International Aircraft Systems Fire Protection Working Group Meeting

Hosted by the United Kingdom Civil Aviation Authority (CAA), London, United Kingdom

June 23-24, 2005

Thursday, June 23, 2005

Handheld Extinguisher Draft Advisory Circular (AC) Review – L. Speitel

Louise reviewed the purpose of the Advisory Circular. She reviewed the FAR requirements for handheld extinguishers. She also reviewed the MPS for handheld extinguishers. The first decision was: should there be one AC for all handheld extinguishers or separate ACs for halon replacements. The approach was reviewed. The FAATC Fire Safety Branch is providing guidance material to the FAA ACO. Louise explained all aspects of the approach. She reviewed the throw range. The results of the User Preference Survey were reviewed. The Agent Toxicity; Safe Clean Agent Concentration section was presented. The tables indicating the Agent Toxicity: Minimum Safe Compartment Volume were presented and discussed. The development of the ventilation tables was explained. Louise presented graphs of the Kinetic Modeling of Arterial Blood Concentration in Ventilated Aircraft for the various agents. She reviewed the AC language for Halocarbon Fire Extinguishers.

Cargo Compartment Smoke Detection – R. Hill

Update on Sandia CFD Transport Code – validation experiments in DC-10 test article at FAATC have been completed. Feedback was requested on the model distributed to 10 member users by April 1, 2005. Airbus was the only one to comment.

Cargo Fire Detection Project: a draft of the cargo fire detection standardization test project will be published shortly. No further work will be done at the FAATC related to cargo compartment fire detection unless the FAA Transport Directorate ACO asks the FAATC to conduct additional work and provides funding for the research. Russell Stark described some problems with multi-criteria smoke detector testing.

Flammability Studies Using Monte Carlo Analysis with Gaussian Distributions of Key Mission Parameters – R. Hill

The FAATC Fire Safety Branch has written a user's guide for the model. The Monte Carlo model was displayed and explained. There are provisions in the amended version of the model for an inerting system.

Fires in Inaccessible Areas – R. Hill

A diagram indicating the "hidden/inaccessible" areas in an aircraft was shown. Cargo compartment is not included as part of the inaccessible areas, because there was a separate project on cargo compartments. The ports were not very effective in a wide-body aircraft. The effectiveness is highly dependent on the nozzle design.

NEA System Installation in 727 Test Article – R. Hill

Dick presented diagrams of the system installation and described the goals of this system for extinguishing fires in hidden areas in overhead space. The test program will evaluate this system and determine if it is practical/feasible.

Inflight Fire Fighting Video – R. Hill

The outline has been sent to international aviation authorities for review/comments.

Aircraft Cabin Air Quality – R. Hill

Background: short term crew exposure to contaminents that are toxic such as decomposing engine and hydraulic fluids. Work will not begin on this project until funding is received from FAA sponsor. Proposed research will be conducted on the Fire Safety Branch's 747 SP and 737 aircraft.

Engine Nacelle Testing Update – R. Hill

Work to be done in the near future: Investigate/analyze overpressure behavior in the engine nacelle simulator.
Purpose: capture environment of overpressure produced by HFC-125 and by Halon 1301 and characterize the magnitude of the environment and attempt to understand the phenomena. Graphs of HFC-125 overpressure analysis –based on initial observations were presented.
Remaining Work: CF3I equivalence iterations for pool fire and spray fire, cold agent testing, completion of overpressure analysis.

NASA Fire Detection Research Progress – B. McKnight

Cargo Hold Fire Detection Technology:

Reduce 150 to 1 false alarm rate – goal: reduce false alarm rate by 80%
Safety and economic issues

Approach:

Base Platform Sensor Technology
Work done in-house at NASA
Collaborated with:

FAATC – testing
NIST – testing
Sandia National Lab – analytic modeling
Case Western University – sensor development
Ohio State University – signal processing
Makel Engineering – sensor packaging, test and commercialization

CO + CO2 gas sensor array/MEMS Smoke Sensor

Bob described both types of sensors and provided photos and schematics. MEMS smoke sensor originally designed for International Space Station. These sensors were combined and tested at the FAATC. The sensors were tested using a dust distribution apparatus and water vapor distribution system. Next the sensors were tested in FAATC cargo compartment detection test apparatus. The results of these tests with a flaming resin block were presented.

NASA Hidden Fire Detection System (FY '06-'10)

- Self-contained power
- "lick and stick" sensors

NASA OBIGGS Research Progress

NASA's role complementary to near term success of FAA and Boeing. Bob described the in-house and outside efforts. Explanation/description of hollow fiber membrane (ISO-300 microns size). A photo of an installed hollow fiber membrane was presented. The system component weight comparison tables for 737 and 747 aircraft were presented. Bob reviewed the Valcor and Honeywell results/status. NASA is also conducting some fuel tank protection research/work for security purposes=Security Inerting Design Guidelines.

Vaporization of JP-8 Test Fuel in a Simulated Aircraft Fuel Tank Under Varying Ambient Conditions – R. Hill

Motivation: TWA 800 accident
Diagram: location of fuel vapor
Experiment was designed to simulate in-flight environment around fuel tank
Aluminum tank was placed in the FAATC altitude chamber that simulates sea level to 100K feet and temperatures from 100F to 250F
Test matrix was reviewed
5 gallons of fuel was used for each test, dry tank tests, and Isooctane (pure component fuel)
Test procedures were reviewed for each condition
Results were reviewed for each condition
Modeling fuel vaporizations
Physical considerations
Principal assumptions
Brief reviewe of jet fuels
Characterization of Experimental Fuel
Validation of the Well-Mixed Assumption
Ullage gas temperature predictions
Results of modeling at various conditions were presented and explained
Conclusions about model results
Overall conclusions

Friday, June 24, 2005

Modeling In-Flight Inert Gas Distribution in a 747 Center Wing Fuel Tank – R. Hill

Background: to support the OBIGGS development work, Fire Safety Research has been developing models of ullage inerting given inert gas deposited and lifecycle.

- Assists in the development process and allows for system development, cost analysis, and trade studies.
- Models have to be simple to be useful for the applications.

Previous work:

Multi-bay GBI Inerting Models
FAA built and performed tests in ¼ scale (747 CWT Model)
    Presented graph of Analytical Model Inerting Data Comparison
    Presented graph of CFD Model Inerting Data Comparison
FAA built and performed tests in ½ scale Airbus A320 CWT using altitude chamber
Developed analytical model of ullage oxygen concentration in a single bay tank based on inert gas added and altitude change
    A320 flight test descent data compared with model results

The results of cascading inerting were reviewed.

Graph of 747 SCA Flight Test Descent Data compared with model results.
Summary: Fair agreement for analytical model and scale model to flight tests.

Pack Bay Oxygen Depletion due to OBIGGS Leaking – R. Hill

This is planned research at FAATC. To support potential future OBIGGS certification, FAA Fire Safety wants to study the effect of large NEA leaks from an OBIGGS in a bay on the depletion of oxygen in the bay and surrounding areas. The 747 SP ground test article will be used with the FAA OBIGGS to study ground service personnel. A diagram of 747 SP pack bay with OBIGGS installed was displayed. Dick reviewed the potential tests.

Lithium Battery Fire Tests – R. Hill

Primary Batteries:

Halon 1301 chemically ineracts with the burning lithium and electrolyte – with no effect on fire intensity
Temperatures found in a suppressed smoldering cargo fire are sufficient to ignite a primary lithium battery

FAA report has been published. A RSPA Interim Final Rule has been issued.

Lithium-Ion Battery Flammability Tests – R. Hill

Initial testing will be done with 18650 type cells routinely used to power laptop computers (similar to size of a U.S. AA battery)
Additional tests may be done with flat prismatic cells used in cell phones
Tests will be conducted at 100% and 50% charge

The test conditions were described.

Preliminary Lithium-Ion Test Results

Lithium 18650 cells have been received from 3 different manufacturers
Tests conducted at 100% and 50% charge
Typical 50 % charge responded to alcohol fire (see presentation for specific details)
Photos displayed of batteries after test remains after explosion
Results of 100% charge response to alcohol fire (see presentation for specific details)

The initial results are very different than the report the manufacturer provided the FAA.

Future tests are planned.

An Integrated Fire Protection System – R. Cherry

Background: The concept of an integrated fire protection system has been proposed by the FAA.
This work is contracted by Transport Canada. Ray described the system concept. Ray reviewed the Benefit Analysis Considerations that included review of previous benefit analysis done for the FAA as part of a rough order of magnitude benefit analysis.
Included in this work:

Cabin water mist
OBIGGS/OBOGS

Analyze all data that has been generated for each of the elements of an integrated fire protection system and identify work that is needed.
B. McKnight: What is the end result expected from this study?
C. Lewis: Initial Objective: To determine what issues/challenges need to be addressed and how this can be done and how much will it cost. Further on: Actual testing hopefully in conjunction with the FAATC Fire Safety Branch. As this progresses, we will be realigning for the next steps.
B. McKnight: NASA would be interested in discussing this further.
C. Lewis: Input from industry and other agencies is welcome.
Member question: How will the system address fire in cargo compartment and cabin at the same time?
R. Hill: Historically, those who design fire protection systems for one area (ie: engine) do not consider sharing or linking that system with another area's system (ie: cargo compartment).

Next Meeting

The next meeting will be held November 1-2, 2005, at the Tropicana Hotel and Casino in Atlantic City, New Jersey. Check ww.fire.tc.faa.gov for all the details. If you plan to visit the FAATC while in the area, please clear it with the FAATC Fire Safety engineer you visit, then if you are a non-U.S. Citizen, complete the form available on the Fire Safety Website at ww.fire.tc.faa.gov, and return it as instructed 90 days (3 months) prior to your planned visit.