INTERNATIONAL AIRCRAFT SYSTEMS FIRE PROTECTION WORKING GROUP MEETING

Hosted by EASA, Cologne, Germany

May 19-20, 2009

TUESDAY, MAY 19, 2009

Laptop Battery (Lithium Ion Batteries) Test Video – The draft video was shown during this meeting. Several extinguishing methods were tested including Halon 1211, water extinguishers, non-alcoholic liquids, and ice. Dave explained that the video will be finalized after the FAATC completes its testing.

In-Flight Fire Testing Training Video – This video was recently finalized and is available on the FAA Fire Safety website (www.fire.tc.faa.gov). It will be released as an FAA INFO. The video was originally created to address Advisory Circular 120-80.

Engine Nacelle Update – D. Blake (for D. Ingerson)

MPSe Revision 3 to Revision 4 Overview. Dave explained Doug Ingerson's plans regarding moving forward to MPSe Revision 4 including terminating use of Halon 1301, modifying the halon benchmark process, beginning to characterize fire threats, minimizing the effect of injecting fire extinguishant, modifying the test process, and reviewing agent measurement process (conduct flow observations and revise measurement methods). Dave presented Doug's original time schedule. Current Status: Next: Task Group telephone conference this summer.
Flow Visualization, SSWT Activity – Overview: Photos of this test set-up were presented. Some photos of the imagery were presented. Dick provided some additional explanation regarding Doug's plans to go forward. Dick brought up two items for the Task Group to discuss prior to the Teleconference this summer: The surrogate agent, HFC-125, is a big global warmer, and the FAA Transport Airplane Directorate wants to include a proof of concept test for non-traditional (non-gaseous) agents in an actual engine nacelle.

Options for the Use of Halons for Aircraft Fire Suppression Systems – 2009/2010 Update – R. Hill

http://www.fire.tc.faa.gov/systems/taskgroup.stm

The FAA would like to form a Task Group to update the 2002 Update of the "Options for the Use of Halons for Aircraft Fire Suppression Systems" report. Dick asked the Working Group members to decide if they would like to be part of this Task Group – participation in this Task Group will involve work. If you are interested in participating in this Task Group, please contact April Horner at april.ctr.horner@faa.gov. Louise Speitel will probably be the Task Group chairperson. Dick reviewed the items from the 2002 Update Table of Contents indicating areas/items that will need to be updated/reviewed/added for the next update. Any questions? Any interest in participating?

Handheld Advisory Circular Update (L. Speitel presented by D. Blake) – AC 20-42D is considered in the process of rulemaking, so a draft cannot be released and the AC itself cannot be discussed. However, recent data can be discussed. Standard FAA-accepted PBPK Methodology. Human PBPK Model: describes the uptake distribution, metabolism and elimination within the human body. Simplified Kinetic Model – allows simulation of human arterial blood concentration histories from inhaled constant or dissipating halocarbon concentrations. Simplified Kinetic Model for HCFC-123 for Unventilated Cargo Compartment – plot displayed. John Petrakis indicated that Louise's report should be finalized and released in approximately two months. Once the report is released, the AC will be available for comment on the FAA website.

Status of Research to Replace Halon Extinguishing Agents in Civil Aviation – J. Petrakis/R. Hill

This presentation will be given to ICAO at June 9, 2009. ICAO has asked that the FAA try to represent all of the interests by incorporating comments/feedback from this Working Group. John sent an email with the briefing paper that will be presented to ICAO. This email was sent to all those registered electronically for this Systems meeting as of Thursday, May 14. John reviewed the Summary of ICAO Proposal. Some members have problems with the compliance dates for engine/APU extinguishers – January 1, 2012, for Annex 8, Airworthiness of Aircraft (New Aircraft TC) (Boeing). Lavatory Extinguishers – January 1, 2012: is there a problem? Consensus: NO. There is no mandate for Cargo Compartments. Portable Extinguishers – January 1, 2015, for Annex 8, Airworthiness of Aircraft (New Aircraft TC): Consensus: The year 2015 is probably reachable for a replacement agent that will have consequences as far as weight and redesign on the aircraft, but it probably could be met; but if we are talking a drop-in agent, 2015 is questionable. Annex 8, Airworthiness of Aircraft (New Aircraft TC): Engine/APU Extinguishers – by ICAO Convention, Article 41 Effective Date January 1, 2015. Dick reminded the group that there are agents available that can be used (for example: Novec – not an ozone depleting agent, not a global warmer) that meet the MPS.

Summary of EC Proposal:
Mandatory Halon Replacement – all new aircraft TC (Cut-off Date) and all existing aircraft (End-Date) Respectively.
Lavatory Extinguishers – January 1, 2012, and 2017
Portable Extinguishers – January 1, 2012, and 2021
Engines/APU – January 1, 2012, and 2031
Cargo Compartments – January 1, 2017, and 2031

No apparent mandate for New Production Aircraft until End-Dates.
Retrofit (End-Date) of Halon Replacements for All Applications on All existing aircraft.

IACO/EC Comparison:

	New A/C Prod ICAO/EC	New A/C TC ICAO/EC	Existing A/C ICAO/EC
Lavatory	2012/2017	2012/2012	None/2017
Portable	2015/2021	2012/2012	None/2021
Engines/APU	None/2031	2012/2012	None/2031
Cargo	None/2031	None/2017	None/2031

<u>FAA Proposed AC 20-42D</u>:

Guidance for New Installations of Required Handheld Extinguishers
FAATC Handheld MPS as FAA approved procedures for Halon Replacement Extinguishers

FAA Replacements for Halon 1211
(HFC Blend B, HFC 227ea, HFC-236fa)
Fire Fighting effectiveness
Selection and safe-use
Location and mounting

Developed within IASFPWG
Cancels AC 20-42C, March 1984
FR Notice in 2009 for Public Comment

Dick reviewed the remainder of the slides of the ICAO presentation he and John Petrakis will give to ICAO on Jun 9, 2009.

<u>Withdrawal of U.L. 1093</u> – J. Petrakis

U.L. consulted with the FAA regarding the withdrawal of U.L. 1093. The FAA asked U.L. to postpone the withdrawal based on comments the FAA received. U.L. postponed the withdrawal until October 2014.

Halon Replacement for Airplane Handheld Fire Extinguishers – The Challenges – A. Carlo (Boeing)

See Presentations.

Cargo Fire Suppression by Depressurization Tests – R. Hill

Schematic of pressure vessel test article that can be set to 28,000 feet altitude. Fire tests can be conducted in this pressure vessel. This test article was previously used for aerosol can tests and explosion tests. Dick presented graphs showing results of a number of tests at various altitudes.

Class E Cargo Compartment Smoke Detection and Active ULD Testing – D. Blake

This test program was initiated based on NTSB Recommendations from the UPS DC-8 February 7, 2006, fire (Philadelphia, Pennsylvania). Dave showed photos of cargo area that had been destroyed by the fire and showed transcript of cockpit voice recorder.

NTSB Recommendation A-07-98 to FAA: Ensure that the performance requirements for smoke and fire detection systems account for the effects of cargo and cargo containers on airflow around the detection sensors and on the containment of smoke from a fire inside a container and should establish standardized methods of demonstrating compliance with those requirements (A-07-98).
Photos of FAATC test article aircraft were shown. Test results were reviewed.
Simulated Refrigerated ULD: "Active" LD-3 Container – cargo compartment air is drawn in low and exhausted high at a rate of180 ft^3/min. Six containers were used in these tests. Additional tests are planned with the airflow direction reversed. Upon completion of this test program, the FAATC will publish a report.

A Cost-Benefit Analysis for the Installation of Fire Suppression Systems In Cargo Compartments of Cargo Airplanes – R. Cherry

This work was related to the NTSB Recommendation for fire suppression systems in cargo compartments of all cargo aircraft operating under 14 CFR Part 121.
Freighter Cost Benefit Analysis:

Potential benefits will result from a reduction in: injuries (fatal and serious), damage incurred to the aircraft and its cargo, and damage that might be incurred to property on the ground.
Potential costs of installation of system. Benefit analysis based on: Monte Carlo model, statistical distributions. The period 1967 to 2007 was investigated: 4 accidents caused by cargo compartment fires. Cost per accident based on: primary damage: crew injuries (fatal and serious), and damage incurred to aircraft and cargo. Cost of collateral damage.
Conclusions:
Cost: Liner Installation and suppression system represent significant costs. Benefits: Collateral damage costs are not overly significant – major reduction in crew injuries and aircraft value. Benefit values for each weight category aircraft were presented. Cost vs. Benefit: per weight category – table was presented. Halon fire suppression systems, or alternatives that are likely to be developed for below floor cargo compartments, are unlikely to be cost beneficial. However, other fire suppression systems may prove to be cost beneficial. The report is available on the FAA Fire Safety website.

WEDNESDAY, MAY 20, 2009

Composite and Aluminum Wing Tank Flammability Comparison Testing – D. Blake

This work was done by Steve Summer and Bill Cavage at the FAATC. FAA has released a final rule requiring the reduction of flammability with high risk fuel tanks with the benchmark being a traditional unheated aluminum wing tank. Flammability drivers on the ground and in-flight are documented in the FAA Report # DOT/FAA/AR-08/8. A photo of the test apparatus was shown. Results of Altitude Chamber Testing-Flammability Comparison were presented and explained. Results-Scale Tank in Altitude Chamber: testing shows large increases in flammability with composite wing fuel tank skin not seen with aluminum skin when heated from top during ground conditions.
Test Apparatus – Airflow Induction Test Facility – a photo was shown of this test facility with test apparatus installed. Due to the design, a simulated altitude (ie: reduction in pressure) is observed as the airspeed is increased. Results-40% fuel load, high heat setting; 60% fuel load, high heat setting; and 80% fuel load, high heat setting – graphs of all of these results were shown. Results-60% fuel load, superheated aluminum was shown. Results- airflow induction facility tests: similar to environmental chamber tests, significant increases in both ullage temperature and flammability are observed with composite as compared with aluminum skin.
Test Apparatus – Panel Heat Tests: composite and aluminum panels tests/compared. FLIR Camera Results shown for aluminum panel and composite panel – composite panel has much more concentrated heat. Dave described their planned work: examine the effects of different colored topcoats on the heat rejection of composite and aluminum panels and examine the effects of varying thickness of composite panels. A 727 wing surge tank will be re-skinned for further testing. Question: have different types of fuel been investigated? They used average flashpoint fuel for these tests.

Modeling Jet-A Vaporization in a Wing Fuel Tank – D. Blake
This work was done by Dhaval Dadia (a graduate student working in Fire Safety)

Predicting the influence of the following parameters in the development of flammable mixtures in the ullage: surface temperature, fuel temperature, ullage temperature, pressure, amount of fuel in the tank. Description of model: mass transfer considerations (liquid vaporization, vapor condensation), assumptions (well mixed gas and liquid phases, quasi-steady transport using heat transfer correlations), low evaporating species concentrations, and time dependent values of liquid fuel and tank wall temperatures are known, supplementary assumptions (gases and vapors follow ideal gas behavior, tank pressure is the same as ambient pressure), heat and mass conservation relations (fuel species evaporation and condensation, Henry's Law). A graph showing a comparison of the model results in comparison to the wind tunnel test results (computational vs. experimental results) 40% and 80% fuel loading, aluminum wing tank at heat settings 1 and 2 was shown. It is believed that some of the assumptions were a source of error. Other comparison results were presented. Conclusions: model was validated by three different sets of experimental results, computational model follows the general trend of the experimental results, disagreement in flashpoint value of fuel in experimental cases caused due to model assumption, disagreement in results in the flight test. Steve Summer and Bill Cavage will follow up with additional work at the FAATC.

Measuring Oxygen Concentration in a Fuel Tank Ullage – D. Blake

This work was done by Bill Cavage at FAATC. Measurement of ullage oxygen concentration is important to the fuel tank inerting community when researching methods, validating models and certifying systems. A review of the technologies/methods that were examined was provided (improved FAA gas sampling method, light absorption with unregulated gas sample train (Oxigraf), optical fluorescence using in situ probe (ASF)).

FAA Oxygen Concentration Measurement Method requires regulated pressure – diagram shown. Photos of light absorption method and optical fluorescence (ASF) used in situ were shown – these shown how much simpler these two methods are than the FAA method. The block diagram of fuel tank ullage simulation was shown and described. Results for each were presented and explained. Possible software issue with optical fluorescence method – manufacturer will investigate and correction if necessary. FAA method and light absorption method showed very good agreement, additional tests will be conducted.

Aircraft Cargo Compartment "Testing Update" – D. Blake

This is ongoing work by John Reinhardt at FAATC. MPS Cargo Compartment: Currently planning to test two Halon 1301 replacement agents/systems (Kidde Aerospace/Boeing and Life Mist/Pacific Scientific) at the FAATC. The tentative schedule is to conduct this testing 3rd/4th Quarter 2009. Should lithium ion batteries be included as a fire scenario in the MPS for Cargo Compartments? Input from Working Group members is welcome for consideration. Contact John Reinhardt if you have any input on this.

Intermixing of Cells in Nickel-Cadmium Batteries in Aircraft Usage – D. Blake

This is ongoing work by Steve Summer at the FAATC. RTCA SC-211 committee addresses the design, performance operational and testing issues for Ni-Cad Acid and rechargeable Lithium batteries. Issues have been raised at RTCA SC-211 meetings regarding the intermixing of cells within Ni-Cad batteries used in aircraft. Planned work: FAATC is in the process of obtaining necessary battery analyzer/test equipment and will be running a series of tests to determine the extent of any issues that may arise from intermixing of cells.

Dick explained that by the time of the next Systems Working Group meeting, there is a strong possibility that there will be an NPRM by PHMSA regarding carriage of batteries as hazardous materials.

Considerations on the Physics Behind the Cargo MPS "Open Surface Fire Test" – K. Kallergis

Konstantin discussed the open surface fire tests conducted at Airbus including: test arrangement, type of surface fire, the flow field, test chart, conclusion: whenever the suppression process started, even after the incidence of rollover, it was possible to extinguish the open surface fire in time and completely, however, the required volume of water (mist) exceeded the targets by far, early water mist activation is crucial for the required weight minimization. He is planning to conduct additional tests in the future.

Next Meeting:

November 17-18, 2009 at the Trump Taj Mahal in Atlantic City, New Jersey