INTERNATIONAL AIRCRAFT SYSTEMS FIRE PROTECTION WORKING GROUP MEETING

Hosted by the FAA Technical Center Fire Safety Branch, Atlantic City, New Jersey, USA

October 25-26, 2006

Please note: The presentations are available on the Fire Safety website at www.fire.tc.faa.gov on the Systems page.

WEDNESDAY, OCTOBER 25, 2006

FAATC Hidden Fire Testing Update

OBIGGS Utilization in Inaccessible Areas – S. Summer

Objectives: design and install an NEA distribution system for fire protection of the overhead area of the FAA's 747SP and 737 test articles

Photos of test section for each test article and description of test configuration given

Steve also provided the current status of this test program

Dick explained that this is research work

Hidden Fire Testing – D. Blake

Photos of 727 freighter above ceiling area that has been mocked up/727 instrumentation was described

Steve is investigating the concept and limitations for certain types of aircraft. Dave is investigating how practical these systems would be.

Tests:

4" cubic foam blocks ignited above ceiling: locations of these blocks were given, and results of the tests conducted in a number of locations were presented.

Future Work: determine NEA flow rate requirements with higher capacity air compressor; assess the requirements for the detection system and zone size when adequate NEA is available

Aircraft Cargo MPS Test of FK-5-1-12 – J. Reinhardt

Agent & System Information
MPS Tests and Results

The FAA was interested in this agent because of its atmospheric lifetime and its non-depletion of the ozone.

Agent: EPA/SNAP listed. It is a liquid agent that disperses as a gas.

John described the system used for this agent. It was a commercially available.

Tests conducted in TC-10 test article.

Photo of aerosol can explosion simulation test. A schematic of the pressure vessel was shown.

The MPS Tests & Results were reviewed for aerosol explosion tests, surface burn fire test, containerized fire test, bulk load fire test.

Final Remarks:

This agent passed two out of the four tests. It was not effective, because it did not meet/pass all four tests. John provided some suggestions for this agent based on his observations during these tests.

<u>Cargo Bay Fire Protection with a Fuel Tank Inerting System</u> – B. Cavage

OBIGGS Cargo Bay Fire Protection background, test article methods (ASM Performance Testing), modeling methodology, results presented.

Block diagram of ASM Performance Test Apparatus.
Test Article 747SP Cargo Bay.
The Modeling Method – Altitude Calculation Model was briefly described.
Results – ASM Performance Data.
Results – Time to Inert.
Results of Time to Inert Calculations (graph)
Results of Time to Inert Validation (graph) – performed full-scale test of time to obtain suppression concentrations in the 747SP cargo bay
Results – Time not Inert
Results of Time Not Inert Calculations
Results – Time not Inert Sensitivity
Results of Time Not Inert Sensitivity Analysis
Summary: Results indicate OBIGGS requirements are consistent with cargo bay fire protection (NEA flow very sensitive to bleed air pressure); time to inert results illustrate expected trends (decreases in permeate pressure decrease time to inert); time to inert results (with Halon) illustrate expected trends; sensitivity of time not inert results shows results not sensitive to cargo bay size, but cargo density has large effect.
Recommendations: need to understand better the benefit of any interaction between Halon and reduced oxygen concentration on cargo bay fire scenarios; need to validate the existing cargo bay inert gas Halon model; need to better understand air leakage cause and effect in cargo bays and specifically how the leakage rate changes with altitude and with the amount of NEA deposited in the bay.

<u>Fuel Cells Testing Update</u> – H. Webster

Micro Fuel Cell Fuels: methanol, formic acid, Borohydride, butane, hydrogen stores in metal hydrides.

Items powered by fuel cells are under development. Items that may used micro fuel cells: music player, cell phone, laptop computers, charging systems for charging existing battery packs, flashlights.

Future Tests: working with FAA Hazmat and PHMSA in developing rulemaking regarding fuel cell use in flight, packed in checked and carry-on baggage, and bulk shipping.

Flammability tests will be conducted on the different technologies as production units become available:

Individual units
Bulk shipments
Fuel cells used in powering electronic equipment

<u>In-flight Fire Fighting Training Video</u> – D. Blake

AC 120-80 Advisory Circular published in 2004 based on a recommendation from NTSB. A video covering the points contained in this AC is currently being produced. Dave described some of the details and items covered in the video. The script is close to being finalized. The video will be filmed in the Airbus simulator in France and at the FAA Technical Center's Fire Safety Branch test facilities.

<u>Handheld Extinguisher Draft Advisory Circular Summary</u> – L. Speitel
April is currently formatting this AC. She will send it to FAA Headquarters by early November 2006. The notice for comments should be out in approximately two months.

Louise reviewed the main sections of the AC as well as the changes that have been made since her last presentation on the status of the AC.

<u>Integrated Fire Protection</u> – R. Cherry

Background: the concept was conceived by the FAA and Transport Canada.

The FAATC Fire Safety Branch provided data for this work.

Ray provided the Summary of Main Achievements – Cargo Compartment Water Mist/NEA System.

Currently, consideration is being given to the use of compressors to increase the inlet pressure to the existing air separation modules (ASMs).

- Eaton has supplied RGW Cherry & Associates with compressor weights in support of this project
- We need to know what the characteristics and capabilities are of ASMs operating beyond 60 psia
- To achieve comparable weights with Halon we would need to significantly reduce water system weights

Evaluation of optimization methods that may result in a reduction in system weights:
- Oxygen concentration target
- Cargo compartment leakage

Future Activities – Cargo Compartment Water Mist/NEA Systems:
- Reassessment of Cargo Bay leakage rates
- Investigation of fuel cell technology

There is a need to know about the leakage in the cargo compartment.

Summary of Main Achievements - Cabin Water Mist System:

Determination of the required safety reliability of a cabin water mist system.

Development of a possible activation system architecture for the water mist system.

Determination of the number of fuselage breaks that should be taken into consideration in a cabin water mist system.

Displayed a diagram of the general system architecture of the water mist system.

International Environmental Update – T. Cortina

Climate Change:

Kyoto Protocol officially entered into force on February 16, 2005

There are no international policies and measures.

U.S. will not become a party of the Kyoto Protocol, currently focused on voluntary programs to address green house gases (GHGs), rumors of policy change

California recently passed legislation that regulates GHGs. Other states expected to follow.

Europe:

EU emissions trading scheme – 2005.
Major industries such as oil, steel, cement, glass, and paper have a CO_2 cap.
There have been recent calls in Europe to address transportation in this scheme.

EU F-gas Regulation:

Fluorinated GHGs
Allows Austria and Denmark to keep existing HFC regulations
Member states cannot make regulations that are more restrictive than this EU regulation.
Entered into force July 4, 2006, and applies officially July 4, 2007.
Does not prohibit the use of HFCs for fire protection.

EU Halon Critical Use List:

The list is currently under review to be revised.

EPA SNAP Program:

Significant new alternatives policy (SNAP) proposed rule published on September 27, 2006.
PBr3 acceptable subject to use conditions which limit use to only aircraft engine nacelles.
PBr3 is highly toxic, but a very small amount is used.
It will be installed on Eclipse 500 jet.

Montreal Protocol:

HTOC met in August to complete work on 2006 assessment report.
Assessments reports highlight remaining issues for the Parties related to the transition from Ozone depleting substances to alternatives.
Civil aviation summary:
-only sector that continues to be dependent on halons in new equipment
-lacks a focused plan to implement alternatives in the near future
-some progress noted

-concern that sufficient supplies of halons will not be available to meet aviation needs 20-30 years from now
Halon 1211 is getting difficult to find in U.S. and Europe (5-year supply), price is rising, is there enough for the life of the aircraft currently being manufactured

Detection Systems Discussion w/ D. Blake

THURSDAY, OCTOBER 26, 2006

Vaporization of JP-8 Jet Fuel in a Simulated Aircraft Fuel Tank Under Varying Ambient Conditions - R. Ochs

Introduction
Modeling Fuel Vaporization
Physical Considerations
Principal Assumptions
Characterization of Multicomponent Jet Fuel
Characterization of Experimental Fuel
Experimental Apparatus
Instrumentation
Experimental Procedure – test matrix
Typical Results: Fuel Tank at Sea Level, Constant Ambient Conditions
Validation of Well Mixed Assumption
Ullage Gas Temperature Prediction
Isooctane Fuel Vaporization
Constant Ambient Pressure at Sea Level
Simulated Flight Conditions 30,000 ft. Cruise (graphs)
Determination of Lower Flammability Limit (LFL)
Flammability Assessment – fuel tank at sea level & simulated flight at 30,000 ft.
Conclusions
Recommendations for Future Work in this Area

Wing Tank Flammability Testing – S. Summer

Background
Part I: Test Article: Scale Tank in Altitude Chamber (used existing 128 gal. aluminum fuel tank in altitude chamber for testing)
Block Diagram of Wing Tank Flammability Test Article
Results – Preliminary: large increases in flammability with top heating but takes time to generate vapor (graph)
Part II:
Test Article – Wing Piece in Wind Tunnel (section of 727 wing containing surge tank has been mounted in the low-speed section of the FAA's wind tunnel facility)
Work Status

Aircraft Cargo Compartment Multi-Sensor Detector – A. Girdhari (Rutgers Fellowship Student)

Motivation: current cargo compartment sensors are susceptible to non-fire sources/slow alarm responses times to real fires/100:1 false to real fire alarm ratio
Related CFR
Current Aircraft Cargo Compartment Smoke Detection Systems: light transmission detectors/ionization detectors

Thesis Objectives: reduce false alarm ratio, nuisance immunity and faster alarm response times, detect complete fire signature, employ a multi-sensor detector, develop an alarm algorithm, compare experimental results with computational results
Overview of General Experimental Design
Experimental Testing- 5 real fire sources, 5 nuisance sources
Experimental Locations
Experimental Fire Test Results:
Polyurethane Foam (graphs)
Smoldering Suitcase (graphs)
Nuisance Sources:
Vaporizer (graphs)
Arizona Test Dust (graphs)

Algorithm Development consists of 10 parameters including MIC Voltage Difference and rate of decline of % light transmission per foot and rate of rise of temperature
Algorithm Methodology – 5 algorithms used
Detector Analysis: Multi-sensor vs. Current Detectors
Computational Fluid Dynamic Model (developed by Sandia Labs)
Computational vs. Experimental Results: Resin Cake (graphs)
Experimental vs. Computational: alarm time comparison (table)
Alarm Time Comparison and Spatial Distribution Results: average alarm time uncertainty between computational and experimental, CFD validation, multi-sensor detector range
Conclusions
Recommendations: experimentation with a wider distribution of fire and nuisance sources, detector manufacturing and packaging, more gas sensors

<u>Engine Nacelle Halon Replacement</u> – D. Ingerson

Doug described the test article configuration and operation of the test article. The test methodology was explained. The results of tests conducted with a number of agents were presented and explained. Doug reviewed the conclusions from this test programs. The report on this work is now in the FAA's review cycle. The MPS will be Appendix A of this report.

<u>Observations During MPSe Testing</u> – D. Ingerson

General Behaviors:

Instabilities
Concentration comparisons:
-the largest equivalent concentrations are collected and compared to some reported peak inerting concentrations
-using peak inerting values given is a worst case combustion model premixed gaseous
-graph

Duct Interface Behaviors
-during testing in September 2004 anomalous behavior was noted in the test fixture
-Diagram of duct interface behavior pertinent test fixture geometry
-added 4 opto-electronic devices to detect flame propagation through test fixture
-a box can be mounted which closes out the duct interface completely (diagram showing these changes)

Video of performance of the agents tested during the test program were shown

Flame Attachment Behaviors:
-For these two agents Novec 1230, and CF3I
-explanation of why the flame attachment of these two agents was a concern
-graphs of flame attachment of each agent
-Conclusions: considering the following, the distribution plumbing of these agents would be a logical explanation for the flame attachment problems

Halon 1301 Benchmarks have been catalogued over time for the various testing cycles
The benchmarks show distinct relationships between the fire threats in the test fixture
The benchmarks indicate reliability in the work between 2003-2006

Halon Benchmarks (graph)

Conclusions

<u>Working Group Member Presentations</u>

Aerospace Applications of NanoMist Ultra Fine Fog – J. Michael Bennett, PhD.
N2 Towers Inert Gas Generation System for Fire Protection in Enclosed Aircraft Spaces – J. Michael Bennett, PhD.

Fuel Tank Explosion Protection System (FTEPS) Based on OBIGGS – K. Susko
(contact Ken Susko directly if you have any questions regarding this presentation)

Use of Hazardous Temperature Locator/Valuator System in Today's Aviation – P. Celauro