



Wire to Wire: *Swissair 111 Crash*

Leadership ViTS Meeting

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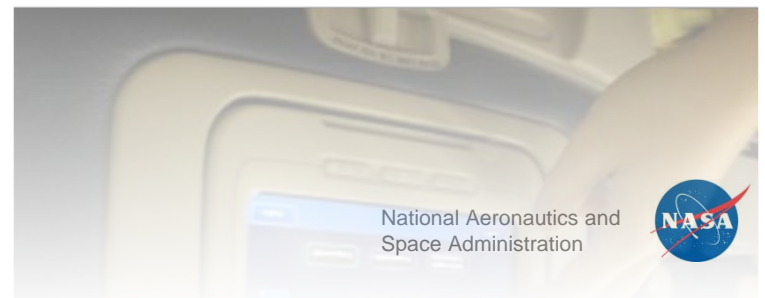


THE MISHAP

On September 2, 1998, Swissair Flight 111, a McDonnell Douglas MD-11 travelling from New York City to Geneva, Switzerland, crashed into the Atlantic Ocean southwest of Halifax International Airport and the island of Nova Scotia. All 229 people on board died - the highest-ever death toll involving a McDonnell Douglas MD-11. The Canadian Transportation Safety Board (TSB) investigation concluded that flammable material used in the aircraft's avionics wiring assemblies allowed a fire to spread beyond the control of the crew, resulting in the loss of the aircraft.

McDonnell Douglas MD-11:

- Structurally based on company's DC-10 design
- Upgraded for more economical and efficient operation via automation using avionics
- Swissair received first MD-11 in 1991
- In 1996, ambitious In-Flight Entertainment Network (IFEN) was installed; combined computer, video and audio technologies to allow passengers to select movies, audio, games, news, gambling, and a moving map through an interactive seat video display



WHAT HAPPENED?



Actual SR 111 flight path

Initial Diagnosis:

- 52 minutes after take-off, Captain and First Officer detect an unusual odor, then visible smoke in the cockpit
- Captain and First Officer agreed that the probable source was the air conditioning system – something crews had experienced before without fire or critical system effects
- Both pilots continue their deliberate – not immediate – actions, unaware of the fire raging in the cockpit attic space

Sense of Urgency but not Emergency:

- Smoke continued to build in the cockpit; Flight crew informed local air traffic control of an urgent (but not immediate) problem
- Pilots request clearance to divert back to Boston Logan International Airport, nearly 300 miles away
- Controllers suggest the closer Halifax Airport, only 60 miles away; Pilots immediately agree and begin initial descent

Uncontrollable Emergency Apparent:

- With First Officer at flight controls, the Pilot began to work through checklist for smoke in the cockpit
- Non-essential power was cut-off, but smoke worsened; Loss of essential flight instruments soon followed
- As they believed they were too heavy to land safely, the pilots circle south of Halifax to descend further and dump fuel
- Pilots finally declare emergency, but nothing else is heard from the crew
- Six minutes later, SR111 crashes into ocean; only 21 minutes had elapsed since the crew first noticed the unusual odor

PROXIMATE CAUSE

- TSB Investigators found an initiating wire arcing event occurred near the In-Flight Entertainment Network power supply unit cable, and easily ignited the flammable insulation blankets in the attic above the cockpit.
- The pilots' initial diagnosis of an unusual odor placed it as a benign air conditioning issue. Once the pilots realized that the smoky odor accompanied actual smoke, they declared an urgent situation and requested to land; however, during the time used to re-route the flight and commence an approach, subsequent systems failures made safe landing at Halifax impossible.

ROOT CAUSE / UNDERLYING ISSUES

Inadequate Aircraft Certification Standards:

- Certification testing procedures did not take into account the full range of potential ignition sources.
- Metalized polyethylene terephthalate (MPET, known as Mylar) covered insulation blankets, along with other installation material near IFEN, were subsequently found to be extremely flammable

Inadequate Fire Detection:

- Cockpit attic, a Non-Specified Fire Zone, was not required to have built-in fire detection or suppression systems
- Area was solely dependant upon human intervention for detecting and suppressing an in-flight fire; yet crew did not have access to attic space

Flawed Emergency Fire Plan:

- Upgraded systems, such as IFEN, were not considered in smoke detection checklist; pilots relied on sight and smell alone
- Misidentification caused crew to spend precious minutes performing navigation and communication tasks that would ultimately prove futile



Recovered IFEN Cable segment with area of melted copper, indicating an arcing event occurred

FOR FUTURE NASA MISSIONS

Safety Margin:

- New materials and evolving systems overcame the large safety margin afforded by time-tested standards, extensive government oversight controls, and a commercial aircraft and expert crew.
- We can readily perceive much smaller safety margins available for space flight hardware.
- Safety cannot simply be designed and built in; it must synchronize to changes in the system. People must create safety on a daily basis.

Human-Rating:

- Human-rating of commercial space hardware will require diligent effort to apply wisdom not once, but continuously.
- Deciding upon a set of essential safety requirements applicable across industrial and national borders will be extremely challenging.
- For human spaceflight there is no such thing as a “minor mod.”

