Fifth Triennial International Aircraft Fire and Cabin Safety Research Conference

Integrated Fire Protection Systems
Transport Canada have commissioned a research study to:

*Identify the feasibility, practicality, and issues that are likely to result from the implementation of such a system prior to the concept being considered a cost-beneficial safety enhancement.*
INTEGRATED FIRE PROTECTION SYSTEMS

We would also like to thank the

U.S. Federal Aviation Administration
U.K. Civil Aviation Authority

for the collaboration and supporting activities given to this project since its conception
OBIGGS = Onboard Inert Gas Generating System
OBOGS = Onboard Oxygen Generating System
OBIGGS/OBOGS

HOLLOW FIBRE MEMBRANES

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CABIN WATER
MIST SYSTEM
INTEGRATED FIRE PROTECTION SYSTEM
Cabin Water Mist System

- Post-crash survivability
- In-flight cabin fire
INTEGRATED FIRE PROTECTION SYSTEM
Cabin Water Mist System – Project

Achievements to date include:

2. Proposed System Architecture (Including an assessment of the number of post-crash fuselage breaks that needs to be accommodated)
3. System Weight Assessment
4. System Reliability Requirements
5. Proposed System Activation Means
6. Water system issues and requirements
INTEGRATED FIRE PROTECTION SYSTEM
Cabin Water Mist System

Probability of Occurrence of Fuselage Breaks

Maximum Number of Certificated Passenger Seats

0 50 100 150 200 250 300 350 400

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

No Breaks

One Break

Two Breaks

Three or More Breaks
INTEGRATED FIRE PROTECTION SYSTEM
Cabin Water Mist System Architecture using dedicated water supplies

- Main distribution pipe connecting all water tanks
- Cabin Water Mist System
- Forward water tank
- Cargo Bay Water Mist System
- Centre water tank
- Aft water tank

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INTEGRATED FIRE PROTECTION SYSTEM

Cabin Water Mist System – Some issues requiring resolution

- System Weight Reduction
- Effects on aircraft systems of inadvertent operation in flight
INTEGRATED FIRE PROTECTION SYSTEM

Equipment Bay Inerting using NEA

- A model has been developed for electrical equipment bay inerting

- Primary Issues
  - Will the system be Cost Beneficial
  - Air flow rates into and out of Equipment Bays
HIDDEN AREAS
INERTING
INTEGRATED FIRE PROTECTION SYSTEM

Hidden Areas Inerting

- Distributing NEA from OBIGGS to extinguish fire in hidden areas by inerting
- Main issue: containing inert condition in the fire area with a high airflow condition
- FAA ongoing research
INTEGRATED FIRE PROTECTION SYSTEM

Hidden Areas Inerting

CUMULATIVE PROBABILITY DISTRIBUTION OF TIME TO BECOME NON-SURVIVABLE

CUMULATIVE PROBABILITY

TIME MINUTES
## INTEGRATED FIRE PROTECTION SYSTEM

### Hidden Areas Inerting – Percentage of Free Space inerted in 8 minutes

<table>
<thead>
<tr>
<th>Aircraft Type</th>
<th>NEA 5%</th>
<th>NEA 8%</th>
</tr>
</thead>
<tbody>
<tr>
<td>B737-800</td>
<td>22%</td>
<td>27%</td>
</tr>
<tr>
<td>B747-400</td>
<td>5%</td>
<td>6%</td>
</tr>
<tr>
<td>B757-300</td>
<td>31%</td>
<td>37%</td>
</tr>
<tr>
<td>B767-300ER</td>
<td>23%</td>
<td>27%</td>
</tr>
</tbody>
</table>

P:\Rgwc0938 Integrated Fire Protection System Phase 2\Final Data and Report\Hidden areas\HiddenAreaInerting.xls
WHEEL WELL INERTING
INTEGRATED FIRE PROTECTION SYSTEM
Wheel Well Inerting with NEA

Main Issues

- Air flows in the wheel well
- Are there more effective ways of achieving the same level of safety?
PASSENGER
OXYGEN
INTEGRATED FIRE PROTECTION SYSTEM

Passenger Oxygen using OEA

- Current Hollow Fibre Membrane technology capable of producing OEA at c 35% oxygen not viable as a direct replacement for the supplemental oxygen system.
However, there is potential to reduce the amount of stored oxygen required with perhaps a consequential cost and weight reduction.
CARGO COMPARTMENTS
INTEGRATED FIRE PROTECTION SYSTEM
Cargo Compartment Water Mist/NEA System

- Halon replacement fire suppression system utilising NEA from OBIGGS and a water mist system has been shown to pass the Minimum Performance Standard FAA DOT/FAA/AR-TN05/20
INTEGRATED FIRE PROTECTION SYSTEM

Cargo Compartment Water Mist/NEA System

1. Development of a comprehensive cargo compartment inerting model which assesses inerting capability and system weight.

- **Aircraft specific data** (Cargo Compartment Volumes and leakage rates, Number of ASMs required for Center Fuel Tank Inerting, etc)

- **ASM performance data based on FAA testing**
2. “Design concepts” evaluated:
   a) Additional ASMs
   b) Supplementing inerting with Pure Nitrogen
   c) Using compressors to enhance ASM performance
INTEGRATED FIRE PROTECTION SYSTEM
Cargo Compartment Water Mist/NEA System

B767- 300ER aft Cargo Compartment 3152 ft³
6 ASMs installed for Fuel Tank Inerting
INTEGRATED FIRE PROTECTION SYSTEM

Cargo Compartment Water Mist/NEA System

FUTURE WORK

- Reassessment of system weight based on FAA testing of cargo bay target inerting level
- Development of a specification for a Water Mist/Nitrogen Enriched Air system
- Investigation of fuel cell technology
- New water mist technology?
INTEGRATED FIRE PROTECTION SYSTEM
Cargo Compartment Water Mist/NEA System

PRIMARY ISSUES
- System Weight
- Power Demand for Compressor System
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**Is this feasible?**