Overview of NASA’s Fire Protection Research

Presentation to Fire & Cabin Safety Research Conference

23 October 01
Atlantic City, New Jersey

Robert McKnight
Acting Manager

Accident Mitigation Project
NASA Aerospace Technology Enterprise------ Goal 1
Enable a Safe, Environmentally Friendly Expansion of Aviation

10 Year Objectives

- **Increase airspace capacity**
  - Double capacity

- **Increase mobility**
  - 1/2 door-to-door time

- **Increase Safety**
  - 1/5 accident rate

- **Reduce Emissions**
  - 1/3 NOX, 3/4 CO2

- **Reduce Noise**
  - 1/2 ground noise
NASA Aviation Safety Program Organization

Program Office –
LaRC (Sam Morello)

Accident Mitigation--GRC

Weather Accident Prevention--------GRC

Single Aircraft Accident Prevention –LaRC

Synthetic Vision-LaRC

System Wide Accident Prevention--ARC

Aviation System Monitoring and Modeling—ARC
General Accident Mitigation Goals:

• Prevent, detect, and suppress in-flight fires
• Technology application by 2007, 2022
General Accident Mitigation Goals:

- Increase human survivability of crash impact and post-crash fires
- Technology application by 2007, 2022
NASA Funding

NASA Project Funding of AvSP Accident Mitigation

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<tr>
<th>Gross Funding M$</th>
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Collaborations (partial list)

• FAA Technical Center Fire Safety Section
• Intl AC Systems Fire Protection WG
• ARAC Fuel Tank Inerting Harmonization WG
• Boeing Phantom Works
• OBIGGS / OBOGS equipment manufacturers
• Sandia National Laboratories
• NIST
• Makel Engineering Inc
• Glennan Microsystems Initiative
Implementation Challenges

• Regulatory uncertainty

• Cost impact
  
  – Increases in cost, weight, maintenance
  
  – Few or no side effects from implementation that will produce:
    
    o Increases in operating efficiency, such as with Weather Accident Prevention technology
    
    o New profit opportunities, such as with Synthetic Vision System technology
2.5.2.3 Fuel Tank Inerting / Fire Suppression / Oxygen

- Boeing study of system requirements completed
- Boeing study of OBIGGS / OBOGS technology
- State-of-the-art completed
- Emerging Technologies (partial list) -
  
  **OBIGGS**  
  Cryogenic Distillation (N2)  
  Pressure Swing Absorbtion (N2)  
  Hollow Fiber Membrane (N2)  
  Combustion Generation of CO2

  **OBOGS**  
  Cryogenic Distillation  
  Ceramic Membrane  

- Requests for Proposal (RFP) being prepared for design phase. Downselects from design phase will enter fabrication and test phase.
## Major Milestones

### 2.5.2.3 Fuel Tank Inerting / Fire Suppression / Oxygen

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<td>Ground Testing of OBIGGS / OBIGS Demo Systems</td>
<td>Ground Demo of OBIGGS Cargo Fire Suppression</td>
<td>TRL 6 Demo of OBIGGS / OBOGS</td>
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2.5.2.1 Cargo Fire Detection

- Microfabricated fire gas sensors developed. SnO2, NASICON
- FAA development of “resin block” standard smoke & fire source
- FAA initial fire tests for development of analytical model completed.
- Sandia completed first version of cargo compartment fire smoke, heat, gases analytic model.
- Testing of microfabricated sensors in FAA Fire Test Facility this fall.
## Major Milestones

### 2.5.2.1 Cargo Fire Detection

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<td>2ND Generation Gas Sensors Tests</td>
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<td>Integration of Gas Sensors / Signal Processing</td>
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<td>TRL 6 Fire Detection System Demo</td>
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R. McKnight

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2.5.2.4 Fire –Safe-Fuels / 2.5.1.3 Crash Resistant Fuel Systems

• Data mining of post AMK research completed. Three research focus areas were identified:
  — Surfactants -- to decrease the vapor pressure of current commercial jet fuels
  — Gelling agents -- to reduce the vaporization rate of atomized fuel
  — Chemical composition changes -- to decrease the fuel’s vapor pressure

• NASA GRC fuel flammability test rig nearing completion

• Robertson Aviation completed its report on crash resistant fuel systems (CRFS). Several research focus areas were identified:
  — Systematic method of evaluating the crashworthiness of designs
  — Frangible, breakaway fuel system fittings and tubing.
  — Breakaway auto shut off valves
  — Fuel tank reinforcement

• NRA’s for crash resistant fuel system research are in preparation.
## Major Milestones

### 2.5.2.4 Fire –Safe-Fuels

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<td>4Q02- Baseline Flammability Testing of Existing Fuels</td>
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<td>2Q03- Fuel Modification Concepts Designed</td>
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<td>Advanced Testing of Fuel Modifications -3Q05</td>
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### 2.5.1.3 Crash Resistant Fuel Systems

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<td>2Q04 Fuel System Tests</td>
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<td>Commuter Crash Test 3Q04</td>
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<td>Crashworthiness Design Guidelines 3Q05</td>
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Aircraft Security Proposals

Submitted to NASA Hq’s aircraft security planning group----

• Fuel Tank Inerting:
  – Development of civil transport inerting technology to inert all fuel tanks for low – slow flight during approaches to airports as well as during departures.
  – Provides protection from incendiary projectiles directed from terrorists at unsecure urban / rural / oceanic areas under arrival and departure corridors.

• Cargo Compartment Chemical Sensors:
  – Development of civil transport microsensor systems which can be networked throughout aircraft cargo compartments and ventilation ducts to detect outgassing from explosive materials or from chemical / biological agents placed in the aircraft.
Web Sites

*NASA Hq Aerospace Technology site* -
www.aero-space.nasa.gov/goals/safety.htm

*NASA Langley Lead Center AvSP site* –
avsp.larc.nasa.gov/

*NASA Glenn AvSP site* -
www.grc.nasa.gov/WWW/grcavsp/index.html

*FAA Tech Center Fire Safety Section site* -
http://www.fire.tc.faa.gov/index.html?top.html&0