INTERNATIONAL AIRCRAFT SYSTEMS FIRE SUPPRESSION WORKING GROUP MEETING

November 16-17, 2011

Hosted by FAATC – Tropicana Hotel-Casino, Atlantic City, New Jersey, USA

WEDNESDAY, NOVEMBER 16, 2011

Flight Deck Smoke Penetration Work Plan – D. Blake

This testing was requested by the FAA Transport Airplane Directorate. Objective: to determine if the current flight deck smoke penetration certification testing is adequate. Tests will be conducted in the forward, aft, and main deck of the 747SP aircraft. Test conditions will include smoke penetration tests using only pack1, pack2, and pack3. Additional tests will be conducted with some of the cargo liner removed for the below the floor tests. Report DOT/FAA/AR-TN03/36 documents previous smoke penetration conducted at the FAATC. This work was in support of new regulations to address aircraft security concerns. D. Ferguson: will you change ducting and air conditioning systems to reflect what is on a freighter. D. Blake: we are looking for input from Boeing, however, our aircraft is very different from a freighter. It is a passenger configuration. We are going to attempt to make it reasonably close to a freighter set-up.
We would consider forming a Task Group on Freighters if there is any interest. Please contact Dave Blake or April Horner if you have an interest in participating on a Freighter Task Group.

Smoke Transport in an Aircraft Cargo Compartment – E. Oztekin

Ezgi reviewed the motivation behind the project. The objective of the present study is to assess predictive abilities of available CFD solvers for smoke transport when applied to aircraft cargo compartments. Fire Dynamic Simulator (FDS) – developed at National Institute of Standards and Technology (NIST): solves Navier-Stokes equations for low Mach number thermally-driven flow, specifically targeting smoke and heat transport from fire; has a companion installation program Smokeview (SMV); has been verified/validated for a number of fire scenarios. Ezgi reviewed the B707 validation metrics, the model set-up, and the results. The conclusions of this research were reviewed: model solutions are in good agreement with the test data for light transmissions, high for ceiling temperatures, much higher for temperatures in vertical, CO/CO_2 concentrations, much lower for heat flux above the fire. Future work: investigate model parameters for radiation and turbulence modeling. If B707 baseline fire scenario is found to be successful: continue code validation. S. Hariram: asked about ventilation.

Fire Suppression in Class E Cargo Compartments – D. Dadia

Container based agents: Water, Novec 1230, nitrogen enriched air, oxygen starvation, aerosol-type agent, fire-fighting foam; zone based agents: water and possibly others. Container based solutions: this was presented during the May 2011 Systems meeting, so a brief overview of results was presented by Dhaval. Future Work: we will be working with fire-fighting foam and run more tests with aerosol agent, test fire suppression agents on battery fires, and conduct tests with a zone water mist system. S. Hariram: will you be doing test in pressurized areas? D. Dadia: maybe once we establish that it works at ground level. What pressure are you planning to run the water mist at for future experiments? D. Dadia: it's a low pressure system.

Halon Replacement Dates – R. Hill

ICAO and EASA halon replacement dates for lavatory, handheld (portable), engine/APU, and cargo for retrofit aircraft, new aircraft, and existing aircraft.

Risk Benefit Analysis for Freighter Fire Suppression/Mitigation Model – R. Hill

This work was jointly funded by Transport Canada and the FAA. RGW Cherry & Associates was contracted to develop this model. Following in-flight fire occurrences on US registered freighter aircraft, where it is suspected that lithium batteries have had involvement, the FAA and Transport Canada commissioned this work. Dick reviewed the mitigation strategies: cargo compartment suppression, external container suppression, internal container suppression, fire hardened containers, pallet covers, primary lithium battery boxes, secondary lithium battery boxes. Model Overview: a Monte Carlo simulation model developed in Microsoft Excel. The model considers each freighter airplane type in the 2010 fleet individually and in combination. Dick reviewed the Mitigation Factor. The model is currently being reviewed by the FAA regulatory customer at this time, and when they are finished, we may be able to make it available via a link (it is an extremely large Excel file and requires at least Excel 2007 to run). Dick gave a quick demo of the model. T. Gehrig: is there a reverse mode? D. Hill: no. D. Dierdorf: how does it handle the fact that most lithium battery cargo is undeclared? D. Hill: most lithium battery cargo is declared, sort of. Within the system you have to distinguish between bulk shipment (known) and not all of those are declared because there are a number of exemptions, then there lithium batteries being shipped with items (ie: radios with batteries) – this hazard is mainly an ignition hazard. Shipping of bulk batteries has two hazards. S. Hariram: this is only for US registered airplanes? D. Hill: yes, because we did not have enough data from the rest of the world to be confident in the data.

Cargo Compartment Smoke Detector AS8036 Standard Revision- K. Bell

SAE International has untaken update of AS8036 to include standard testing for false alarm rates after a request from the FAA. After AS8036 is updated, the FAA intends to update TSO C1. A list of AS8036 team members was provided. Ken reviewed the Next Steps in this project. Complete test identification and definition by November 30, 2011.

False Alarm Rejection Standard – Update – A. Freiling

Cargo smoke detector challenges: fire, fog, dust, insecticides. Andre reviewed the test set-up prototype for dust. Particle size measurement information for Callington insecticide products was presented. The insecticide test set-up prototype was described. A photo of the test apparatus was presented. We next have to investigate how to replicate the particle sizes of the various brands of insecticide.

Icing in Aircraft Fuel Lines – T. Maloney

Tom provided some background on the issues of icing in aircraft fuel lines. He also reviewed work done by the US Air Force, Boeing, Airbus, and previously by the FAATC. Many of these were direct water injection in fuel with or without a nozzle. Objective: perform experiments to better understand nucleation properties of water in jet fuel including investigating: temperature affects, effects of flow rate and flow structure (turbulence, Reynolds number), and possibly material dependence. Test Facility: altitude chamber. Tom described the current tests being conducted at the FAATC. Possible concern: introduction of water into fuel – possible water loss and how to reintroduce water into the system if water loss is a problem. S. Hariram: Is there a Task Group for this project, because I can provide a good amount of information. T. Maloney: no, this is actually part of a master's project I am doing at Rutgers University. D. Hill: I'm sure Tom will be very glad for input from you and others from industry. He can be contacted at 609-485-7542 or via email at Thomas.maloney@faa.gov.

Cargo Heat Release Rate Testing – J. Panagiotou

Review of recent freighter aircraft fires as reasons for this investigation. The fire hazard potential of batteries: ignition hazard, energy release rate, and container aspects (cargo flammability, container material flammability, size of fire at detection and growth rate). Topics addressed: fire load contribution of lithium and lithium-ion batteries and burning characteristics of cargo container fires. Joe described the tests conducted by NTSB at BATFE facility (small scale battery tests) and test set-up. A video of the battery behavior in these tests was shown. The results of the tests conducted were presented. The energy release rate comparison to a cardboard box with shredded paper was shown. Thermal runaway ignition tests were also conducted. The large scale container test set-up and tests conducted were described and presented. Video and still photos of the small and large scale tests were shown. The observations made in each of the cargo tests were discussed. O. Meier: any ideas on the affects of altitude?

Lithium Battery Update – H. Webster

Relative flammability of various common battery chemistries: AA batteries (various types including lithium primary, lithium metal, lithium-ion), test set-up, and results were presented. The lithium metal was the most vigorous. Total smoke release data was presented. Small scale propagation tests were conducted next. A description of each test set-up was given. The results of the small scale propagation tests were described. Medium scale propagation tests were conducted: test set-up and results were described. Low density propagation tests were conducted (test design, test configuration, and results were presented). Oxygen generator over pack test of lithium metal cells: test design description, 3 tests were conducted, and results. Future tests: button cell flammability characterization, lithium-ion low state of charge flammability characterization. S. Hariram: is there any plan to measure the pressures? H. Webster: we have measured pressure in the past.

Intumescent Paint as a Passive Protection Method Against Lithium Battery Fires – D. Dadia

Dhaval provided background on use of intumescent paint in construction industry. The test set-up and test results from open flame and from radiant heater were presented. Cartridge heater test design was described and the results were presented. Conclusions: effectively reflects the heat on coated metals, but on cellulosic materials it delays the effects of the fire. S. Hariram: Boeing has not used intumescent paint for about 25 years because it flaked off due to conditions such as vibrations. We had used it for insulation purposes then. There may be better intumescents now that can stand up to vibrations better.

ICAO Panel Lithium Battery Shipping Rules – D. Hill

The ICAO Dangerous Goods Panel covers this. Legislation on packaging cannot come before legislation on shipment of lithium batteries. The probability that there is going to be very little change in packaging for batteries yet batteries will have more energy in the future as technology advances. The US has banned the carriage of lithium primaries in passenger aircraft, but other countries have not.

Full Scale Battery Fire Test Plan – H. Webster

Purpose: to document the characteristics of large battery fires in a realistic aircraft environment. Test article: FAATC 727 freighter aircraft in Class C cargo compartment with Halon 1301 suppression. The fire load: will be 5000 cells in original fiberboard packaging with adjacent flammable materials 18”x18”x18” cardboard boxes. Two test locations: forward Class C compartment and main deck Class E compartment. Harry explained the measurements that will be taken during these tests and the considerations for these tests. There will be approximately a

dozen tests in the two locations. D. Ferguson: are you planning on changing the liners or using liners that are currently installed? H. Webster: we are going to use the liners that are currently installed. The tests will be conducted during this fiscal year.

Forced Flow Fire Testing with ”cold”-soaked FK-5-1-12 (Novec 1230) – D. Ingerson

Doug presented purposes, tests conditions and constraints, outcomes, observations, and results. Outcomes: no spray fires extinguished, one of 2 pool fires extinguished. Doug described the interesting observations from the tests. S. Hariram: what does this do to the MPS – are we going to be changing things? D. Ingerson: no. D. Hill: we believe the MPS is correct, and if you could vaporize all this to get those concentrations, then it would probably work, it's just that you don't. We were requested to conduct these tests by the FAA Transport Airplane Directorate. For the timeframe we were operating under, there were some things that were changed, if it did not work, we're done, move on. This was not a relight, it was here's your fire threat, extinguish it.

Novec 1230 Cold Testing Outcomes – Airbus – S. Pugliese

Spray and pool fire threats. Work is progressing to understand all the root causes of the test campaign failures. Novec 1230 needs further developments – more than we were expecting. Airbus and Meggitt will continue to work on Novec 1230 systems. D. Hill: I witnessed a few of these tests, when discharged in cold conditions, liquid Novec 1230 came pouring out the bottom of the nacelle – it wasn't vaporizing properly. Novec 1230 doesn't seem to vaporize in cold conditions as it does in warm conditions.

Full-Scale Demonstration Testing with a Solid Aerosol Fire Extinguishing Agent, Initial Discussion – D. Ingerson

Purposes, test circumstances (“high” fidelity environment), photos test site were covered during this presentation. This test program is towards the completion of testing for MPS for this specific solid aerosol.

NexGen Burner for Powerplant Testing – S. Summer

Background, Advisory Circulars and FAA Reports related to Powerplants. FAATC has been tasked by the FAA Transport Airplane Directorate to update the Powerplant test. In conjunction with DGA and EASA, a detailed user survey has been created and has been released on the Powerplants KSN site. We only have 8 responses at this time. Steve presented the current status of the round robin testing. A new lab space powerplants testing has been built up at the FAATC. Currently awaiting installation of new compressor – should be ready in approximately 4-6 weeks. This is the same NexGen burner that was designed for the materials testing but will probably have different fuel and airflow settings.

Burner for Powerplant – European Status – R. Deletain

A similar activity is being undertaken in Europe. ISO 2685 Revision launched at the end of 2008. Status: preliminary cross-testing (Snecma/CEAT lab test) indicates room for variability in results despite same standard followed. This program is currently in standby – last test was end of 2010. Remi reviewed some of the responses to the survey posted on the FAA Powerplants KSN site. A request was made to labs to provide as many details in their responses as possible and also be as precise as possible.

Certification Memo on Large Transport Airplanes with Composite Wing Fuel Tank Fire Withstanding Capability – R. Deletain

Objective: provide specific guidance for the integral fuel tanks within wing structure primarily made of composite material regarding the ability of the tank structure to withstand fire. Remi reviewed the EASA Policy – current. Status: the proposed CM has been published for public consultation and 12 comments have been received and it has been under rulemaking review since early October 2011. It is expected to be released soon. M. Cummings: are you looking into any wings that are aluminum and composite construction combined? R. Deletain: it is quite complex – it is more complicated when you combine metallic and composite materials. S. Hariram: you are looking at the wing that contains the fuel tank only? R. Deletain: yes, it is mainly directed to the fuel tank.

Certification Memo –Fire (EASA) – R. Deletain

Covers the whole aspect of fire from general aviation to large airplanes. Remi reviewed the areas and some specifics of the CM. The CM will be published on the EASA website for public review and comment (consultation). This is part of the EASA rulemaking process. We (EASA) need to have a bit of internal discussion as to whether all aspects can be covered in one CM or if they should be split into a number of CMs. I hope to have more information by middle of 2012. Will EASA identify differences with the FAA requirements? R. Deletain: I think we will have to try to achieve some harmonization with other major airworthiness authorities at some point.

Liquid Burner Development for Powerplant Fire Test – S. Tambe (University of Cincinnati)

Objective: develop the operating conditions for the NexGen burner for powerplant fire tests including repeatability and reproducibility. Approach: first step was presented at the Systems WG meeting in May 2011. The next step: fire test results from NexGen burner operated at the same heat flux and temperatures. Future Work: derive the NexGen burner settings. Conclusions from pervious work: adding the turbulator and four 1”x3/4” tabs creates a more stable airflow. Air sensitivity and fuel sensitivity graphs were presented. Current Study: fire tests using burner settings with the same measured temperature and heat flux: different airflow rate and different thermocouple size, two sets of tests: large and small size samples of AL6061 with thermocouples on the backside. Samir showed photos of the test rig and indicated the thermocouple locations and exposure area for each sample size. Samir reviewed the test results for each sample size. Recommendations: the fuel and airflow rates should be monitored and documented. Guidelines should include precise air and fuel flow rate settings. Were your thermocouples calibrated traceable to NIST? S. Tambe: these were not calibrated traceable to NIST. These tests were conducted over the past three months. The spec says that the TC should be between AWG20 and AWG30. U of C recommendation is to use the larger thermocouple since the smaller thermocouples are destroyed much more quickly.

THURSDAY, NOVEMBER 17, 2011

Electronic Flight Bag (EFB) Hazard Assessment – S. Summer

Electronic devices used to replace paper materials typically found in the pilot’s Flight Bag. There are three classes of flight bags. Class I and II responsibility falls under FAA flight standards. Class III EFBs are subject to airworthiness standards, as they are considered installed equipment. Proposed Testing: a brief set of tests is planned to assess the potential hazard posed by class I and class II EFBs. Steve gave an overview of the test plan and set-up. Two test scenarios will be conducted and documented (video).

Environmental Update – T. Cortina

Climate Change: two year study of earth surface temperatures by prominent physicist and climate septic Richard Mueller of U of CA at Berkley. Study found that earth's surface temp has increased by 1.6 degrees since 1950s.

Negotiations on a new climate treaty to replace Kyoto Protocol after 2012 have become a contest between competing principles. Kyoto Protocol based on principle of "common but differentiated responsibility" which developing countries want to keep. Kyoto Protocol covers the green house gases (GHGs).

Climate Policy – International: Aviation-ICAO Regulation: Resolution on GHG emissions from aviation was adapted by ICAO in October 2010. Global target of 2% increase in fuel efficiency per year until 2050.

Climate Policy – Europe: EU Emissions trading system (ETS) covers only CO_2. Now in second phase (2008-2012). Covers 10,500 facilities in 27 EU countries (oil, steel, cement, glass, and paper). Plan is to include aviation emissions from 2012 and would cover all airlines flying in/out of EU airports.

Climate Policy – United States: 2009 comprehensive climate change legislation passed the House. In April 2011 legislation passed the House that would have blocked EPA from regulating GHGs. Neither passed Congress. Currently 18 bills in Congress that would impact EPA regulation of GHGs.

Montreal Protocol: Two proposed amendments submitted in May would add HFCs to Montreal Protocol and slowly phase down their production.

Australia has passed a carbon tax. This tax does not cover HFCs.

ICAO Resolution A37-9 on halon replacement was adapted by ICAO in September 2010. It sets timeframes for halon replacements in aviation. Dick Hill covered this in some detail on Wednesday and the table he presented is included in the presentations from this meeting.

Halon 1211 Stratification/Localization in Aircraft – L. Speitel

AC20-42D Halon 1211, Halotron 1, and BTP are unsafe for use in Boeing airplane flight decks and other small volumes. Goal: develop a test-based multiplication factors to allow higher concentrations than AC20-42D guidance provides: small aircraft, flight decks, and large cabins. Louise reviewed the Method being used: for flight decks and large cabins tested were conducted in the FAATC Fire Safety 737 article recently. Reports are being reviewed for small aircraft. Louise reviewed the Cabin Test Plan. Photos of the test set-up were shown. The test plan for the flight deck tests was reviewed (tests were completed in early November 2011). Photos both scenarios of the flight deck test set-up were shown. Additional Work to be done: Run CO_2 discharge test for cabin to obtain cabin air change time. Obtain good air change times for the flight deck. Ventilation: all of these tests were done with one air pack on. D. Blake: Is there a consideration of the crew being on oxygen? D. Hill: The AC is general guidance, but how that guidance is used is up to the ACOs and manufacturers. Louise: No, the guidance tells the crew to be on oxygen first. We did make it clear that the crew should be on protective breathing equipment first.

Halon Replacement for Airplane Portable Fire Extinguishers Progress Report – D. Ferguson (for M. Madden)

Objective: provide a progress report on the development of BTP. The steps to commercialization were reviewed. Some of these have been completed. U of Illinois at Urbana Champaign paper on 3D atmospheric modeling will be published in the Journal of Geophysical Research-Atmospheres. Estimated completion date for testing is 4th quarter of 2012.

ASTM D7673-10 Standard Specification for Halon 1211 – M. Robin

Need for a standard specification for Halon 1211 prompted by the mid-2009 discovery of contaminated Halon on aircraft. Scope: requirements for Halon 1211 as a firefighting medium, does not address equipment or hardware (these will be a separate standard). Material requirements are defined in this standard. Mark reviewed the test methods. This standard has been issued. Previous 1211 Standards: MIL-DTL 38741A and ISO 7201-1.

Composite and Aluminum Wing Tank Flammability Parameters – S. Summer

Steve reviewed the results of work done previously by the FAATC. Report DOT/FAA/AR-11/6 covers the previous work and is available on the FAA Fire Safety website. Current Tests: 727 wing surge tank test article has been re-skinned with composite material and placed alongside aluminum 727 wing surge tank. Testing conducted to compare tank flammability of aluminum and composite. Steve presented the results of the Panel Heat Tests. Wing Tank Test Article: modified to allow for interchangeable top and bottom aluminum and composite skins. Airflow Induction Test Facility photos were shown including photos of the installation of the test article. Air Induction Facility test results were presented. 727 wing tank test article results were presented. Conclusions: white top coat and black top coat both result in tank temps and THC measurements that are consistent with composite fuel tank. Next Step: aluminized paint is being purchased and being applied to composite panels.

Fire Containment Cover ISO Standard Development – D. Blake

Requested by FAA with plans to later reference this standard in an FAA TSO. The draft version of the standard has been finished and will be submitted to the parent organization for a vote on finalization. The requirements in this Standard are stringent. S. Hariram: does it include the fastening methods for the nets to the covers? D. Blake: yes.

Halon Contamination SIB-2009-39R1 – R. Deletain

Revision of Safety Information Bulletin (SIB). A list of the ADs that are still valid is included in this presentation. Remi reviewed the Recommendations. The SIB draft is in review and should be published in the near future.

Halon Purity Certification Methods – R. Hill

Purpose: Investigate approval and quality control issues for fire extinguishing and suppression agents. Transport Canada is funding this contract. The UK CAA is requesting and managing the bids for this contract. The information has been published in the European Journal. For detailed questions contact Claude Lewis and Transport Canada at lewisc@tc.gc.ca.

CSRTG Aircraft Accident Database – Migration to FAA Fire Safety Website – R. Hill

The UK CAA has contracted the management of this database for many years is now no longer supporting the updates/management of this database, so the FAA is now working to incorporate EASA into the CSRTG and the database will now be managed/updated by the FAATC. It is still currently under the old URL based in the UK, but it will be moved to an FAATC server in the US. FAATC contract personnel have been trained on how to maintain/update the database, and a user's manual will be posted with the database.

CAA Training Videos Development – R. Hill

FAATC will be working jointly with UK CAA on development of training videos: two sets of videos – multiple five minute clips on lithium batteries aimed at various audiences to show hazards – not intended as training videos, and a set of aircraft maintenance videos (10-15 minutes). Maintenance videos will include coverage of: wiring issues, care of thermal acoustic insulation, cabin lighting, hydraulics, and hot air ducting. These videos will be designed to show the importance of following procedures and being careful not as training on how to do specific maintenance jobs/tasks. When these videos are completed, they will be available on the FAA Fire Safety website (http://www.fire.tc.faa.gov).

Analysis of Suppressant-Enhanced Overpressure in the FAA Aerosol Can Simulator – G. Linteris

Halon 1301, HFC-125, 2BTP, Novec 1230 are being compared in this investigation. Greg provided background on this project, descriptions of calculations done, details of the study, and results of the tests conducted. The research is continuing.

SAE S-9 Handheld Fire Extinguisher Committee – M. McLean

EASA asked SAE to take on this project on handheld, and it was incorporated into the S-9 committee. There are 14 members: FAA, airframe manufacturers, fire extinguisher manufacturers, chemical manufacturers. We intend to have agent-free standards for the equipment. We will roll out an aerospace standard for handheld and lavatory extinguishers. This group will meet today and tomorrow.

Working Group Member Presentations:

Fire Blue Dot – R. Chauhan (Aerofil, Inc.)

Raj presented a video demonstration of tests conducted of the Fire Blue Dot System.

Next Meeting:

May 23-24, 2012
EASA Headquarters
KÖLN, Germany