Strategic Approach to Fire Safety

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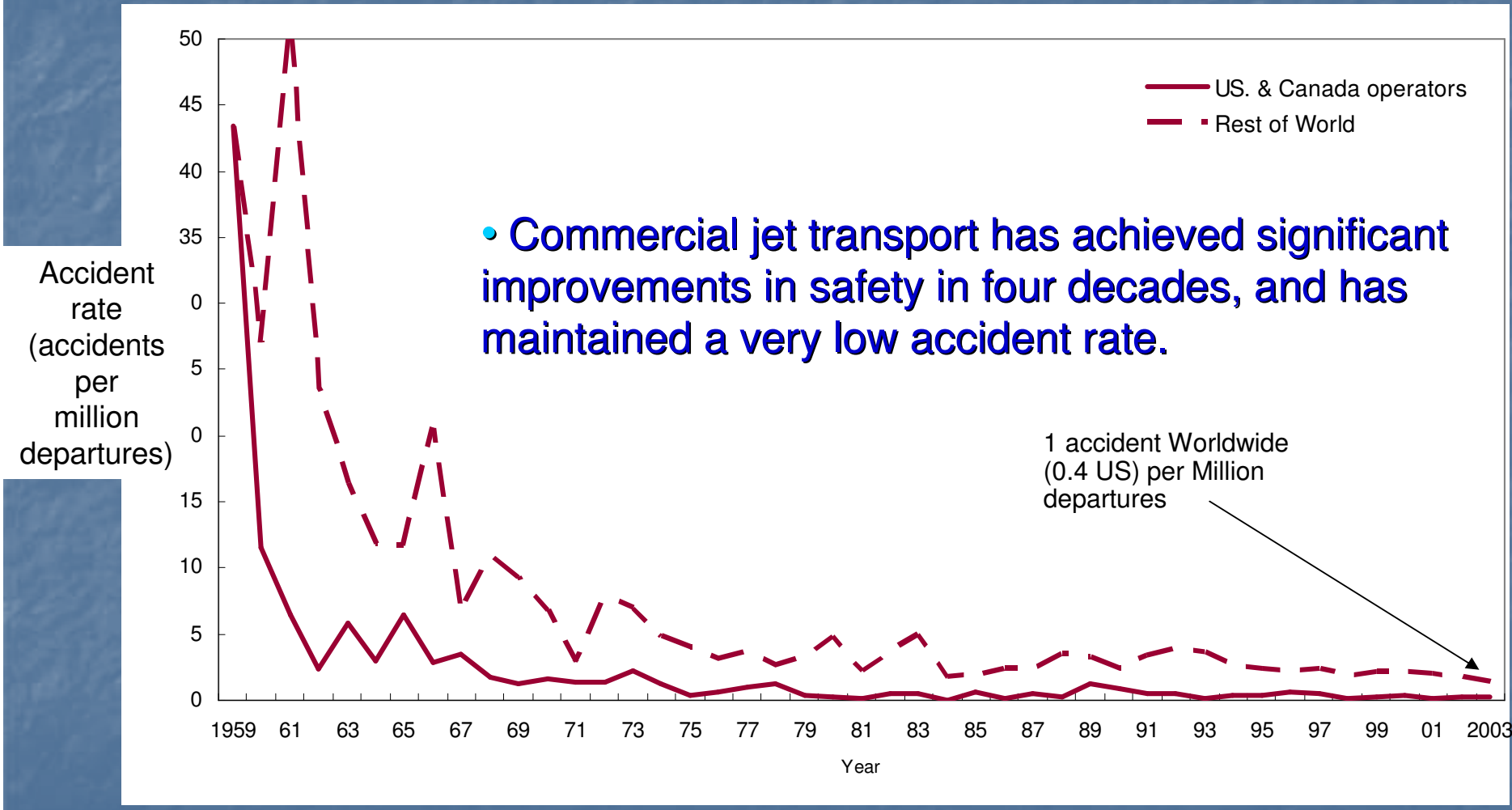
U.S.A. and Canadian Operators Accident Rates

Hull Loss and/or Fatal accidents - Worldwide Commercial Jet Fleet - 1959 through 2003



2003 STATISTICAL SUMMARY, MAY 2004

Source: http://www.boeing.com/news/techissues/pdf/statsum.pdf

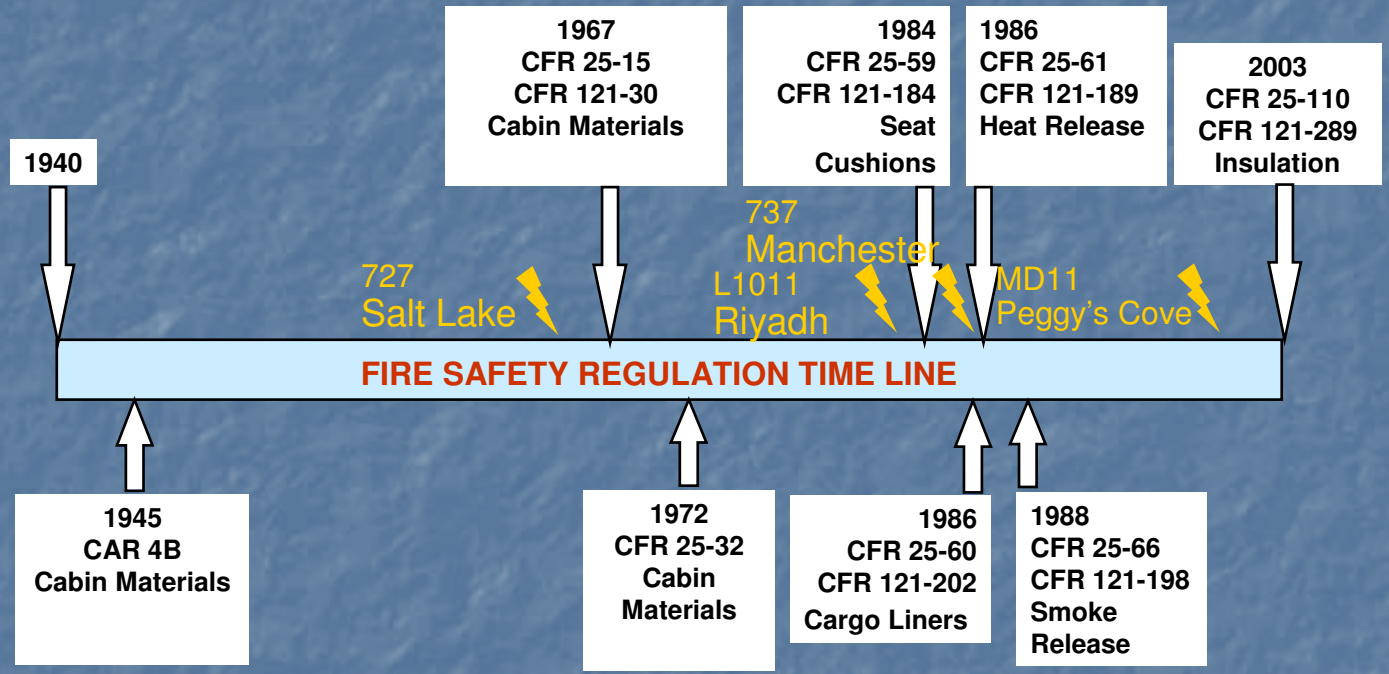
Fire Safety Strategy Summary

- Similar to other accident causes, fire events were much more frequent in the early years of commercial jet aviation
- Many fire safety improvements have been adopted… cargo systems, seats, cabin materials, lavatories, insulation and so on
- Fire accidents have been reduced to a very low rate
- But today's fire safety strategy remains based on events from early in the history of jet transport

Proposed Strategic Focus

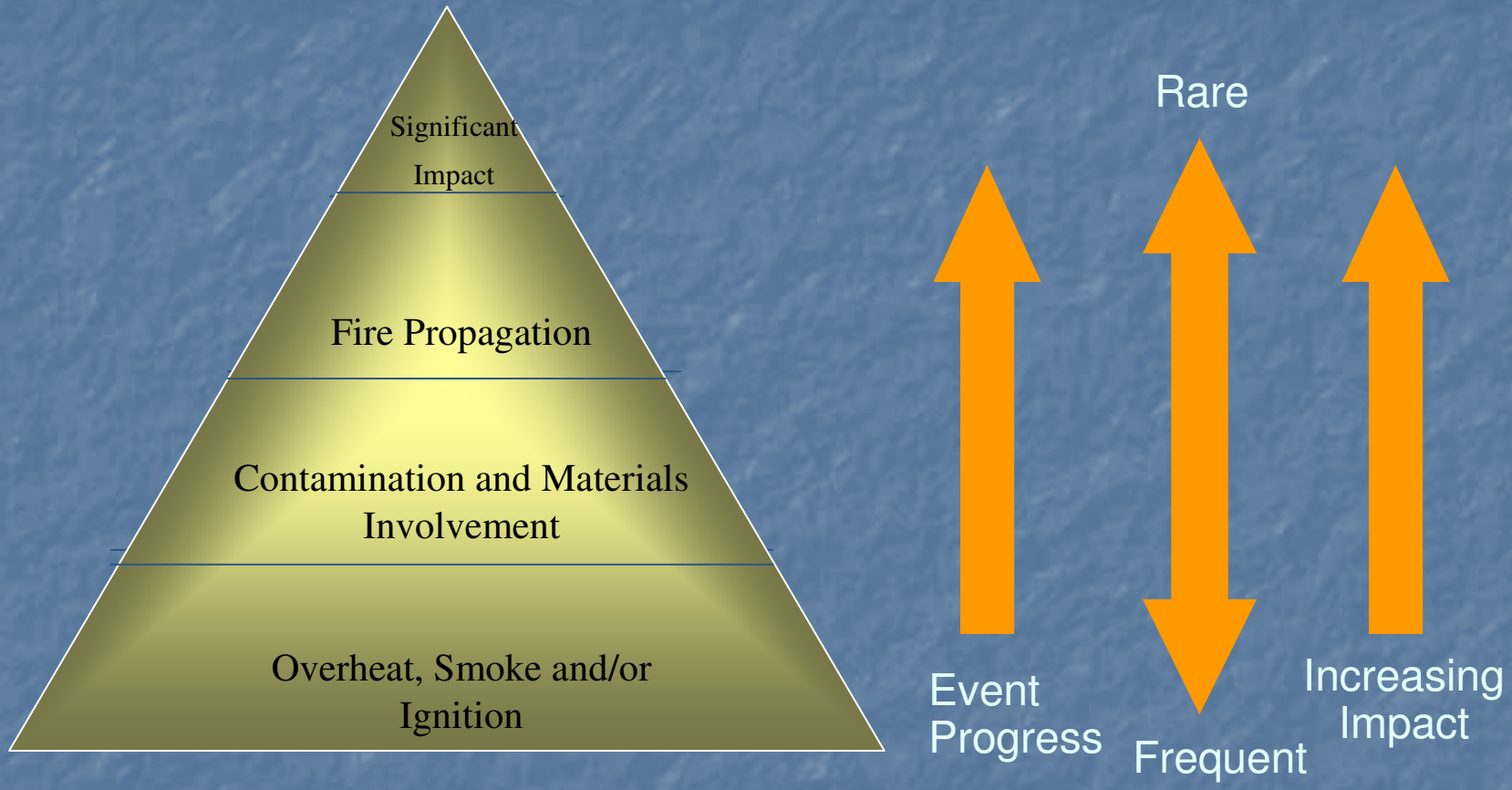
- Focus on the prevention of frequent 'precursor' events to enhance fire safety

Timeline of Regulatory Change
- Materials Example

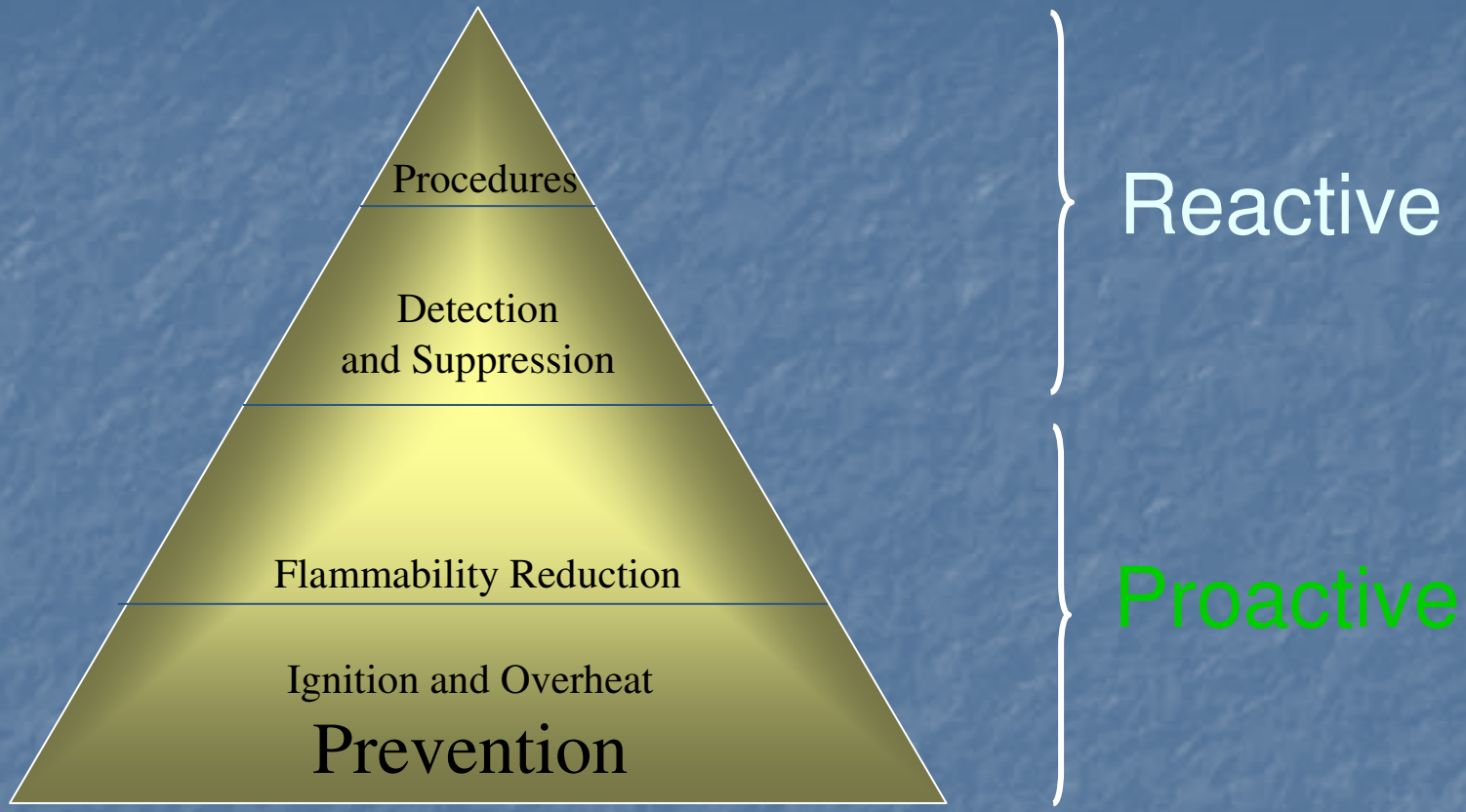


- *Fire strategy historically based on prior events*

Source: J. Peterson (Boeing) - modified



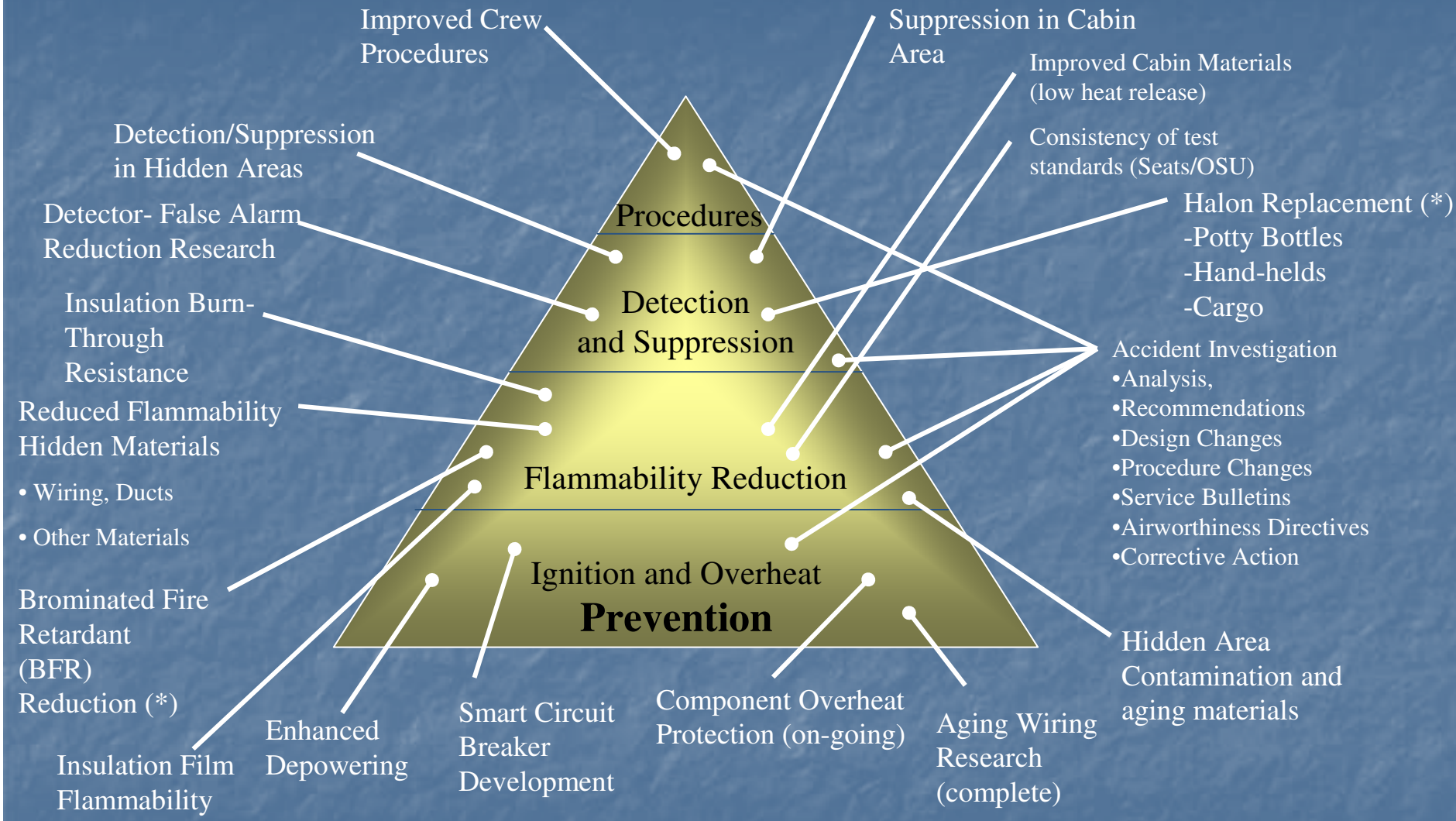
Counter Methods for Fire Events



- Focus strategy on ‘proactive prevention’

Source: K. Krieg/R. Nicholson/T. Porter (Boeing)

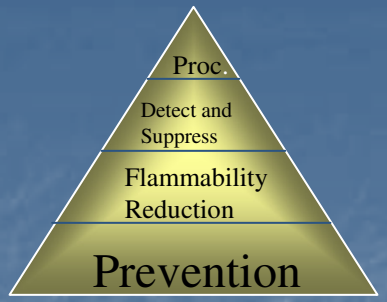
Pressurized Compartment Industry Fire Safety Activities



Focus, Priority, Effectiveness … Strategy?

Source: K. Krieg/R. Nicholson/T. Porter (Boeing)

(*) Note: Not safety enhancement, however common industry resources



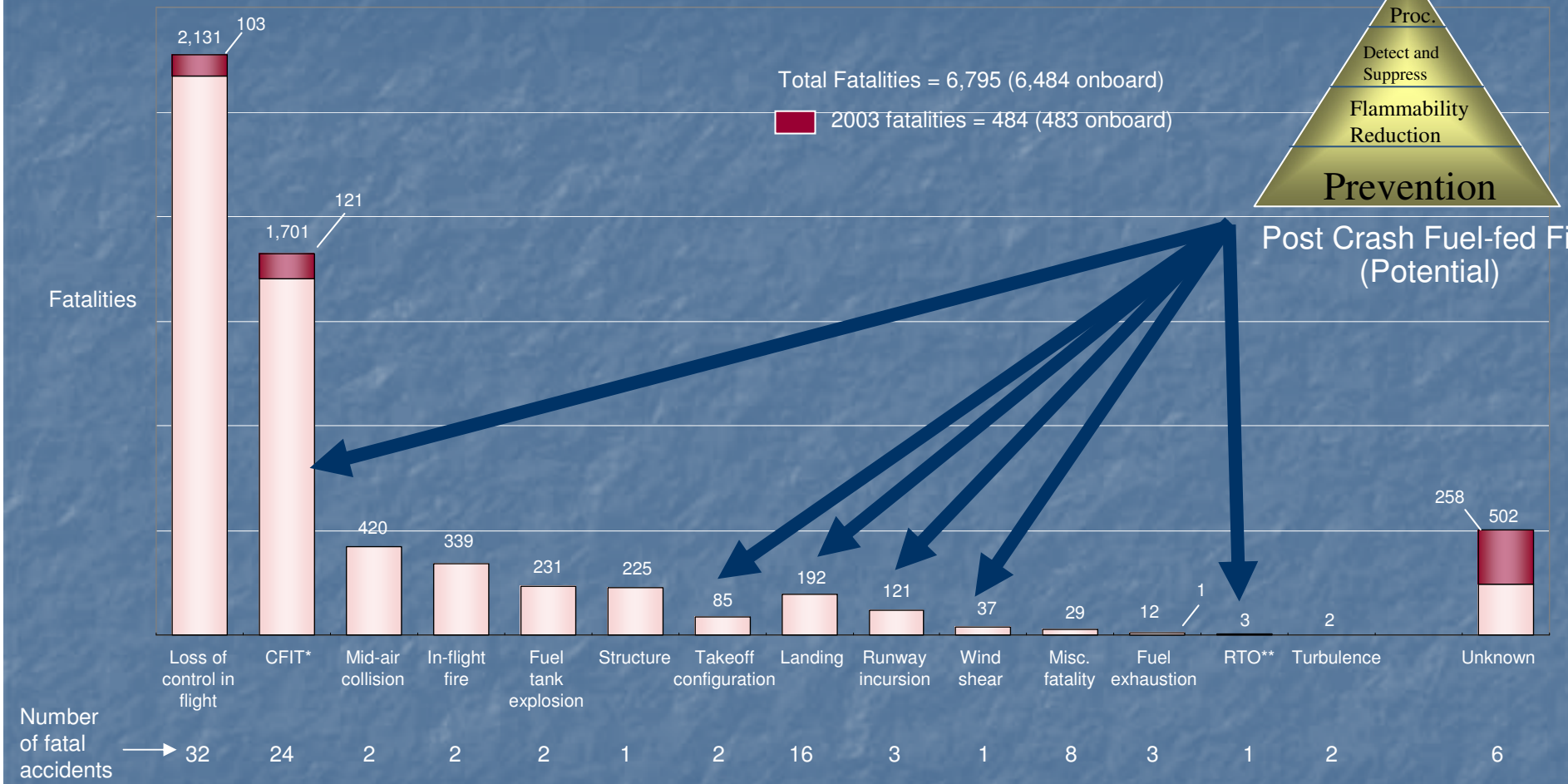
Post Crash Fuel-Fed Fire

Post Crash Fuel-Fed Fires

- Accident **Prevention** through CAST

Fatalities by Accident Category

Fatal Accidents - Worldwide Commercial Jet Fleet: 1994 - 2003



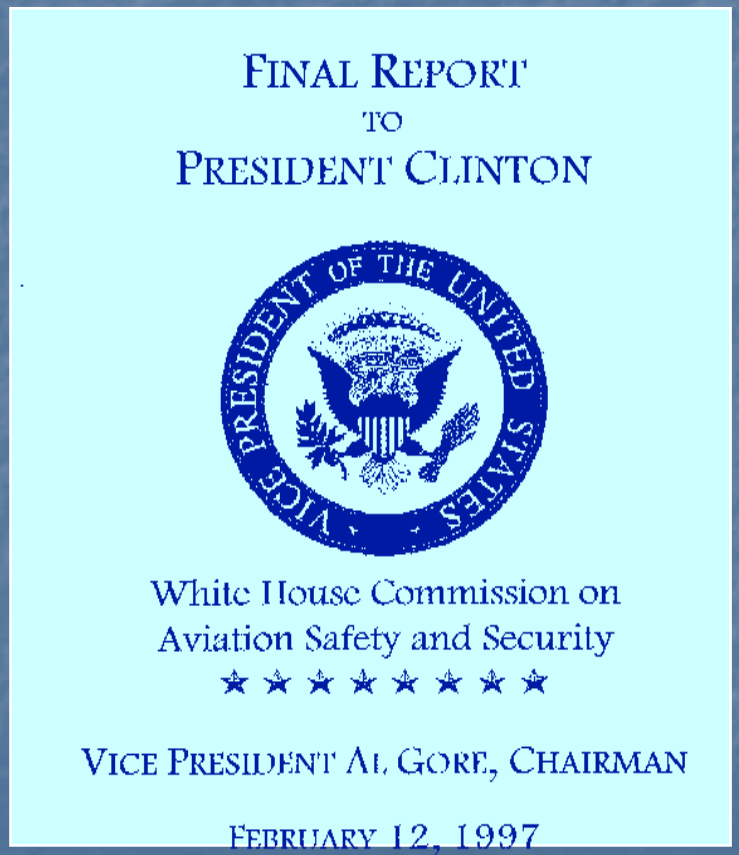
Note: Accidents involving multiple, non-onboard fatalities are included
Accidents involving single, non-onboard fatalities are excluded
Fatalities/accidents are placed in one category only.

* CFIT = Controlled Flight Into Terrain
** RTO = Refused Takeoff

2003 STATISTICAL SUMMARY, MAY 2004

Source: http://www.boeing.com/news/techissues/pdf/statsum.pdf

In the U.S., our focus was set by the White House Commission on Aviation Safety

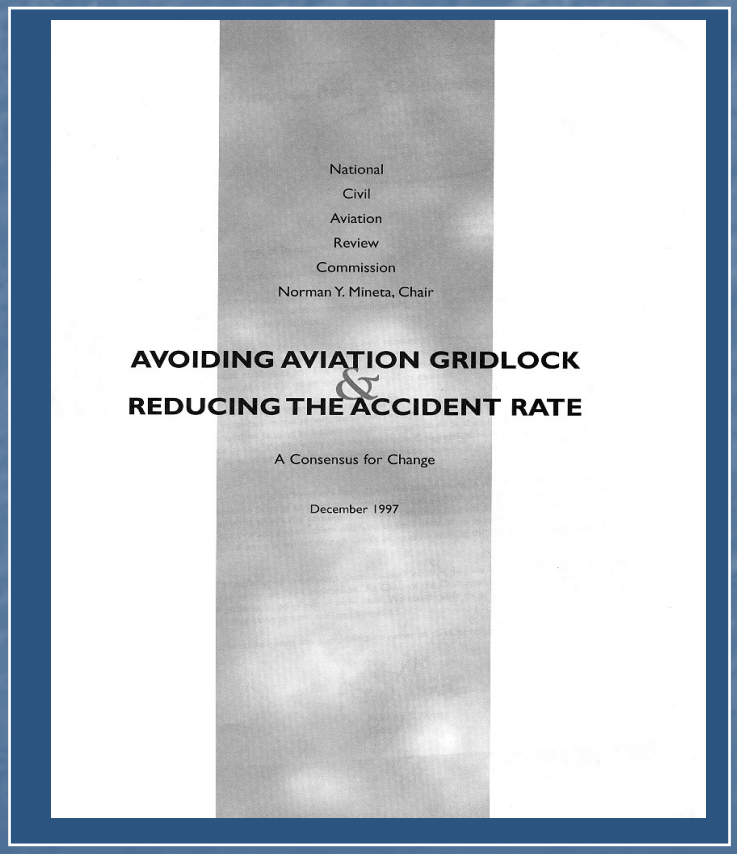


1.1 **Government and industry should establish a national goal to reduce the aviation fatal accident rate by a factor of five within ten years and conduct safety research to support that goal**

1.2 **The FAA should develop standards for continuous safety improvement, and should target its regulatory resources based on performance against those standards**

Source: Safer Skies Briefing, 6/2003, K. Olsen (FAA)

The National Civic Aviation Review Commission (NCARC) on Aviation Safety Provided Additional Direction

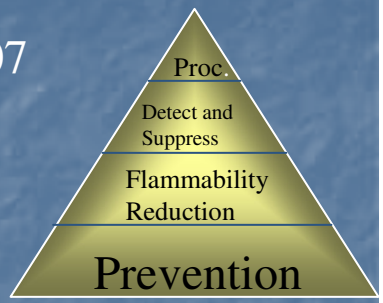


- **FAA and the aviation industry must develop a strategic plan to improve safety, with specific priorities based on objective, quantitative analysis of safety information and data**
- **Government should expand on their programs to improve aviation safety in other parts of the world**

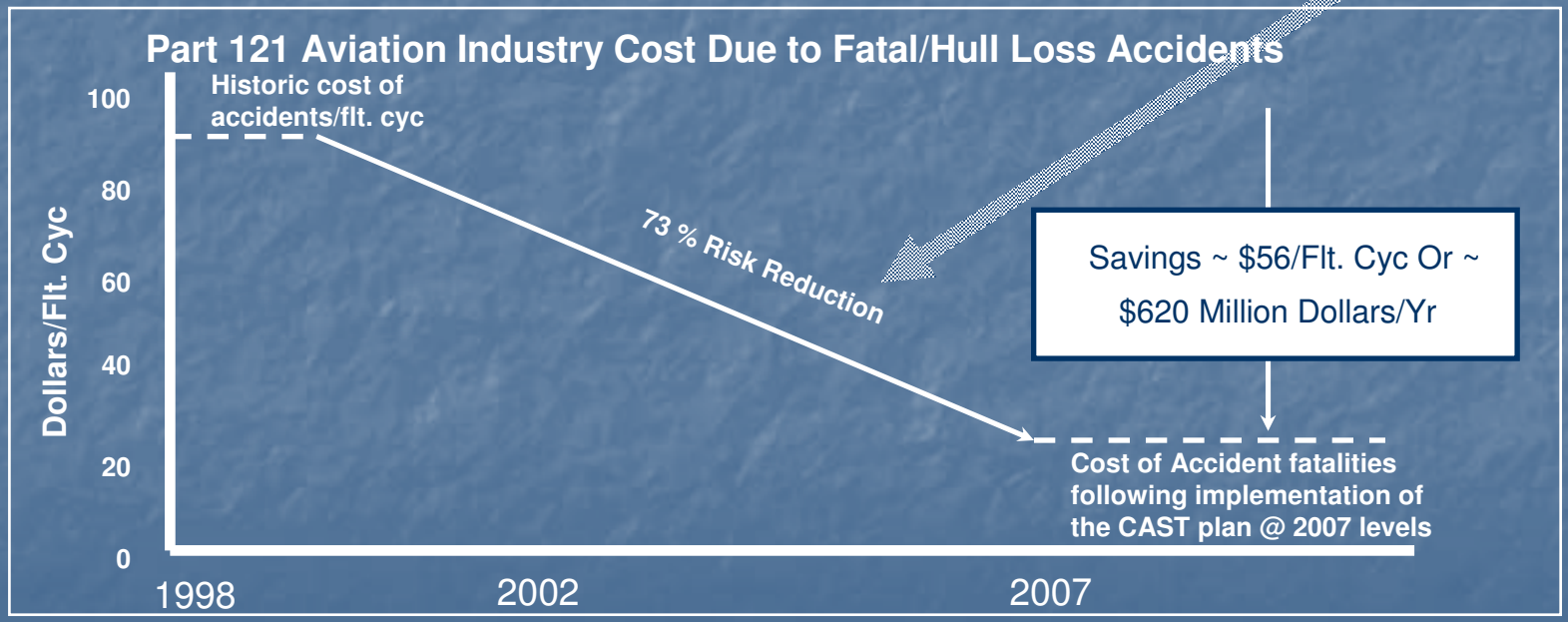
Source: Safer Skies Briefing, 6/2003, K. Olsen (FAA)

CAST Goals

- Reduce the U.S. commercial aviation fatal accident rate by 80% by 2007
- Work together with airlines, JAA, ICAO, IATA, FSF, IFALPA, other international organizations and appropriate regulatory/ government authorities to reduce worldwide commercial aviation fatal accident rate



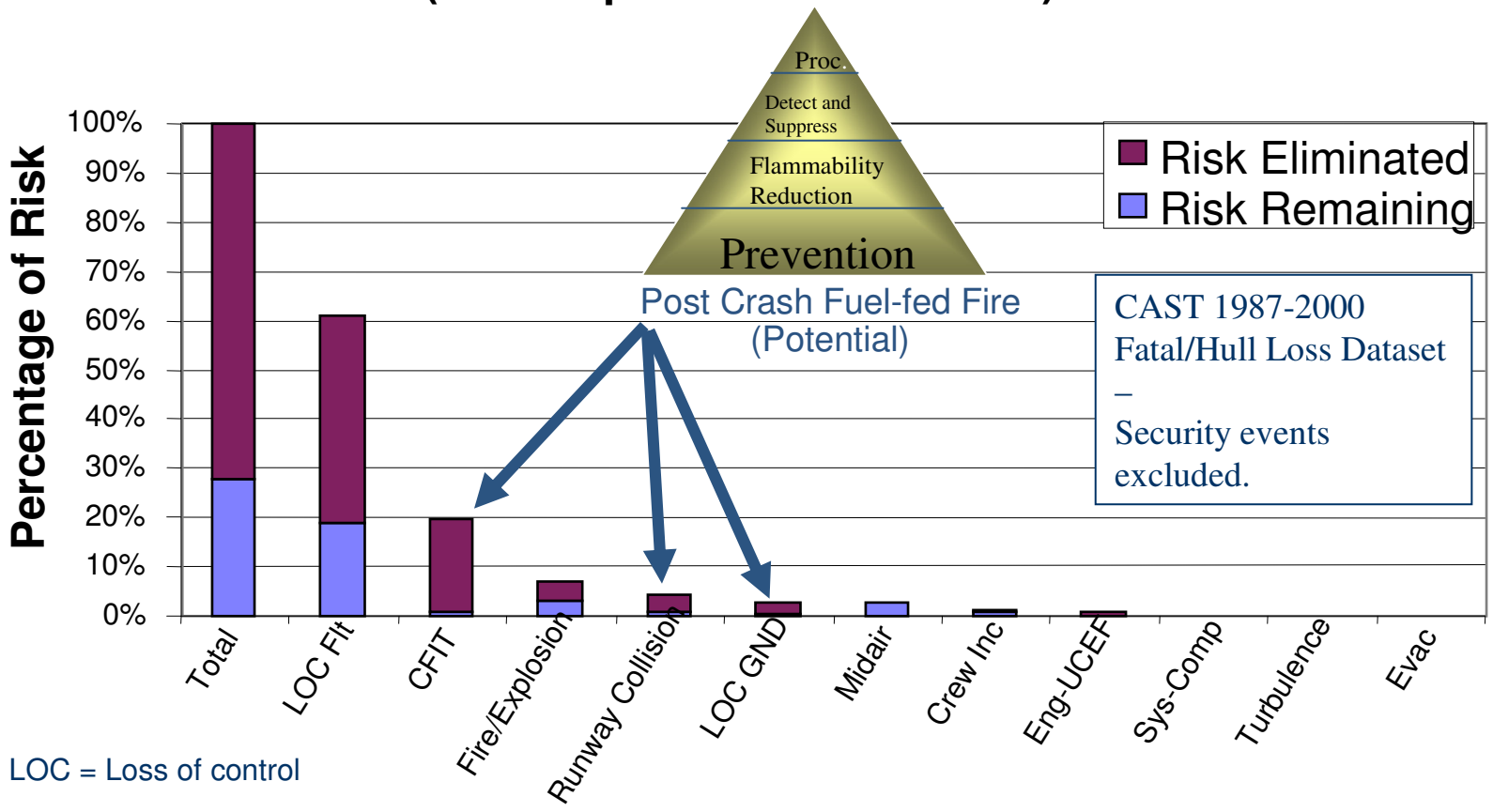
Post Crash Fuel-fed Fire (Potential)



Source: Safer Skies Briefing, 6/2003, K. Olsen (FAA)

Hull Loss & Fatal Accidents (U.S.)

Percentage of Total Fatality Risk Mitigated by the CAST Plan (2007 Implementation Values)



LOC = Loss of control

Source: Safer Skies Briefing, 6/2003, K. Olsen (FAA)

In-Flight Hidden Fires

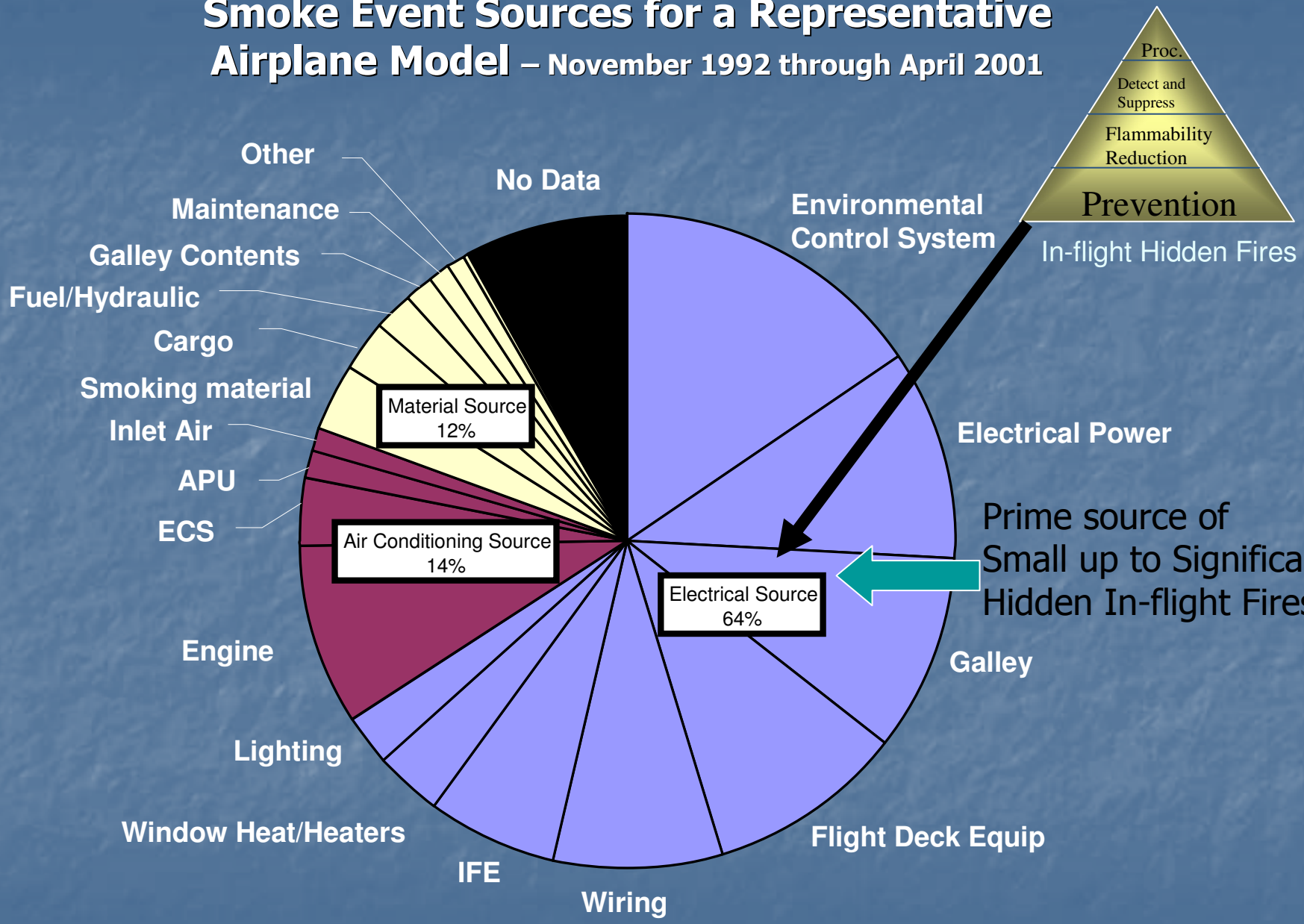
- **Prevention**

In-Flight Hidden Fires

- Significant progress has been made in reducing major fire events.
- Frequent small scale smoke and fire events continue to occur
  - Smaller events are 'precursor' to the very rare significant smoke/fire events
  - Industry addresses events based on single event diagnosis
  - Also, there are significant economic impact of small events due to air turn backs, diversions, and subsequent maintenance
- A different approach based on 'root cause' criteria that focuses on prevention is now required to reduce risk of major fires and improves economics
  - Use the CAST 'data driven' process as a model for in-flight fires
  - Focus industry resources on global solutions, processes and tools to prevent small scale frequent fire and smoke events to reduce the risk of major events

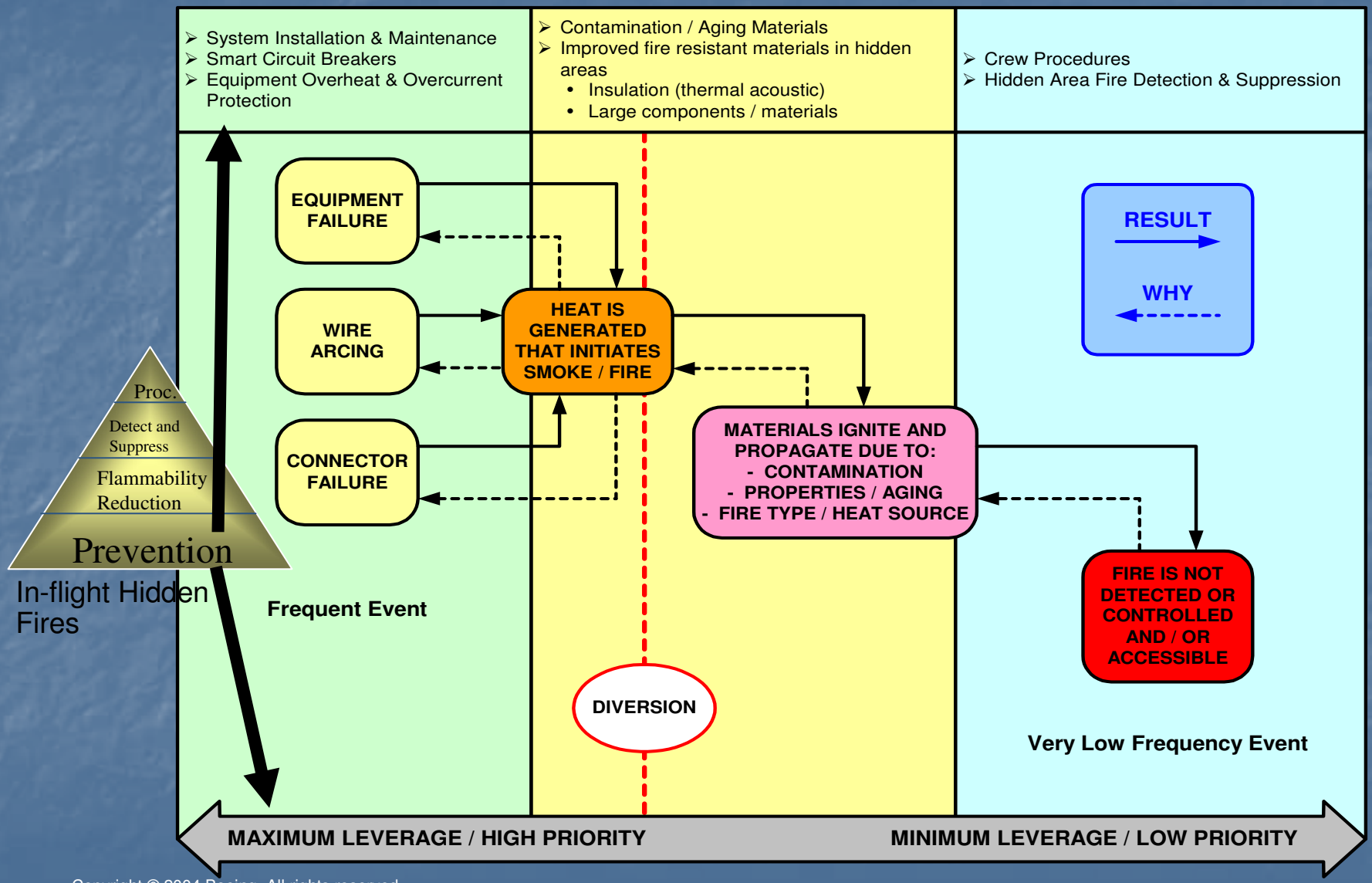
In-flight Hidden Fires

Smoke Event Sources for a Representative Airplane Model – November 1992 through April 2001



Source: Boeing, Aero Magazine, No. 14, April 2001J. Morton, R. Nicholson
http://www.boeing.com/commercial/aeromagazine/aero_14/

In-Flight Hidden Fire Event Sequence - Example



Conclusions and Recommendations

- **Post-Crash Fuel-Fed Fire**
  - Fire Safety Industry adopt and accept the CAST Risk Reduction plan for accident prevention.
    - Worldwide implementation through ICAO and others

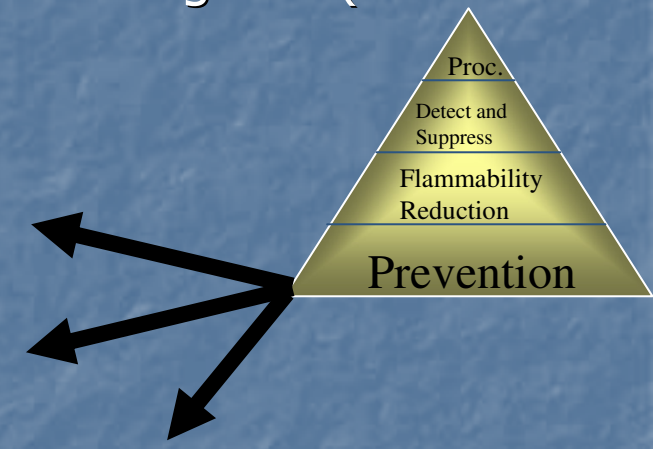
- **In-Flight Hidden Fires**
  - **Fire Safety Industry Should Implement:**
    - Improved maintenance practices and methods - ATSRAC
    - Systems 'over-current' and 'over-heat' protection (1)
    - Non-Essential Equipment standards enhancement
    - Aftermarket (STC) equipment installation standards enhancement
    - Smart Circuit Breaker (arc fault/GFI) with fault ID servicing tools (1)
    - Contamination/Aging – Materials and Maintenance
  - **The UK AAIB advocates a similar approach:**
    - **Bulletin No: 6/2004, Dated 21 May 2004. (2)**

(1) Priority on non-critical systems

(2)Source:http://www.dft.gov.uk/stellent/groups/dft_avsafety/documents/page/dft_avsafety_029072.hcsp

Conclusions and Recommendations (cont'd)

- Recommend: Industry Strategic Steering Committee (CAST like) for all fire types:
  - Industry working together to measurable common goals (i.e. standards) to enhance safety
  - Data Driven Process focused on Prevention
    - Forensic:
      - Identify and eliminate the historical risks
    - Diagnostic
      - Identify and eliminate the current risks
    - Prognostic
      - Forecast the future risks and design them out of the future
  - Target resources and implementation process for maximum effective industry value



- Boeing supports and is ready to participate in industry team(s) based on PREVENTION.