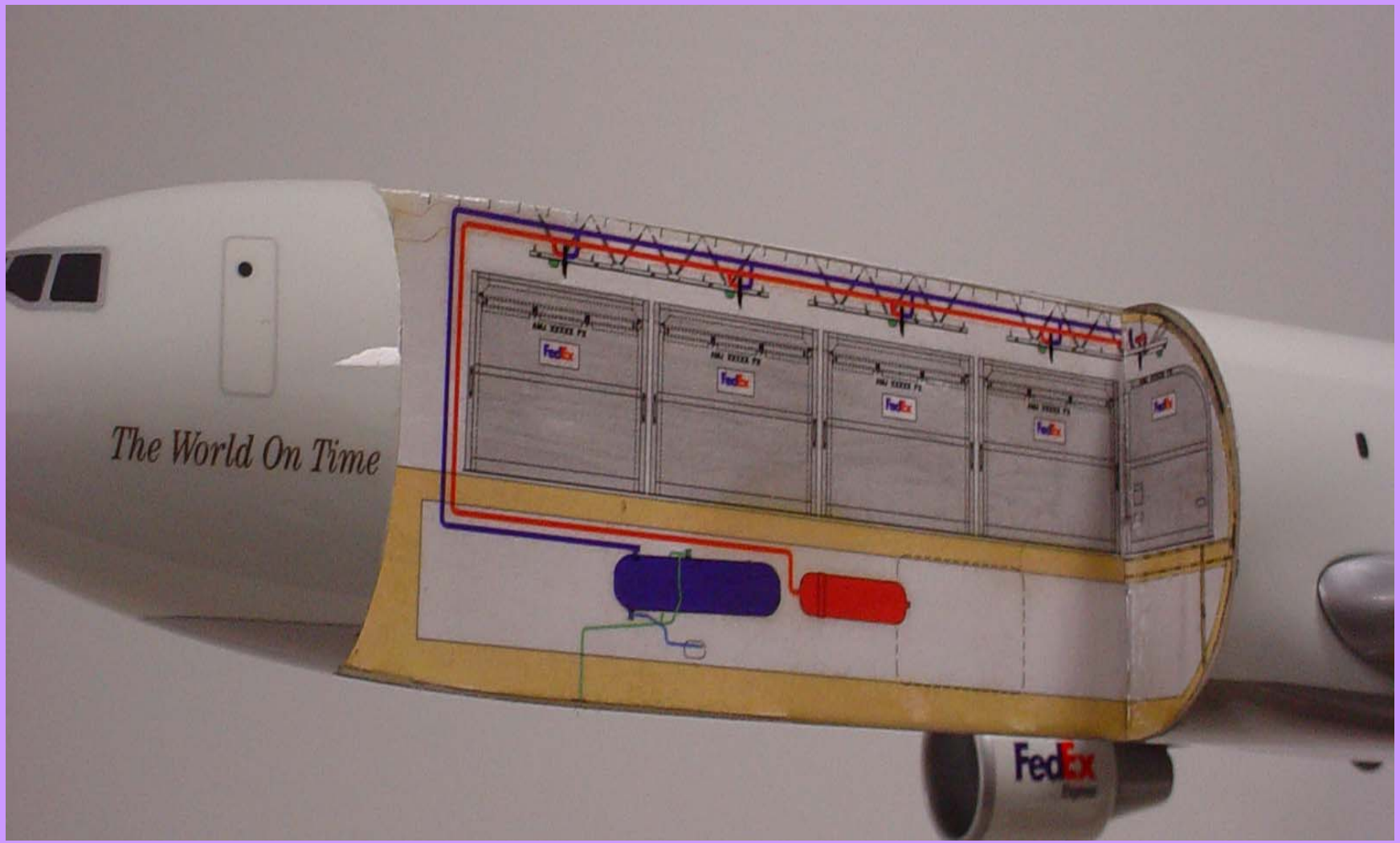
FedEx Fire Suppression System

Description of the FedEx FSS

- The Remote Puncture Mechanism
  - Provides a method to apply agent to the inside of a container with no preflight attachment
  - Adjusts to height of containers
- A new agent: Cargo Foam®
  - Effective, Biodegradable, Safe, Persistent
  - Will absorb toxic fumes
  - Has blast mitigating potential
  - **Has extinguished the FAA's deep-seated fire in an FAA witnessed tests!**

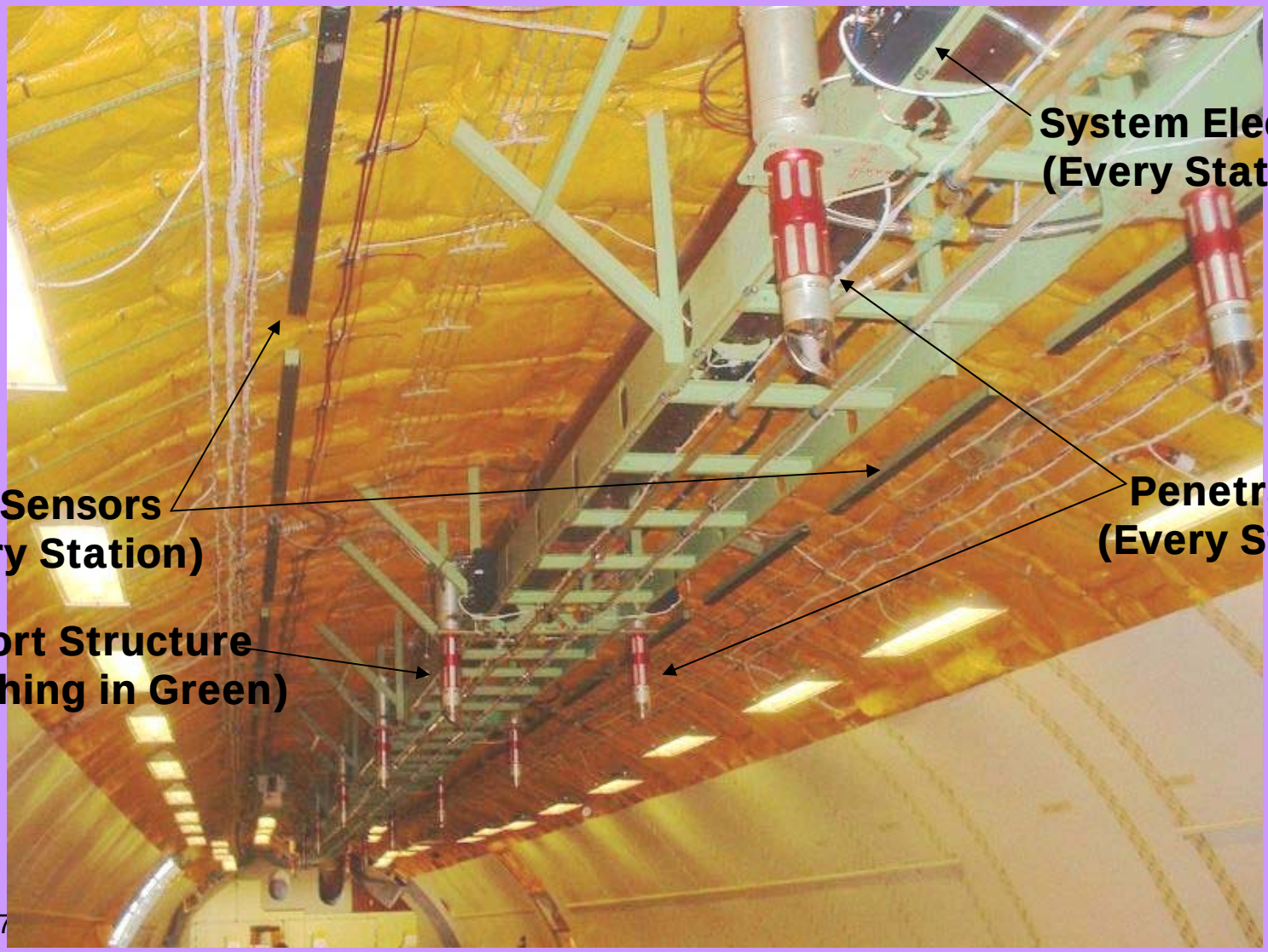
FedEx Fire Suppression System

Cutaway view of system



FedEx Fire Suppression System

FedEx FAA Certified FSS Installed on MD-10



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Breach of AMJ container within 15 minutes demonstrates undeclared hazmat fire WITHOUT fire suppression

Note: Container has new fire resistant roll-up door

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Container Problems – Poly-vinyl Roll-up Door

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FSS Demonstration with Fire Retardant Door and Foam Retention Modifications Totally Suppressed Fire

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Peltz Pallet Bag

- Halon® or foam is ineffective when used on pallet fires
  - No containment of agent
- Today hazmat is shipped on pallets internationally
- Pallet bag is a passive system to suppress a fire
  - Fire contained but not extinguished
- Prototype pallet bag fire testing proves the concept will survive a 4+ hour fire and meet ETOPS requirements!
- Pallet bag material selection trade study
  - Target completion Sept. 2007
  - In-service evaluation will follow, with final material selection based on durability, weight and cost by early 2008

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Peltz Pallet Bag Testing

Pallet Bag contains fire during 3+ hour burn test!

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Pallet bag removed after 3 hours – freight still on fire but fully contained in bag!

FedEx Fire Suppression System

FedEx Fire Suppression System Overview

- MD10-10 FSS FAA Certified STC issued August 4th 2006
- The MD10 system is a “technology demonstrator/proof of concept” system and FedEx has demonstrated the ability to:
  - Thermally detect a randomly located fire event
  - Automatically deploy the fire agent
  - Annunciate a fire event to the flight crew
  - **Extinguish a container fire**
  - Retract the system after deployment for quick unloading
- **The Peltz bag was demonstrated to be effective to safely contain a fire for 4+ hours**
- We plan to install an improved version on an MD11 in August 2008. This installation will be a production ready version of the Federal Express Fire Suppression System.

Container Modifications

- Our testing reveled that certain modifications were needed on our containers to optimize the Fire Suppression system.
  - The Poly-Vinyl roll up door material will be replaced with a more fire worthy material
  - Edge sealing the rollup door will help retain foam, prevent packages from experiencing water damage during inclement weather, and add an element of security to the container
  - Container tops must be painted or have a decal applied to improve their thermal emissivity