INTERNATIONAL AIRCRAFT SYSTEMS FIRE PROTECTION WORKING GROUP MEETING

May 22-23, 2013

Hosted by EASA – Köln, Germany

Meeting Agenda:

WEDNESDAY, MAY 22, 2013

9:00-9:15 AM	Welcome, Meeting Logistics, and Introductions
9:15-9:30 AM	Flight Deck Smoke Penetration Testing (D. Blake)
9:30-9:40 AM	Smoke Transport Code (D. Blake)
9:40-10:00 AM	Cargo Smoke Detection False Alarm Rejection Standard AS 8036 Status (A. Freiling)
10:00-10:15 AM	*Break*
10:15-10:35 AM	Status of NexGen Burner for Powerplant Testing (R. Hill)
10:35-10:50 AM	EASA Powerplant Installation – Fire Testing (R. Deletain)
10:50-11:10 AM	Temperature Mappings of NexGen and Propane Burners: Update of Round Robin Fire Test – (Y. Kao)
11:00-11:25 AM	Commercial Aviation Safety Team (D. Blake)
11:25-11:55 AM	SAE/ISO Standards on Fire Containment Covers and Fire Resistant Containers (D. Blake)
11:55-1:30 PM	*Lunch*
1:30-1:45 PM	Bulk Storage of iPads (R. Hill)
1:45-2:00 PM	Water/Ice in Fuel Research Activities – EASA (R. Deletain)
2:00-2:30 PM	Class E Cargo Compartment Fire Suppression Testing (D. Blake)
2:30-2:45 PM	*Break*
2:45-3:05 PM	Lithium Fire Scenario – Cargo MPS (D. Blake)
3:05-3:25 PM	Risk Benefit Analysis for Freighter Fire Suppression/Mitigation Model Report (R. Hill)
3:25-3:35 PM	Industry Collaboration/Consortium (IC) Research Effort to Develop a Single, Industry-Wide Non-halon Fire Extinguishing Agent for Engine and Auxiliary Power Unit Fire Zones. A proposal of the IC's structure, statement of work, deliverables, and schedule will be discussed. (R. Bennett)
3:35-4:05 PM	International Coordinating Council Aerospace Industries Association Cargo Compartment Halon Replacement Working Group Overview (ICCAIA CCHRWG) (R. Bennett)
4:05 PM	Additional Discussion

THURSDAY, MAY 23, 2013

9:00-9:20 AM	HFC-125 Test Observations in Nacelle Fire Simulator (D. Blake) Status of FAA Engine Nacelle Reports

9:20-10:00 AM	Full-scale Lithium Battery Testing (R. Hill)
10:00-10:20 AM	Passive Fire Protection for Lithium Battery Shipments (R. Hill)
10:20-10:40 AM	Extinguishment of Lithium Batteries (R. Hill)
10:40-10:50 AM	*Break*
10:50-11:00 AM	Status of RTCA Document – Batteries (R. Hill)
11:00-11:15 AM	Cone Calorimeter Battery Heat Release Rate Testing (D. Blake)
11:15-11:35 AM	UPS Update (J. Ransom)
11:35-12:00 PM	Effect of Loading on Handheld Extinguisher Agent Stratification (D. Blake)
12:00-1:30 PM	*Lunch*
1:30-1:50 PM	Handheld Extinguisher Optimization (T. Carriere)
1:50-2:05 PM	Handheld 2-BTP Update (M. Madden)
2:05-2:35 PM	Analysis of Suppressant-Enhanced Overpressure in the FAA Aerosol Can Simulator– Project Update (G. Linteris)
2:35-3:05 PM	Halon Contamination Work (C. Lewis/L. Wallace)
3:05-3:25 PM	Proposed Study on Smoke, Fire, Fume Events (R. Hill)
3:25-3:35 PM	2013 Conference (R. Hill)
3:35-4:00 PM	Working Group Member Presentations 3:35-3:45 PM Shipment of Lithium Ion Batteries Work at Akro Fireguard – J. Green
4:00 PM	Additional Discussion/Closing

Meeting Minutes:

Wednesday, May 22, 2013

Flight Deck Smoke Penetration Testing – D. Blake

This test program was requested by the FAA Transport Airplane Directorate. Objective is to determine if current flight deck smoke penetration certification testing is adequate. Testing will be conducted in forward and aft cargo compartments. Dave reviewed the instrumentation that will be used for the tests. CO_2 decay rates were measured. Results of cabin exchange rate results (for forward and aft cabin) were presented in graph format. This is fairly close to what we had for in-flight. Cargo exchange rate results for forward and aft cargo compartments were presented. We are preparing to start the testing. A couple issues came up: we are in a discussion phase regarding use of smoke generator vs. real smoke for smoke penetration (as experienced during the lithium battery tests recently conducted at FAATC – see lithium battery tests presentation). Hariram: You are doing a CO2 decay in various cargo compartments and main deck, right? Blake: we are looking just to establish ventilation rates with our test aircraft. Hariram: are you following the same procedure as we do for these tests? Blake: yes, that's the plan. Blake: we want to consult with Boeing in order to do it in the most representative way we can. For our aircraft, I believe we can only shut off heat. For main deck, if we can get some conditions most representative of freighter, we'll look to Boeing for information. The current question is what source of smoke to use for these tests. Madden: You are testing the lower compartment with the liner removed. I assume you will test with the liner as well. The only way the airplane can fly with the liner missing is with no cargo.

Modeling of Hidden Fire Smoke Signature in Aircraft- D. Blake (for Ezgi Oztekin)

A Case Study of Overhead Area – FAA AC 120-80; Objective: 1) to improve understanding of hidden in-flight fires with the help of analytical tools; and 2) to build analytical capabilities that will complement the existing experimental work for other fire scenarios. The ultimate goal is to predict source of fire in entire airplane. Ezgi uses the NIST Fire Dynamic Smoke Model that is publicly available. Dave reviewed the methodology for this project. Bench/lab scale work will be conducted initially. Eventually, the plan is to run full scale tests in the FAATC 747SP test article. Ongoing work: measurement of each and every object is a major challenge – any information Boeing is able to share will be appreciated. Ferguson: is the purpose of this modeling to look at places where smoke detection can be located? Is it intended to be used for smoke detection or some other reason? Blake: where you can inject handheld extinguishers and for overall capability if you see/smell smoke whether you can predict where the source of that smoke is. Hariram: is there any plan regarding smoke traveling from the rear of the aircraft to the flight deck? Blake: long range goal of the model would be to predict how a fire would spread, but this is a long range goal. I don't know if Boeing has done any work regarding this.

Cargo Compartment Smoke Detector AS8036 Standard Revision- Andre Freiling (Airbus)

This working group was organized in April/May 2011 to revise this Standard. Acknowledgement was given to the working group team. The internal ballot has been finalized and is just about ready for public ballot process. EN/UL smoke detector fire test standards: wood fire and flammable liquid fire tests were used. Fog build up in cargo compartment can lead to false alarm in cargo compartment. The test procedure and test set-up for dust were reviewed. Insecticides also contributed to false alarms in the cargo compartment. Ambient light test procedure is used. Summary: the Committee has finalized its work and the public ballot is about to start. I am not sure of the SAE process for reviewing the document. Contact Andre and he will investigate with SAE and let you know. Hariram: Did you consider animal dander or flowers as sources of false alarms in cargo airplanes? Andre: it was considered, but dust was decided on as the main source. Keep in mind this is a Minimum Standard. Hariram: Did you look at pressure? Pressure used to give us nuisance alerts at one time. Andre: there are paragraphs in the document that deal with pressure drop. Overpressure is not part of it. Hariram: I did not see Curtiss Wright as a committee participant. Andre: They were participating in the beginning, but did not stay with the team. Blake: I believe the TSO has words to address the overpressure.

Status of NexGen Burner for Powerplant Testing – R. Hill (for Steve Summer)

Background: numerous FAR's mandate fire protection in aircraft powerplant fire zones, most are general. Advisory material: there are a number of different AC's and reports, also. None of the burners in these reports are currently available. Chapter 11 of the *Aircraft Materials Fire Test Handbook* (available at www.fire.tc.faa.gov) specifies the Park DPL 3400 burner that is no longer available. Industry is left with the propane burner which can be obtained and is typically preferred due to its consistency and ease of use, however, propane and jet fuel flames are fundamentally different. FAATC Fire Safety Branch was tasked by FAA Transport Airplane Directorate to develop burner performance standards for the NexGen burner for powerplant testing. The Roadmap to NexGen Burner Implementation for Powerplant Testing was reviewed – ending with a revision to AC20-135 that will incorporate all work done in this project. The Round Robin tests and planned tests were reviewed. Additional work: Much of this work has already been done within the International Aircraft Materials Fire Testing Working Group (see Materials meeting presentations under 'Materials' tab at www.fire.tc.faa.gov): flame retention head investigation, AC20-135 subgroup has been formed and a conference call was held May 7, 2013. Hariram: the fuel that you will use for the NexGen burner? Hill: If you use diesel fuel, it can be a lot different than Jet A or kerosene. Kerosene seems to give very similar results to Jet A. Mullender: flame retention heads: is there any risk that you are building in obsolescence using an off the shelf FRH? Hill: No, you could probably build an FRH. There would be a CAD drawing, so they could be made. The sonic choke is also available from several different companies and with some difficulty could be made, also. One of the unique features of the sonic burner is that you don't have to calibrate it using temperature and heat flux. Member Question (Element): how would you know when to replace burner parts? Would you have to check it after every test? Hill: You may want to do a use a thermocouple rig to check the burner. Member Question (Element): how would you know there is no

degradation of the components? So, it's a full tear down and clean up after every test? Hill: No, we have used the NexGen burner for cargo liners and seats on the Materials side. When you use this burner, everything is repeatable and reproducible. The sonic burner is going to be the burner used for seats, cargo liners and burnthrough tests. There are approximately 100 labs worldwide that will be using the sonic burner for materials tests. Hariram: Will the propane burner be outlawed? Hill: That's a question for FAA Regulatory side. I cannot answer that. Gehring: Didn't you use the heat flux and temperature to establish temperature, airflow, etc.? Hill: Yes, that was one way of doing it, but we haven't determined if that will be the way. All of this will be determined through the Round Robin work.

Powerplant Fire Testing – Status – Remi Deletain (EASA)

CEAT/DGA presentation during the Materials Working Group meeting in October 2008 – difference in severity. ISO 2685: 1998 Systematic Review – Meeting 13 November 2008. Kick off May 2010. Additional testing was performed in 2010. FAATC NexGen for powerplant application in 2010. Since 2010, the activity has been on standby. FAATC/EASA/FAA fire testing survey launched in July 2011: many differences between labs, bad reproducibility between labs, good repeatability (test results). May 2013 the AC20-135 subgroup was launched. Way forward: need to address the variability and recurring interpretation issue. We would like to put the focus on the function to be performed under fire. Other points to be considered: Restrictions on types of materials to be addressed (Ti, Mg, etc.), Combustor burnthrough: EASA generic CRI. ISO 2685: not the most adequate support to capture ALL ongoing certification issues, especially dealing with interpretations, need for EASA interpretive Material. Shall be revised to take into account some issues. Hariram: one application that causes a lot of problems: specification of aluminum in CS 25-878: are you going to be addressing this? Deletain: We have a generic CRI. There will still be a difference with the FAA. Hill: to working Group members: in the AC, is there a need for advisory material for toxicity and smoke especially when using composite components as in firewalls (ex: firewall between engine and cockpit) when composites replace steel or aluminum components? Mullender: Rolls Royce has just issued safety guidance to safety houses and test houses to treat composite materials like asbestos when fire testing because we have recently determined that there are particles become small similar in size to asbestos.

Updates of Round Robin Test and Temperature Mapping for NexGen and Gas Burners – Y. Kao (University of Cincinnati)

Round Robin: test of 2024 aluminum sheet (600 mm x 600 mm). Effect of Calibration Pattern of TCs: the burnthrough time decreases with the increasing covering area of calibration TC pattern with the same calibration. Effect of Vertical Alignment of Test Sample and Effect of Horizontal Alignment of Test Sample were reviewed. Effect of Calibration Standard of Fire Test: burnthrough time is much shorter following FAA standard than those following ISO 2685 standard. The current ISO document was written in 1992.
Conclusion: the calibration issue of TCs is a critical factor of fire test result. Both alignment issues have impact on the test result although the impact is less than that of the TC pattern. The burnthrough time is observed to be inversely proportional to the input amount of propane flow rate.
Temperature Mapping: A schematic of temperature mapping was shown. Temperature Heat Flux Mapping for Gas Burner: observations were reviewed. Conclusion: for NexGen Burner and gas burner: profile of flame is influenced by the orientation of the burner setup, even the fuel and airflows are the same. The hottest region of the NexGen burner is around 2 inches above the centerline of the burner.

Commercial Aviation Safety Team (CAST) for Cargo Fire Protection – D. Blake

Cast Member Meeting at High Level: establishes tasks and outcomes. JIMDAT – working level members. Safety Enhancement 127: aims to reduce cargo fires through new or revised standards for the construction of standardized and improve cargo containers that include fire-suppression or fire-containment systems. This SE led to the development of draft SAE AS6453 and ISO/CD 14186 standards for Fire Containment Covers (FCCs). These standards are very close to finalization. It also led to development of a draft standard for Fire Resistant Containers (FRCs).
Cargo-Mitigations for Hazardous Material Fires: this has just been voted on recently by the high-level CAST members and is waiting on approval before planned activities begin. It is expected that safe methods to ship

lithium batteries will be included in this. The FAATC will now start to be involved in this since it includes fire safety issues. Louchez: is EASA represented in CAST? Blake: EASA is a member of CAST, but I am not sure what level of involvement EASA has in CAST. Ferguson: Do you see the new CAST activity on hazardous material impacting the standards for these containers? Blake: It's possible.

SAE/ISO Fire Containment Covers (FCCs) and Fire Resistant Containers (FRCs) Standards Development – D. Blake

For FCCs: SAE6453 and ISO/CD 14186 are in the final approval phase and should be published shortly. These standards are essentially identical. The FAA intends to reference the SAE standard in a revision to TSO C90.
For FRCs: ISO TC/20/SC9 has approved a project to develop a standard for FRCs and the effort has commenced. SAE will begin its version of the standard in September 2013. FAA intends to issue a TSO for FRCs that will reference the new SAE standard.

Class B Fires in AAY Container – D. Blake (for Dhaval Dadia)

Dhaval conducted some Class B fire tests as a result of some concerns expressed by Pete Chittenden (EASA) at a previous meeting. A photo of the fuel pan setup was shown. A graph of the test with an empty container results was shown. A graph of the tests with a loaded container was shown.

Bulk Storage of iPads – R. Hill

Use of iPads/tablets supplied by airline as personal entertainment devices – stored on-board. FAATC: the effect of iPad battery overheating was observed under various conditions. Tests have been done with other Lithium-ion devices and cells to understand propagation and heat release. The Test Matrix (planned tests) was presented. The work is being done in conjunction with the FAA Transport Airplane Directorate and the Civil Aviation Authority of Singapore (CAAS). The iPads will be provided by CAAS. The information obtained from these tests will be property of the FAA. We will be producing a thermal runaway in one battery and seeing if it spreads. Ferguson: what sort of activity is going on right now to write a standard, who would write it, and who would it be applicable to? Hill: The FAA Transport Directorate is aware of what we are doing but is currently not working on a standard. We will send results to FAA Regulatory. CAAS has applicants that want to use these devices as their on-board entertainment systems.

Water/Ice in Fuel Research Activities – Remi Deletain (EASA)

Remi gave background for this research project. Expected release of final report is June 2013. EASA.2010.OP.08 Call for Tender: water in aviation fuel under cold temperature conditions "WAFCOLT". 4 offers received. Final report will be made available at end of May 2013. EASA.2012.OP.14 "ICAR" ice accretion in fuel systems. Interim report end of May 2013. Seminar on water/ice in aviation fuel, May 29, 2013, at Institution of Mechanical Engineers, London.

Class E Cargo Compartment Fire Suppression Testing – D. Blake

Background: a number of main deck freighter incidents/accidents in recent years prompted this work. Objective: calculating air exchange rates, measuring effectiveness of a zone-based water mist system. Measuring air exchange rate in FRC: oxygen starvation is an important factor in FRCs. Photos of the experimental setup were shown and a description of the experimental setup was provided. Zone-based water mist system: Objective: to determine the effectiveness of a water mist system as a viable fire suppression system in a Class E cargo compartment. A photo of the new upper deck cargo area at the FAATC was shown. It represents a wide-body freighter. Full and half load pallet and AAY container fires will be investigated. Planned work: conduct tests to determine the upper limit of air exchange rates in containers. Conduct tests to determine an appropriate fire load that contains lithium batteries. Thierry: the water mist system is a system you already have available at your facility: have you given any thought to changing droplet size or other factors as part of the test matrix. Blake: it is, and we are definitely willing to take input from industry members

who have more experience in working with these types of systems. If anyone would like to provide suggestions or input, please contact Dhaval Dadia or Dave Blake. Input for consideration is welcome.

Lithium Fire Scenario – D. Blake

DOT/FAA/TC-TN12/11 Halon Replacement Cargo Compartment MPS (2012 Update). Four current scenarios: bulk load, containerized load, surface burning flammable fluid, and aerosol can.
Effectiveness of Halon 1301 lithium-ion battery fire –these tests used 8 cells over an alcohol pan fire. Conclusion: Halon 1301 did not stop propagation from one to another. Large scale tests at FAATC: We have some testing planned with a large number of batteries – starting with around 100 batteries. We also have tests planned with 5,000 batteries. Madden: I think you said you will not be doing any lithium-metal battery tests, because airlines are not allowed to ship lithium-metal batteries in large quantities. What about aerosol cans? Hill: I think 72 ounces are allowed in checked baggage. Rogers: I am on the ICAO committee and can provide the specific requirements if you are interested.

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

This work was done by RGW Cherry & Associates based in the United Kingdom. Background: there have been 5 cargo fire accidents on U.S. registered freighter airplanes to date (2 with possible lithium battery involvement). Future risks assumed proportional to cargo revenue ton miles. Risk model predicted: 6 further accidents over next 10 years, corresponding annual cost of accidents $50 million. The new Model and Report are available at www.fire.tc.faa.gov. The Model is a Monte Carlo model. Report published in April 2013 (available on FAA Fire Safety website). The current model looks at mitigation: 7 selectable mitigation means – individual or combined. Dick reviewed some of the main features of the model. The model is in Microsoft Excel. Gehring: is this model recognized by the operators? Hill: We just published this in April 2013, so I don't know how many operators know about it yet.

Industry Collaboration/Consortium (IC) Research Effort to Develop a Single, Industry-Wide Non-Halon Fire Extinguishing Agent for Engine and Auxiliary Power Unit Fire Zones.
A proposal of the IC's structure, statement of work, deliverables, and schedule will be discussed – Robin Bennett (Boeing)

This will also be presented at the HARC meeting in Chicago next month. Proposal: define a common non-halon fire extinguishing agent for engines and auxiliary unit fire zones. Hill: it sounds like you are looking for something that already exists not developing a new agent in the two year timeframe that you have projected for this initiative? Bennett: that's why we are going to HARC. Is it an agent problem or is it a delivery system that has to be enhanced or improved for something that is already available. Maybe we as an industry have to pool our resources. Hariram: it's possible that we can rework a delivery system for CF3I. We are looking to pool our resources to come up with a solution as an industry. We all have a common goal to meet the ICAO requirements. Kallergis: Are you concentrating on engines because of the deadline? In principal would it be feasible to work on cargo, also? Bennett: Yes, because of the 2014 deadline. In principal it is feasible to work on cargo. I will talk about the cargo group next. There is some overlap in the two groups in the statement of work. Linteris: It looks like one key step is the agent and the manufacturers coming forward with their proposals, so why haven't they done that already in the past 10 years or so? Bennett: There are proposals already for development of agents that need further development and funding. That is why this group is being proposed. Gehring: are there any initiatives in the U.S. for phasing down use of some F gases? Bennett: No, we don't have any specific regulatory requirements, but the U.S. government has proposed phase down. Hariram: the amount of HFC 125 you need to replace halon increases the carbon footprint.

International Coordinating Council Aerospace Industries Association Cargo Compartment Halon Replacement Working Group Overview (ICCAIA CCHRWG) – Robin Bennett

The first meeting was held in November 2012. We went through the requirements to make this an official working group under the ICC AIA. Robin reviewed the Terms of Reference for this group. The next meeting will be held May 23, 2013, after the close of the Systems Working Group meeting.

THURSDAY, MAY 23, 2013

HFC-125 Test Observations in Nacelle Fire Simulator/Status of FAA Engine Nacelle Reports –
D. Blake (for Doug Ingerson)

Tests: cargo compartment, pressure vessel, and nacelle fire simulator
Cargo Compartment (July 1997): exploding aerosol can simulator in 727 lower lobe compartment, numerous photos were shown of test sequence,
Cargo Compartment (Sept. 1997): Bldg 275's DC-10 lower lobe cargo compartment, HFC-125 use, 2 part injection of agent
Schematic of cargo compartment test article was shown
Pressure vessel testing (Dec 2003-Jan 2004): no ventilation and pressure tight, 11m^3 size, schematic and photo of simulator were shown, summary of results presented
Nacelle simulator tests (Dec 2004): Bldg 205 nacelle fire simulator, fire threat of this test JP-8 spray fire, HFC-125 single, one time injection of agent, schematic of nacelle simulator was shown, and photos of the test were shown.
A summary of the pertinent tests was presented.
Hariram: was Doug able to measure any overpressure when he tested in the nacelle? Hill: there was not a significant overpressure with the HFC-125 in the nacelle simulator. After the CF3I and BTP tests, he went back to the video of the HFC-125 tests to check for overpressure. Linteris: If you go back and look at the talk I gave in Long Beach (Nov. 2012), the agents act a little bit like fuels. I talked about this in the Long Beach presentation in more detail. Gehring: are there any incident reports, where the military has observed some structural nacelle damage when extinguishing with HFC-125? Blake: we haven't heard of any. Doug has worked with the military quite a bit, so he probably would have heard or we would have heard something. Madden: aerosol can simulator: do you know why it states the overpressure is many magnitudes higher than overpressure from a single aerosol can, but then it doesn't go on to explain why you guys decided it was okay to go on knowing those facts. Blake: the simulator contents replicate the contents of an aerosol can (large can of hairspray). We had to do it in a controlled way, that's why we couldn't use an actual aerosol can.

Full-scale Lithium Battery Testing – R. Hill (for Harry Webster)

FAATC 727 freighter full-scale tests in upper deck Class E compartment (no suppression) and we will be doing Class C compartment with suppression in the near future. We did not have standard airflow prior to the detection, because we can not have anyone in the aircraft to change it. We had emergency airflow conditions only. Test sequence: baseline, lithium-ion 5000 18650 cells, lithium-metal 4800 123A cells, 5000 mixed alkaline, NiCad, and NiMH. Photos of instrumentation setup were shown and described. Dick reviewed the results of the tests conducted in the Class E compartment: the 5000 lithium-ion18650 cells were at 50% charge for the test, 2792 cells were involved in the fire by time of extinguishment. The mixed cells test was basically a non-event. The lithium-metal: test terminated at 16 minutes, very, very intense fire, it was extinguished because the temperature above the ceiling was getting too high, there was quite a bit more smoke at the end of the test than there was with the lithium-ion cells. Next lithium-ion test terminated at 18 minutes, oxygen went down to 18% but fire still was not being controlled even though oxygen was down, there was a lot of smoke in the compartment.
Class C Tests – Upcoming – Same scenarios using Halon discharge. After these tests we will be repeating the previous tests with a fire resistant container and a fire containment cover.
A time-lapse video of the lithium-metal test was shown. Madden: is the fireproof container a ULD container? Hill: it is a fire resistant ULD being manufactured for an end user. The cover will be or will be close to one that meets the new requirement. It will be one that has been tested to normal fires. These containers and covers have not been tested with large battery fires before. Madden: will those tests happen this year? Hill: they will take place fairly quickly after the Class C tests are completed. Rogers: were the packages prepared how they would be shipped? Hill: absolutely, because they were tested the way they were shipped to us via air. Chittenden: do we know what percentage of lithium batteries carried by air are metals? Hill: I would estimate 10% or less. I think most of the metals are shipped by ship rather than air. The U.S. bans the bulk shipment of metal batteries in passenger aircraft. Rogers: I would say metals are 1 to 2% range carried by air.

Passive Fire Protection for Lithium Battery Shipments – R. Hill

Incidents: Dubai Accident (2010) and UPS DC-8 (2006). Objective: to try to better understand the variation in cell packaging and the state of charge and how does state of charge and/or packaging affect from fire incident. We investigated various types of separators and various states of charge of batteries. If you can keep the batteries at 50% state of charge, you can find some materials that will protect. At less than 50% state of charge, most materials work. At more than 50% state of charge, most materials do not protect from thermal runaway. A water pouch above the batteries was also tested. Summary: tendency for cells to propagate is highly dependent on the state of charge of the cell. Water is effective in absorbing energy and preventing propagation. When a cell explodes it may break apart the cell package and decreases the likelihood of propagation. Future Tests: perform cardboard as shipped tests with other Lithium-ion chemistries. Additional tests with primary cells.

Extinguishment of Lithium Batteries – R. Hill (for Tom Maloney)

How effective is the agent at cooling the battery to stop propagation from one cell to the next. Most agents will stop flaming electrolyte cell, but Halon and many others cannot cool the cell to stop thermal runaway. This focuses on stopping the thermal runaway from one cell to another with the agent – the cooling affect of the agent. Test Setup: heated plate. We used a number of agents including water. Water and the aqueous agents exhibited the greatest cooling effectiveness. Increasing the flow rate of the aqueous agents caused higher temperature reductions. The gaseous agents showed little cooling effect and increasing the quantity of gaseous agent did not improve the cooling. Member question: what about water mist? Hill: you want the water on the laptop or the battery cell. A water mist system may drop the temperature a little but probably would not drop it enough. Water directly on the fire seems to be the most effective.
Andre: are you looking also into detection – improved detection? Hill: at the present time we are not looking at detection. This project is strictly looking at fires in electronic devices carried by passengers in the cabin.
Rogers: The NTSB put out recommendations for detection.

Status of RTCA Document SC-225– R. Hill (for Steve Summer)

Minimal operational standards for small and medium sized batteries rechargeable lithium batteries permanently installed on aircraft. These batteries power various components in the aircraft not APUs. This committee has been meeting regularly since March 2011. A draft document has been submitted for review and comment, and the committee has started reviewing the comments.

Cone Calorimeter Battery Heat Release Rate Testing – D. Blake

Dave showed a photo of the cone calorimeter and described it. It is used a lot in the fire science field. Heat release of lithium, lithium-ion and lithium-polymer batteries, heat release of lithium-ion 18650, and comparison of different battery chemistries of AA batteries alkaline and lithium were part of the cone calorimeter tests. A video of the lithium-ion battery test in the cone calorimeter was shown. The results of this series of tests will be published as an FAA Technical Note.

Engineering Safety in Air Shipments – UPS Update – Capt. John Ransom

UPS Flight 6 Philadelphia prompted creation of UPS IPA Safety Task Force. Lithium-ion battery shipments are growing at a rapid rate and are expected to grow higher. UPS is installing Emergency Vision Assurance System (EVAS) on all UPS aircraft. All UPS airplanes have crew type oral/nasal masks. Training improvement especially for dealing with in-flight smoke/fire/fume events. Checklist – UPS has committed to improving checklist design and layout. Fire Containment Covers (FCC): UPS purchased a number of these. We have already started use of these in Hong Kong in March 2013 and plan to add two per month. They will also be placed on high energy shipments and shipments from unknown shippers. Container redesign. Aerosol

suppression device – lowers temperature and keeps re-ignition from happening. ULD and suppression: we conducted a test with a "real world load" in our fire containment ULD design. The video of this "real world load" test was shown. Next Steps: we will conduct additional testing. UPS would like to see industry and regulators work together to develop fire safety certification rules and standards reflecting current (and future) technologies. UPS is working on a new ULD door different than the one on the container used in the test. Gehring: how does EVAS work? Ransom: a large piece of plastic that is Y-shaped that attaches to a piece of Velcro already there – it inflates to provide visibility of the instruments and out the front of the cockpit. Chittenden: how does the aerosol suppressant work? Ransom: it is potassium based and brings the temperature down. There is a sensor that has a number of different things that will set it off. It is also temperature activated. It is a current product. It is used a lot in ground based transportation in Europe.

Effect of Loading on Handheld Extinguisher Agent Stratification/Localization in Small 4-Seater Aircraft – D. Blake (for Louise Speitel)

AC20-42D related work. Objective: evaluate the effect of loading on Halon 1211 stratification in a ventilated 4-seater GA aircraft. Dave described the tests conducted using a Cessna 210 aircraft.

Handheld Extinguisher Optimization Using SNAP-Listed Agent – Thierry Carriere

Investigate drop-in replacement for Handheld 1211 extinguishers. Agent being investigated is Novec 1230. The proposed atomization technology background was presented. Adaptation of technology to Novec 1230. Propellant gas can be either N_2 or CO_2. Optional bladder can be installed inside the agent bottle so it can be operated upside down. Spray pattern and cone angle were also investigated. In-house class B testing has started (3B & 5B pan fires). FAA seat toxicity test not yet attempted. The first round of tests was conducted in March 2013 at US Army Aberdeen (MD) Test Center. Indoor facility set up for up to 10B fire (heptane & JP-8). Goal of this test series: define performance envelope of ADA's experimental Novec HH unit and advance component design. Test series summary: 3 days, 30 pan fire tests. Next steps: need to further optimize atomizer and nozzle to improve the performance on heptane fires (target 5B). Plan to perform new series of tests in June/July 2013 with Novec (dates TBD). Project final report by end of this summer. Our product is the atomization technology not the agent, so other agents can be considered. Hill: how many times did the Halon 1211 extinguish the 5B pan fire? Carriere: the firefighter was able to extinguish one out of two 5B pan fires with the Halon 1211. It is challenging that you need a highly trained person to perform the test.

Halon Replacement for Airplane Portable Fire Extinguishers Update – Mike Madden

BTP is not an ozone depleting substance. Mike reviewed the key steps required to commercialization. This work began in 2009 by means of contract with American Pacific to manufacture the BTP. The work done to date and observations were reviewed. PBPK modeling is in progress. We are currently evaluating reproductive screen results and deciding where to go from here. Member Question: could you see the agent being used for engine and APU applications? Madden: I think the only issue is the overpressure which Dr. Linteris is investigating.
Hill: you can probably for the aviation market to make decisions to get around some of these things, but would a company want to make a manufacturing plant for an agent that it may be tough to market to other businesses. Madden: It would be better to have a bigger market. If the reproductive warning on the MSDS cannot be removed, it will be a real challenge to market and we'll need to reevaluate moving forward. Member Question: comparison of BTP to CF3I. Hill: CF3I has been SNAP approved for non-occupied areas. It has this connotation of being toxic so that people don't want to touch it. Whether it's justifiable or not, it gets the reputation.

Exothermic Reaction of Fire Suppressants: Behavior of Brominated and Chlorinated Compounds – Greg Linteris

Goal: why is the overpressure occurring (FAA Aerosol Can Simulator test) with the added suppressants? Tools: we are using numerical simulations (with kinetic modeling) and experiments. 2-BTP did not work in FAA Aerosol Can Simulator. Brominated compounds and iodinated compounds to be investigated. R-123 has

a chance of working in the FAA Aerosol Can Simulator. It is expected to give less overpressure than HFC-125 in the Aerosol Can Test. Chlorinated compounds in general have a better chance of working in the Aerosol Can Test than fluorinated compounds. The next steps were reviewed. HCFC-123 and CF3I will be tested in the FAA Aerosol Can Test apparatus. Continue development of laboratory-scale experiments.

Study Regarding Fire Extinguishing/Suppression Agents' Quality Processes – Claude Lewis/Lionel Wallace

Claude reviewed the two drivers for this work. Objective: to investigate the quality processes in use in North America and Europe. Lionel Wallace of RGW Cherry & Associates presented the specifics of this work. Principal Recommendations: agent manufacturers and recycling organizations are generally not overseen by the Authorities. The issue is who should carry the burden on the purity of the agent.
Quality control: effective quality control of the agent can only realistically be assured at point of insertion into extinguisher or component. Other concerns: Bulk holding and batch stock, test laboratories (should laboratories or person taking sample be accredited), and equipment/component overhaul (overhauled equipment may not be subject to the same controls as new equipment). Question: any differences between equipment on aircraft in US and Europe – is it acceptable to just have a UL tagged extinguisher to go on a US aircraft. We are keen to hear from aircraft maintenance and manufacturers. Hariram: we are recently facing type I or Type II halon. The ASTM spec that controls halon has got two types (Type I and Type II). There are some companies that refill halon which inadvertently refilled them with type I halon which has an uncontrolled amount of nitrogen in it. This results in a lower quality of halon for extinguishing purposes. The suppliers spec calls for Type II halon. It occurs when the bottle is sent in for hydro testing. This is currently happening in the industry. This is happening with halon 1301 bottles. There are three airlines I work with in Europe and one airline I work with in Hong Kong that have experienced this. Wallace: I think we need to look at the overhaul and filling of bottles.

Fire, Smoke, and Fumes Occurrences on Transport Airplanes – A Study – R. Hill

Collection of data relating to false fire, smoke or fume warnings on US registered transport aircraft greater than 12,500 MTOW into a database. Analyze the data including a 10-year period. It will cover engines, cargo compartments, cabin, and hidden areas. Pugliese: Do you have a target date? G. Greene: The procurement process has started, but we have not got a specific target date yet. The procurement process takes some time. Hill: It will take a few months to get it started and then several months to collect the data. Hariram: I did a similar study 25 or so years ago, and one of the most common causes was electrical issues in the cabin.

2013 Seventh Triennial International Aircraft Fire and Cabin Safety Research Conference

December 2-5, 2013
Philadelphia, Pennsylvania, USA
Attendee Registration is free
Register and additional information, hotel information at: www.fire.tc.faa.gov

Working Group Member Presentations:

Shipment of Lithium Batteries, Technology Concept, Development and Testing at Akro Fireguard – Jonathan Green

Concept: Loose fill packing media (similar to "packing peanuts"). Following exposure to heat/fire forms a homogeneous barrier material. Akro Fireguard used a Park oil burner for these tests. A suppressed cargo fire test was also conducted – Thermal Resistance Test. A graph of the temperatures recorded during and after the test was presented. A battery runaway test was also conducted. A 75-watt cartridge heater replaced one of the batteries for this test (15 batteries and 1 75-watt cartridge heater). There is still quite a bit of work to be done as part of this study. This was the initial part of the study. Campbell: Are there any toxicity concerns with the material you are using? Green: the material is a fairly inert material, phosphorus based.

Next Meeting

There will be no fall 2013 meeting. The 2013 Seventh Triennial International Aircraft Fire and Cabin Safety Conference will replace the fall 2013 meeting.
The next Systems WG meeting will be held in spring 2014.