INTERNATIONAL AIRCRAFT SYSTEMS FIRE PROTECTION WORKING GROUP MEETING

November 1-2, 2005

Hosted by the FAA Technical Center Fire Safety Branch, Tropicana Casino-Hotel, Atlantic City, New Jersey, USA

TUESDAY, NOVEMBER 1, 2005

Handheld Extinguisher Guidance Material for Draft Advisory Circular – L. Speitel

The Handheld Extinguisher Task Group is recommending that a separate A/C for Handheld Extinguishers be prepared separate from the Halon Replacement A/C.

This information is for all types/sizes of aircraft including toxicity considerations.

Reviewed Toxicity Considerations:

- decomposition products
- toxicity of the halocarbon itself.

This information will be provided to the FAA Transport Directorate.

Dick Hill requested that this group finalize this work and forward it to the FAA Transport Directorate by the end of 2005.

A copy of this presentation is available at www.fire.tc.faa.gov.

This Task Group will meet on Wednesday afternoon, November 2, 2005.

Cargo Compartment Testing Update – D. Blake

Project terminated due to lack of support for a flaming fire as the detection standard. Draft report has been written and submitted for review and publishing. No plans for a revised AC 25-9A.

Sandia Smoke Transport Code work is still on-going. Release of final version of the code is expected in early 2006.

Enhanced Cargo Monitoring (Container Communication Interface) - K. Schmoetzer (Airbus)

Enhanced Cargo Monitoring
- Container Communication Interface

Study Item

Klaus Schmoetzer (Airbus) presented a study item that deals with the possibility to enhance the cargo monitoring capability within transport aircraft. Customers & insurances want to know what happened to the shipment (to manage quality assurance and liability issues).
The “Cargo Communication Interface” (CCI) principally will base on a wireless connectivity between a container/pallet (ULD) and the aircraft. Locally at ULD level the CCI will provide an interface to a so-called “sensor platform”.

The sensor platform will provide standardized interfaces to enable connection of various sensors to monitor e.g. temperature, humidity, pressure, gazes, smoke, temperature raise of rate, etc close to the cargo.
The presented study shows how a "container communication interface" can be integrated into an overall communication concept thus to enhance monitoring of cargo in flight. This monitoring capability can be an added value to Customer, Forwarder, and Airlines e.g. monitoring of the temperature of goods is essential to the Cool Chain business (pharmaceuticals). Also transportation of Hazardous Materials (HazMat) maybe profit from the ability to add specific to type sensors to the goods and thus to get data shipment related during flight.
A copy of this presentation is available at www.fire.tc.faa.gov.

Dick asked if the container RFID technology was being coordinated across the airline industry or just within Airbus. Klaus indicated that there is no coordination in industry at this time, but Airbus has tried to standardize the RFID technology, so it can be used throughout industry. Airbus is still studying/investigating this communication interface.

Smoke Generation for Certification and Ground Flight Tests – K. Behle (Airbus)

A copy of this presentation is available at www.fire.tc.faa.gov.
Theoretical Background: Requirements

- JARs and Advisory Materials

Background: Guidelines

Today: Parafin Oil Smoke Generator (used by Airbus)

Smoke Amounts – Airbus Method (linked to TSO C1d)

Additional Tests – Flaming Resin Block

Influence of Ventilation Rate

Summary/Conclusion

Engine Nacelle Halon Replacement – D. Ingerson

Doug described two overpressure situations where the chemicals (2BTP and HFC-125) involved acted as fuel instead of fire suppressant. A photo was shown of one of the overpressure events.

Hidden Fire Testing

Hidden Fire Work – D. Blake

727 Test Article will be used for nitrogen fire suppression testing in hidden areas in the cabin. Dave described the planned hidden fire tests. He reviewed the test objectives. In the future he will look into protection other hidden areas with nitrogen enriched air (cheek areas, cargo areas). He is open to hearing ideas for future testing as well.

OBIGGS Utilization In Inaccessible Areas on a Wide Body Aircraft – S. Summer

747SP Test Article will be used. Steve will be looking at distribution of the NEA and optimization of the distribution system. He reviewed the objectives of this test program. He described the test configuration and the test section of the aircraft. He provided the current status.

An Integrated Fire Protection System – R. Hill

(prepared by RGW Cherry and Associates for Transport Canada)

This concept has been proposed and presented by the FAA for many years. The system concept was described.

Primary areas addressed to date:

Benefit Assessment
Initial feasibility assessment of cargo water mist/nitrogen mist systems
Initial feasibility assessment of hidden areas with an 'on demand' system

Cargo Compartment 'On Demand' Fire Protection
(divert nitrogen from its present use assuming there is an inerting system for the center tank)

Need for cargo bay protection. NEA will be investigated for use as cargo bay protection using Air Separation Modules (ASMs).

Dick asked Working Group members to provide data on the pressure needed to optimize ASM performance to Ray Cherry.

Hidden Area Fire Suppression – R. Hill

(prepared by RGW Cherry and Associates)

It is theoretically feasible to use the ASMs currently stored on an aircraft for hidden area fire protection.

Question: When do you think you'll have some results from the 727 and 747 tests at the FAATC?
D. Blake: The 727 hidden fire test program should begin in a few weeks. It is near term.
R. Hill: There should be some data from the 727 hidden fire test program to present at the next Working Group meeting. The 747 is a more long term program.

The Use of Onboard Nitrogen for Cargo Fire Suppression – B. Cavage

This is preliminary.work.

Background – Cargo Bay Fire Protection

747SP Test Article set up so this testing and the hidden fire testing work can be conducted in it.

Rendering of cargo bay with Gas Sample Locations

Test Method

Preliminary Results

Summary

Pack Bay Oxygen Deletion Due to OBIGGS Leaking – B. Cavage

Background
Test Article Method
Results: preliminary tests illustrated the hazard was minimal due to difficult in reducing the O_2 in pack bay.
Summary: It's very difficult to achieve a low oxygen concentration in the pack bay with operating equipment.

Update of NASA OBIGGS and Fire Detection Research

State of NASA's Aviation Safety and Security Program and its Aircraft Fire Protection Element – C. Chang (NASA)

NASA Research Program Situation:

Aviation Safety work at NASA will not start until FY2007. NASA will not conduct any Aviation Safety work in FY2006.

AvSP-1 Results

OBIGGS high-temperature membrane under development by Honeywell and Valcor. Valcor has been redirected to develop an even higher temperature membrane.

Cargo Hold Fire Detection Technology – J. Xu (NASA)

Outline
Need for Low False Alarm Detection Technology
NASA Research Approach
Goal: develop, test, demo fire detection system technology in ground test facility cargo compartment environment.
Approach
Fire detection system development
Chemical Sensor Application Development Areas
Overall Fire Detection Approach

Jennifer presented the results of the tests conducted in the FAATC Cargo Bay test article.
Summary

Fuel Tank Protection at NASA Glenn Research Center – C. Chang

Adaptive OBIGGS: the input, the problem, the outcomes
Improved Inert Gas Recovery from Combustion Derived Inerting (13 More N_2 Recovery or ¼ less Bleed Air Needed) – this chart was presented.

Ignition Sensitization Minimum Ignition Energy Dependent on Spark Duration – chart presented.
Fuel Modification Reduces Ignition Overpressure
Fuel Tank Protection – Deflagration-to-Detonation Transition
In-Tank Real-Time Multi-Species Fiber Optic Flammability Sensor

Inflight Firefighting Training Video – D. Blake

AC 120-80. The video will supplement this Advisory Circular. The outline was presented to the International Cabin Safety Research Technical Group for comments/input. The U.K. CAA will hire a screenwriter to work on the video. The majority of the footage will be shot at the FAATC in its test aircraft articles. This video is not meant to replace the training that airlines give to the cabin crews. It is meant more as an educational/awareness video to show realistic use of firefighting equipment (ie: fire extinguishers, actual use of protective breathing device).

WEDNESDAY, NOVEMBER 2, 2005

The Effect of Fuel on an Inert Ullage in Commercial Airplane Fuel Tanks – B. Cavage

Background
A block diagram of the experiment configuration was show and described.
Test Methods – 2 Primary Areas
Calculations – Two Ways Ullage [O_2] Increases – Bill explained the basics of the calculations
Results: Sea Level Testing
- Graph: Increase in [O_2] Over Time with Different Stimulations
- Graph: Resulting Maximum Increase in Ullage [O_2] due to Fuel (this was not a closed system)
- Benefit of Inerting Through Fuel

Results: Altitude Testing
- Graph: Change in [O_2] Increase due to Altitude
- Graph: Resulting Max Increase in Ullage [O_2] due to Altitude
- Graph: Comparison of Stimulation Methods at Altitude
- Graph: Comparison of Lab Stimulation with Flight Test Data

Summary: oxygen evolving from fuel is a misnomer, changes in ullage oxygen concentration due to a adjacent fuel are a result of the equalization of the partial pressures of gases at the fuel ullage interface and is difficult to get without mixing fuel ullage together

The Fuel Tank Flammability Assessment Method – S. Summer

An MSExcel-based macro initiated in 1998 and still used an comparative tool to assist in determining the potential fleet-wide flammability exposure of a fuel tank.

Program Overview: Flowchart

Program Overview: User Inputs – A series of inputs requested of the user in order for the program to run the assessment. Steve provided explanations for a number of these inputs.

Program Overview: Main Calculations

Program Overview: Outputs – Sample Chart of Fuel Average Flammability Exposure;
Graphs: Time-Based Plot and Ground-Based Plot

Two Screenshots of the results of the sample assessment were displayed and described. Screenshots of the FRM Page were also displayed and described. Screenshot of Single Flight Analysis Page.

Current Status: The program has been completed and is planned to be released with the NPRM. It is being translated into a Visual Basic version. A User's Manual has been completed for the MSExcel version.

Al Moussa: When you assess the FRM, what criteria for flammability do you use? The FRM is whatever you make it in the model (ie: nitrogen inerting system or other – you code this into the program).

Factors Affecting the Limiting Oxygen Concentration Required for Ignition in an Aircraft Fuel Tank – A. Moussa

Lithium Battery Fire Tests – H. Webster

The concern is regarding the shipment of lithium batteries on pallets via aircraft (often in passenger carrying aircraft).

Background: There were several incidents involving lithium batteries and lithium ion batteries.

Incidents: April 1999 (LAX): Pallet dropped on ramp, caught fire and burned itself out. No known external ignition source.

Summer 2004 (Fedex in Memphis): Lithium Ion Batteries in container loaded onto aircraft, smelled smoke and realized it was the container that had been loaded into an aircraft, removed container, and it burst into flames upon removal.

Primary Battery: Major Findings

It takes a small ignition source to ignite the bulk packed batteries. Harry described how the batteries are packed. Halon 1301 does nothing to suppress the lithium ion battery fire.

Liquid that oozes from ignited batteries, can damage cargo liners.

When the batteries burn, they contribute a pressure pulse in the cargo compartment. A handful of batteries (5 or 6 batteries) he tested raised the pressure by 2 psi.

RSPA Interim Final Rule Issued: Prohibiting transport of lithium batteries on passenger aircraft.

Lithium Ion Battery Flammability Tests

18650 Type Cell Lithium Ion Battery Tests: These cells are in laptop computer batteries. Harry described the test conditions.
A single battery is tested first and then groups of batteries are tested.

Preliminary Lithium-Ion Battery Test Results

FAATC received 18650 type cells from all five (5) manufacturers.
Tests have been conducted on cells from three of the manufacturers to date.

When ignited these batteries release a liquid that is highly flammable.
Batteries were tested at 50% charge and 100% charge. Harry described the differences observed when these battery cells were ignited at each of the charges.
He showed video footage of the following:

Tests of a Single Battery:

First Event at 50% Charge
Second Event at 50% Charge
First Event at 100% Charge
Second Event at 100% Charge

Harry noted to group that the charge in the battery does make some difference.
Exploding Battery 50% Charge
Exploding Battery 100% Charge

Photos of 18650 Cell after Exposure to Alcohol Fire and an 18650 cell after it exploded.

Preliminary 5% Halon Test Results: these tests were conducted with 8 batteries that were confined to a specific area. The Halon extinguished the fire but the batteries continued to release electrolytes.

Cargo Liner Exposure Test Results

Pressure Pulse Tests

Recently conducted at the FAATC.
Batteries tested in $10m^3$ steel chamber at 50% and 100% charge.
Preliminary Results: A single battery raises the pressure in this test chamber .2 psi.

Future Tests

Harry described the future tests planned on lithium ion batteries.

<u>Fuel Cells</u> – R. Hill

The next generation of power sources for laptops and cell phones is going to be fuel cells. The fuel that will be used as the power source may already be banned: ie: methanol, formic acid, hydrogen stored in metal alloy, boro-hydride compounds. Fuel cells may be disposable or rechargeable. The disposable devices could contain as much as 200 ml of butane, methanol, etc. Is it safe to have these in checked baggage? How many can be shipped? Some of these fluids are banned from shipment on passenger aircraft. There are requirements now that prohibit carriage of some of these fluids in passenger aircraft cabins. There is a push from industry to replace lithium batteries with fuel cells. Once the FAATC completes the lithium and lithium ion battery test program, they will be conducting research on the fuel cells. In smaller amounts, are these safe to carry onboard the aircraft cabin? The FAATC is coordinating a test program with the U.K. CAA. S. Limaye: The Department of Energy has a big program on the use and safety of using hydrogen and other types of fuels. Dick asked him for the contact name at the Department of Energy.

Working Group Member Presentations

"Next Generation OBIGGS Developments – Phyre Technologies" – S. Limaye

Next Meeting

The next meeting will probably be held in April or May 2006. Any company interested in hosting a meeting in Europe or the U.S., please contact April Horner.