INTERNATIONAL AIRCRAFT SYSTEMS FIRE PROTECTION WORKING GROUP MEETING

May 18-19, 2016

Hosted by Airbus, Toulouse, France

Agenda:

WEDNESDAY, MAY 18, 2016

9:00-9:10 AM Welcome and Meeting Logistics – D. Blake (FAATC)
9:10-9:20 AM Attendee Introductions
9:20-9:35 AM Airbus Introduction/Welcome – Ian Goodwin
9:35-9:50 AM Detection Issues – SAE Standard – D. Blake (FAATC)
9:50-10:05 AM Smoke Source Project Update – D. Blake (FAATC)
10:05-10:20 AM *Break*
10:20-10:35 AM Status of NexGen Burner for Powerplant Testing – S. Summer
10:35-10:55 AM Results of Recent Tests Conducted at University of Cincinnati – Ryan Hasselback (University of Cincinnati)
10:55-11:15 AM Powerplant Fire Test/Analysis of RR2014 DGA's Test Results/Calibration Means Outlook – Serge Le Neve (DGA)
11:15-11:30 AM SAE/ISO Standards on Fire Containment Covers and Fire Resistant Containers -D. Blake (FAATC)
11:30 AM-12:00 PM Smoke, Fire, Fume Events Study – R. Hill (FAATC)
12:00-1:30 PM *Lunch*
1:30-1:35 PM Class E Cargo Compartment Planned Work – D. Blake (FAATC)
1:35-1:55 PM Recent Developments in Cargo Compartment Protection – Adam Chattaway (UTC Aerospace)
1:55-2:25 PM UPS Concerns and Update – Bob Brown and Ed Walton (UPS)
2:25-2:45 PM Class C Cargo Compartment ULD Suppression Agent Penetration – D. Blake (FAATC)
2:45-3:15 PM Cargo Fire Suppression Using ODA from a Fuel Cell – S. Summer
3:15-3:30 Flammability of Materials in a Low-Concentration Hydrogen Environment – S. Summer
3:30-3:45 PM Break
3:45-3:55 PM Commercial Aviation Safety Team Update – D. Blake (FAATC)
3:55-4:20 PM Halon Replacement for Airplane Portable Fire Extinguishers – Progress Report – Mike Madden (Boeing)
4:20-4:30 PM Reconsidering Carbon Dioxide as a Nacelle Fire Extinguishing Agent – Update – (FAATC)
4:30-4:40 PM EASA Rulemaking Activities – R. Deletain (EASA)
4:40-4:50 PM Engine/APU Halon Replacement Industry Consortium - Halon Alternatives for Aircraft Propulsion (HAAPS) – Thibault Pelletier (Airbus)
4:50-5:05 PM Cargo Compartment Halon Replacement Working Group (CCHRWG) Update – Robin Bennett (Boeing)

THURSDAY, MAY 19, 2016

9:00-9:20 AM Status of ICAO Lithium Battery Activities – (FAATC)
9:20-9:40 AM Status of the SAE G-27 Lithiuim Battery Packaging Committee– Doug Ferguson (Boeing)
9:40-9:55 AM Battery & Fuel Cell Industry Working Group Updates – S. Summer
9:55-10:15 AM Thermal Runaway Initiation Tests – T. Maloney (FAATC)
10:15-10:30 AM *Break*
10:30-10:45 AM Gas Analysis of Lithium Metal Button Cells – T. Maloney (FAATC)
10:45-11:05 AM Flammability of Mixed Battery Gases and the Inerting Effects of Halon – Update – T. Maloney (FAATC)
11:05-11:30 AM Working Group Member Presentations

11:05-11:20 AM Multi-disciplinary Model for Smoke Movement Simulation -Multidisciplinary thermo-structural model FAR / CS 25 appendix F Part III – Gaetano Mirra (Finmeccanica Aircraft Division)

11:20-11:30 AM Fire Barrier for Battery Packs - Arnaud Montesino (RJP), Julien Thiery/Guillaume Guery (Saint Gobain)

11:30-11:40 AM P3 HAFEX – Development and Qualification of a Halon-alternative 5BC Cabin Handheld Fire Extinguisher for Commercial Aircraft with 2BTP – Joachim Scholz (P3 Aviation GmbH)

11:40-11:45 AM 2016 Triennial Conference – R. Hill (FAATC)
11:45 AM-12:00 PM Additional Discussion / Closing

Meeting Minutes:

WEDNESDAY, MAY 18, 2016

Airbus Welcome from Ian Goodwin (Airbus Product Safety Department)

Cargo Compartment Smoke Detector Certification - D. Blake (FAATC)

TSO C1e was updated in 2014 and referenced SAE AS 8036. The big change that evolved was some requirements for false alarm rejection. Dust, insecticide, ambient light, and combined temp, pressure, and humidity cycling tests are part of this TSO. This is new criteria. The problem is what has traditionally been done: certifying with theatrical smoke. Dave's question to Working Group: Is a Task Group on this issue desired by the IASFPWG? Please let Dave Blake or April Horner know. Freiling: I am involved in the SAE Committee on this. I am willing to support this Task Group. Simpson: Would the remit of that group be to look at a new Standard? Blake: Yes, that's what the FAA Transport Directorate wants us to look into. Simpson: We would like to participate in the Task Group. Blake: I think it would be beneficial to have industry participate in this project. Baker: Boeing would also like to participate. Embraer/AOA/Bombardier/Siemens/UTC/Honeywell/EASA will also participate in this Task Group. Please send April an email with the contact details for the participant from each organization.

Smoke Source Project – D. Blake for R. Morrison (FAATC)

Dave reviewed the objective of this project and showed a video of a test conducted in the FAATC 727 aircraft test article. An IR was also shown. Smoke meters were used during the cockpit test.

Lithium Battery Smoke Simulation tests - Purpose: compare different theatrical smoke generating smoke sources to a 4800 lithium primary battery fire test performed in a Class E cargo compartment – how to generate a smoke that has that behavior. This test was set up in the DC-10 test article. Photos of the test set up were presented: ViCount and Rosco 1900 (FAA set up) generators. Dave described the specifics of the test set up and the details of the tests conducted. The initial results were presented. ViCount and Rosco 1700, 1900, and 3000 models were tested. A video of the differences of the Rosco with no helium and with 60/40 helium/air was shown. Plans: Rosco 1700, 1900, and 3000 series theatrical smoke generators will be tested further and then in the same B 727 Class E cargo compartment as the 2/3/16 battery tests were conducted. Hariram: what was the configuration of that airplane for the battery tests? What type of barriers? Blake: Doug Ferguson can answer that question. Ferguson: the test aircraft was configured as close to an inflight aircraft fuselage as possible for an aircraft that was sitting on the ground. The flows were as close as possible to an in-service aircraft. To the extent that the airplane could be set up to an aircraft inflight, it was set up. Hariram: are there differences in particle sizes in the smoke that comes out? Blake: There is definitely a difference in particle size. The temperature of the fire is significantly higher, also. Pugliese: did you try to evaluate the speed of the smoke during the 727 smoke test? Blake: no, it was just a measure of the obscuration levels in the cockpit. Madden: How are you going to equate the next tests to density, etc.? Blake: we will evaluate if it is enough to equate the penetration that occurred. Blake: there is a concern that the certification criteria might not be adequate (because of Asiana – there was smoke penetration). I am not aware of any thoughts of rulemaking at this time. Question: have you done any work to try to characterize the smoke coming out of a small lithium battery fire? From a temperature point of view? Blake: we have temperature measurements from full-scale testing. We did chemistry analysis but not particle size from lithium battery smoke. Hariram: wouldn't it be prudent to look at the particle size. Blake: I don't see it that way. I see it as overcoming the Delta P. I think the Delta P is what is the difference. The properties generated in a hazmat fire are different from those of the smoke generated from a theatrical smoke generator. Question: did you consider doing a Class A fire. Blake: Harry did that and there was no smoke penetration. There was no smoke penetration with alkaline batteries. Danker: are you aware of some of the work Rob Ochs did with particle identification with the oil burners. I'm thinking it might be a mechanism. The smoke generators are water droplets, correct? Blake: Yes and yes. It is a variable, but I don't know how significant it is. Chattaway: were you able to measure any pressure? Blake: No. We could not measure a difference when we tried. Maloney: In the battery test, it was measurable. It was a fraction of PSI. Question from HSL representative (UK): I have spoken to responders to ground-based lithium battery fires and they are all surprised by the amount of smoke generated by lithium battery fire. We are conducting some testing. Rohrbach: What I had in mind was to make a benchmark test in an enclosed area. If you create just smoke, it may look different in a Class E than in a Class C compartment. There are different ways to handle the smoke. Blake: I think the concern is for a Class E. We are focusing on the issue that generated the concern for now.

Next Generation Fire Test Burner for Powerplant Fire Testing Applications – S. Summer (FAATC)

Steve provided a brief overview of the background and purpose of this work. We have been tasked by TAD to develop some performance and calibration settings for the NexGen burner for powerplant fire testing. A Powerplant User Survey was done, and initial Round Robin testing was conducted. We are now in the process of follow-on Round Robin testing to further those calibration set points and make sure that the burner we implement and the settings we implement are applicable for powerplant testing and are of the same consistency of past burners. We have done a slight change in burner set up from the initial set up. Steve Rehn is conducting the FAATC testing on this project. The Task Group was interested in conducting some tests on non-metallic materials. Steve Rehn has been doing some tests and trying to get some suitable materials. The results of these tests were presented. The Task Group will meet the afternoon of May 19, 2016. We have also been working on some AC 20-135 revision. We have formed a sub-group within our Task Group to look at the AC – all the items that we clarified needed to be cleaned up as a result of the User Survey. We realized we needed some formal participation from the FAA. The FAA has formed an internal group ACOs and Directorate – Sham Hariram has been working with us to gather industry comments/input so FAA can better identify what areas have to be looked at. We are looking to implement in two phases: Phase I; incorporate NexGen burner as an acceptable burner for powerplant testing and we would look to clean up some of the initial wording within the AC. Phase II: On a longer term focus, looking for a more complete revision of the AC – look at additional issues such as vibration requirements, etc. Roudebush: has there been any thought about comparing the current burners in the field against the NexGen burner? Summer: yes, that is part of the intent of the Round Robin – comparison of current burners to NexGen burner.

Results of Recent Tests Conducted at University of Cincinnati – Ryan Hasselbeck (University of Cincinnati)

Ryan reviewed the tests conducted at University of Cincinnati since the fall 2015 Systems WG meeting. Burnthrough test results were presented. Burner Configuration – Temperature Maps were presented. Conclusions: temperatures remain consistent and burnthrough times seem to be repeatable. Recommendation: move to ignitorless stator configuration as used on the Materials testing side. Tim Salter (FAATC) has been working to quantify the factors which lead to large discrepancies in temp measurements across test labs on the Materials fire testing side. Ryan showed photos of the test set up at University of Cincinnati. Summary: additional testing is required – air velocities. Spencer: what instrument did you use to measure velocity? Hasselbeck: hot wire anemometer. Question: did you include heat flux measurements? Hasselbeck: we did not do heat flux measurements. We are not sure how much we trust these. Davis: air flow measurements were done with the burner not running? Hasselbeck: yes. Danker: earlier in your presentation you mentioned a 150° difference in a Round Robin? When was that temperature seen? Hasselbeck: at the end of the test. This was the data that Tim Salter had provided to us. You may want to ask him for clarification on this. I haven't used the burner in a vertical orientation for any tests at University of Cincinnati. Dang: moving forward are you going with the recommendation of going with the ignitorless stator. Summer: our burner is currently set up with the ignitorless stator. The details are available on the FAA Fire Safety website. Question: didn't we see data presented in Atlantic City last year that when we moved to the ignitorless stator, we saw the temp dropping – talking about calibration data? Summer: I will go back and take a look at that data. Dang: this test has no backside airflow rate? Hasselbeck: yes.

Powerplant Fire Test/Analysis of PR2014 Comparative Testing at DGA – Serge Le Neve (DGA)

Powerplant fire tests: sonic burner tests: 4 points of measurement, 3 directions. Test results (burnthrough time and airflow) of park burner compared to sonic burner. Plate thermocouple is

a small slug calorimeter: comparison tests 1 plate calorimeter vs. 3 plate calorimeters. Harirram: Flame buoyancy – we account for flame buoyancy – why is it that your test results are different than what we normally see? What about the park burner? I was expecting the flame buoyancy to be above the center line. Le Neve: it may be specific to our burner. Dang: are you going to do flame temperature mapping? Le Neve: yes, I have to do it.

SAE/ISO Standards on Fire Containment Covers and Fire Resistant Containers – D. Blake (FAATC)

FCCs: TSO that references the new SAE Standard AS6453 was published in July 2014. The TSO is slightly different than the Standard mostly just removing the items the TSO does not cover. A meeting was held last month in Geneva – a new project was approved to revise SAE AS 6453 – the current version allows unlimited external flaming on the FCC if either: the external flame is not in close proximity to a thermocouple, or the fire load has shifted and measured temperatures from thermocouples that are no longer with 4+/- ½ inch from the FCC are no longer valid. Dave showed a video of FCC external flaming.

FRC – ISO/CD 19281 was published in February 2016. SAE is developing their own Standard AS 6278 – it is still under development. There are differences in these Standards. ISO/SAE harmonization is desired.

Unresolved Issues: external flaming on FRC. Lithium batteries – there is a push to require a lithium battery test for both of these Standards. Possible delayed smoke detection from a fire originating in either a FCC covered pallet or inside a FRC. FRCs with built-in detection and/or suppression systems.

Smoke, Fire, Fume Events Study – R. Hill (FAATC)

RGW Cherry and Associates – 3 databases were used to create an Excel spreadsheet database on occurrences of smoke, fumes, fire over a 10-year period (2002-2011). The database will be made available to the public on the FAA Fire Safety website in the future. The final report is in progress. Dick presented several examples of the data that can be generated by this database.

Class E Cargo Compartment Mitigation Strategies – D. Blake for D. Dadia (FAATC)

Lithium-ion batteries are currently banned from carriage as cargo on passenger aircraft. They can still be shipped on freighter aircraft but at a lower state of charge. Dhaval completed this testing recently: Class-A fire load with FCC - 18650 batteries (200 batteries and 1,000 batteries) at 30% SOC. Also, Fire Containment Bag (FCB) smaller tests were conducted with 18650 batteries at 30% SOC (200 batteries and 1,000 batteries). Dave presented the data collected from these tests. 200 Batteries test: FCC successfully contained the fire for 4 hours. There was some deformation of the fire load. 1,000 Batteries test: This was a 4-hour test. A video of this test was shown. The fire was generally contained within the FCC but it failed within the criteria as it is written now. The batteries are almost entirely vented and consumed by the fire. Hill: the batteries were used as packaged when they arrived at the FAATC in early April. Danker: what is Section 2 packaging? Blake: you can put no more than 8 batteries per package, but they could be overpacked per consignment. Now, each Section 2 package must be individual. There are also notification requirements. Rohrbach: we implemented now 30% SOC for freighters. Ferguson: did you turn off the cartridge heater at some point during the test? I don't think it will make any difference in the result of the test. Blake: Yes. Question: where did you place oxygen sensors? Blake: it was above the batteries. The FCB is made of

the same material as the FCC. In the 200-battery FCB test, the batteries were the only fire load. The FCB test was 3 hours in length. The results of these tests were presented. No flaming occurred outside the bag. 1000-battery FCB test: a video of the test was shown; the test length was 5 hours; the cartridge heater failed about 1 hour into test; all 1,000 batteries were consumed. Dhaval plans to conduct another full-scale FCC test with the FCB inside. Chattaway: Next test: what additional data do you think the next test will give you? Blake: I'm not exactly sure. Rohrbach: Did they only propagate in a closed environment? Blake: we previously have done propagation tests on batteries by themselves and in Section 2 packaging. Hill: I think that what you can take out of this is that 30% SOC does not guarantee that the batteries will not propagate. Chattaway: This is a very important step forward, but consider testing on different cell types. Blake: there will be a report published later on these tests. Hill: it's not necessarily the percent SOC, it's also the energy density that is important to consider.

Cargo Compartment Testing at UTAS FPS – Adam Chattaway (UTAS)

Adam reviewed the background and reason for this test program. Exploding Aerosol Can Tests were conducted – we tested inert gas, gas mixtures, and water mist. We selected inert gas to test in the cargo compartment full scale test. Baker: you didn't test HFC-125? Chattaway: No, we did not test it. Cargo Compartment Tests: full-scale cargo compartment tests were conducted. Adam reviewed the results of the tests conducted. Other considerations with use of inert gases: overpressure mitigation; system integration; certification. UTAS FPS has a suitable test article and has completed all four of the MPS test elements. Madden: you mentioned you did some tests with lithium batteries? Chattaway: our tests were largely confirmed by subsequent tests by the FAATC and other groups. The other test we did was inert a 43-liter inerting sphere. As the chemistries change, I see the need to do these tests again. We haven't looked at CO_2 – to me, it is not an inert gas. Simpson: I think the reluctance is the toxicity issue. Chattaway: if you have a mixture of gases, you are into multi-parameter certification. Hill: have you considered other ways of getting the high rate nitrogen you need such as chemical generators? Chattaway: at that time, we couldn't identify a suitable chemical generator company. Simpson: I think we had spent a lot of time in the late 90s and early 2000s with inert gas generators work with the military. There may be better technologies for this now.

Managing Risk in Battery Transportation – Ed Walton (UPS)

Risk in Cargo Airline Operations: UPS 1307, UPS Flight 6, and Asiana 991. Factors influencing risk: counterfeiting and products that really are not what they say they are. UPS is focusing on: spare batteries; batteries in equipment; bulk shipments. In 2015, there were 8 events in cargo aircraft – 50% were spare or loose batteries and 50% were batteries in equipment. None were bulk shipments. The combination of two mitigation strategies greatly improved safety at UPS: EVAS – full face mask; polypropylene containers in aviation – becomes a very violent fuel – it does meet the cargo container FAR. Fire Containment Covers at UPS: we have done a lot of testing independently. We have 118" FCCs for a double-fold at the bottom and a fire resistant net is integrated into the cover. We don't move a lot of palletized freight, but they are used for unknown shippers and electronics. MACROlite FRCs: we currently have 3400 in use and another 14,000 on order. We took on the challenge of FRC Redesign. Next steps: UPS willl resume testing in June 2016. Summer: with all the FRCs and FCCs UPS has in service, have you had any incidents? Walton: no, we haven't. Rogers: UPS Flight 6 – you mentioned that it was a large format battery. Walton: it was an E-car battery that was not declared. Blake: The official report the NTSB used was not that specific on what caused the fire. Dang: what is the suppression agent? Walton: a potassium powder type agent. It was not developed by UPS. There are several different manufacturers of the same type of source.

Class C Cargo Compartment ULD Suppression Agent Penetration – D. Blake for D. Dadia (FAATC)

Tests have shown that flammable vapors from batteries in thermal runaway could accumulate in cargo containers. Dave described the Class C Compartment test set up and showed a photo of the set up. Results: agent in the compartment dissipates much quicker than theoretical calculations. This issue is not as pressing as it was prior to the ban of the lithium ion battery shipments in passenger aircraft (2016).

Cargo Fire Suppression Using Oxygen Depleted Air from a Hydrogen Fuel Cell – S. Summer (FAATC)

Background on this project was provided. Objective: look into effectiveness of using ODA from fuel system from a Hydrogen Fuel Cell system at maintaining fire suppression O_2 levels following an initial knockdown in an aircraft cargo compartment. A diagram of the test set up was reviewed. Photos of the test set up were shown. The test instrumentation was described. The test plan was reviewed. Steve explained the test procedure. ODA Delivery Characteristics – Tests #1, 2, 3 graphs were reviewed. Cargo Bay Oxygen Concentrations & Relative Humidity – Tests #1, 2, 3 graphs were reviewed. Summary: ODA from fuel cell system has the potential to maintain an oxygen deprived environment under a variety of operating conditions. Results with increased leakage flow raise questions. We will run additional tests next week. Next Steps: we still have some further data analysis to do: cargo bay door and BERS data. We are looking at doing some analytical calculations based on the leakage flow we had. This was an initial look at the capability of using the ODA from the fuel cell system. Baker: any thoughts on how this would scale to a larger airplane? Summer: it's dependant on what you are using the fuel cell for and what supply of ODA it is producing and, of course, the economics of it. Baker: were you monitoring the compartment pressure? Summer: yes, we saw virtually no pressure rise. Bennett: did I see the temp range was around 120-130 for the ODA exhaust? Summer: yes.

Flammability of Materials in a Low-Concentration Hydrogen Environment – S. Summer (FAATC)

Steve Rehn did this work. Industry is looking at the use of hydrogen fuel cells for power on board aircraft. Vertical Bunsen Burner Test (Chapter 1 of Aircraft Materials Fire Test Handbook) was used for this project. A photo of the test set up was shown and described. Test results for a 1/16" woven carbon fiber material were presented. A fabric seat cover material was also tested – results were reviewed. An 8-ply unidirectional carbon fiber was tested – results were reviewed. Videos of all of the tests conducted were shown. Conclusions: hydrogen concentrations below the LFL can have a significant impact on material fires; as hydrogen concentration increases: more of the material is consumed and they burn at a faster rate.

Commercial Aviation Safety Team (CAST) Update – D. Blake (FAATC)

The CAST process if very proscribed. Detection and suppression systems – various issues. The emphasis is voluntary here where participating organizations will voluntarily implement CAST recommendations without regulations. Dave explained how the CAST process works.

Halon Replacement for Aircraft Portable Fire Extinguishers – Progress Report – Mike Madden (Boeing)

US EPA SNAP has published a NPRM putting forward a notice of proposed acceptability of BTP for handheld and engine nacelle/APU systems – the comment period ends June 2, 2016. No

comments have been received yet. It is anticipated that there will be at least a 90-day EPA review of comments. FAA AC-20-42D, Hand Fire Extinguishers for use in aircraft – new halon 1211 replacement agents must have and meet an applicable ASTM specification. Hopefully, we will have an ASTM spec later this summer. FAA Hand MPS has been passed. Underwriters Laboratories (UL) has a number of required tests – we are currently working through these tests in anticipation of SNAP approval. Greiner: you mentioned there are open points with regards to the ASTM. What kind of approval is meant by that? Madden: the voting closes at the end of June, and it is expected to get approved. If it doesn't get approved, it will go back to the writer of the specs for revision and then go back to the Committee. That spec is meant for continued maintenance. It is also crucial for when you have companies outside of the manufacturers fill the bottles.

Reconsidering Carbon Dioxide as a Nacelle Fire Extinguishing Agent – Update – D. Blake for D. Ingerson (FAATC)

CO_2 is currently recognized as acceptable by the FAA in AC 20-100 (f1977). Doug has identified the potential hazards of using CO_2. Doug will start some testing in the simulator in summer 2016 and present the results during the triennial conference in the fall.

EASA Rulemaking Activity Regarding Halon – Remi Deletain (EASA)

Remi outlined the status of several EASA rulemaking activities regarding halon. His presentation is available on the FAA Fire Safety website. Gehring: is EASA and/or FAA going to issue a paper regarding HFC-125 for commercial aircraft use? Is this something you have on your radar? We would like to have some official paper on this. Deletain: EASA has no plans to issue a specific issue paper on this. We need to have knowledge of what you intend to design. Gehring: I think our application for type certificate will be middle of next year. However, we do have to supply some details to suppliers.

Engine/APU Halon Replacement Industry Consortium – Halon Alternatives for Aircraft Propulsion (HAAPS) – Thibault Pelletier (Airbus)

Thibault provided a brief background and an update of the HAAPS work to date. Phase I is nearing completion. A copy of this presentation is available on the FAA Fire Safety website with the other presentations from this meeting.

Cargo Compartment Halon Replacement Working Group (CCHRWG) Update – Robin Bennett (Boeing)

This Working Group is authorized by the ICCAIA. May 2013 was the kick-off of this Working Group. CCHRWG is progressing towards ICAO 39th Assembly. A copy of this presentation is available on the FAA Fire Safety website with the other presentations from this meeting.

THURSDAY, MAY 19, 2016

Status of ICAO Lithium Battery Activities – R. Hill for H. Webster (FAATC)

The ICAO Dangerous Goods Panel (DGP) met in October 2015 in Montreal, Canada. The multidisciplinary group made some recommendations. Several formal proposals were put forward to mitigate the risk of lithium batteries not packed with equipment. There was much debate, and the voting members decided against the formal proposal and modifications were developed. The presentation details Addendum No. 3 (packaging instructions) effective April 1,

2016. The Air Navigation Commission (ANC) approved all of the changes to the Technical instructions submitted by the DGP previously outlines in Addendum 3. The ANC was tasked by the ICAO Council to draft a paper to consider the ban of shipments of lithium-ion cells and batteries on passenger aircraft – much debate ensued. The ANC voted to recommend a temporary ban on the shipment of lithium-ion batteries (shipped in bulk, not in equipment or with equipment) on passenger aircraft. The ban would take effect on April 1, 2016, and remain in effect until safer methods of shipment are developed.

Status of the SAE G-27 Lithium Battery Packaging Performance Committee – Doug Ferguson (Boeing)

Doug provided a brief background on SAE Technical Committees for those not familiar with these committees. The Committee Charter for this Committee is available on an SAE website. There is a Writing Team (20 people) developing a straw man proposal of what the document will look like. The proposal then goes to the entire G-27 Committee (over 160 people) for comments. Some comments have already been received. The next G-27 Committee meeting will be held May 19-20, 2016, in Toulouse, France. The next Writing Team meeting will be held in June 2016 at the FAA Technical Center in the U.S. The Writing Team consists of approximately 20 people: regulatory authorities, operators, pilots, battery manufacturers, test houses, and aircraft manufacturers. The optimistic projected timeline aims to have a packaging standard by the end of 2016. Normal timing for an SAE Standard is 18-24 months, so this is abbreviated and may take the full 18-24 months. The point is to address aircraft level hazards when creating the Standard. Roudebush: what do you consider an uncontrolled fire? Ferguson: with lithium batteries all of the normal methods of controlling the fire and fire protection features on the aircraft may not be effective enough to control a lithium battery fire. External and inside out (thermal runaway of cell within packaging) both need to be addressed.

Battery and Fuel Cell Industry Working Group Updates – S. Summer (FAATC)

Battery: RTCA SC-225 Rechargeable Lithium Batteries and Battery Systems and RTCA SC-235 Non-rechargeable Lithium Batteries
Fuel Cells: EUROCAE Working Committee

RTCA SC-225: Formed in March 2011 to provide certification guidance and MPS for lithium batteries and battery systems permanently installed in aircraft. The committee has been working on an update to RTCA DO-311A, submitted to the Program Management Committee in June 2015. The PMC rejected that document due to formatting and editorial issues and they wanted a better categorization of the batteries it covers. The group has been working since June 2015 on these issues. There are safety based tests and performance based tests. There are also categories of venting methodology. The committee is looking to have the updated final document submitted to the PMC in June 2016, if ready.
RTCA SC-235: Working on an update to RTCA DO-227. This group is currently working on drafting the test procedures. Their focus has been on a more precise definition of thermal runaway. Steve reviewed the group's thermal runaway definition. Planned completion of document is April 2017.
Fuel Cell EUROCAE/SAE Joint Committee: Formed in December 2008 with the objective to provide design, integration, and certification guidance for hydrogen supplied fuel cell systems on board transport category aircraft.
Fuel Cells – Energy Supply ARC: Aviation Rulemaking Committee formed by the FAA. The presentation provides a link to the FAA ARC Charter document. The initial meeting was held in September 2015. The objective is to have a final Recommendation report completed by April 2017.

Lithium Battery Thermal Runaway Initiation Variation – T. Maloney (FAATC)

These tests were conducted to provide information/data to the RTCA SC-235 Committee and the SAE G-27 Committee. RTCA SC-235 is creating a standard for lithium metal batteries on board aircraft and there is disagreement about different thermal runaway initiation methods. The SAE G-27 Committee needs to specify heating rate in their document. So, the FAATC did some experiments/tests to provide information/data for these groups. A photo of the combustion sphere used in all of these tests was shown, and the test set up was described. A list of the specific battery chemistries that were tested was shown. The gas volumes measured in these tests were reviewed. Results of the tests conducted were presented.

The Flammable Gasses Produced by Lithium Button Cells in Thermal Runaway – T. Maloney (FAATC)

Tom provided a brief background on this project and past work. These were Li-Metal Button Cell tests. Tom described the test procedures: oven tests and heat plate tests were conducted. The results were presented. Summary: volume and composition of button cell vent gasses vary depending on environment. Cells that were heated at a higher ambient pressure produced more of a reaction.

Flammability Limits of Lithium Battery Thermal Runaway Vent Gas in Air and the Inerting Effects of Halon 1301 – T. Maloney (FAATC)

This is work done by Matt Karp at the FAATC as part of his Masters Thesis for Rutgers University. A photo of the test set up was shown. The test procedure was explained. 100 tests were conducted.

Working Group Member Presentations:

Multi-disciplinary Model for Smoke Movement Simulation &
Multidisciplinary Thermo-Structural Model FAR/CS 25 Appendix F Part III – Gaetano Mirra (Finmeccanica Aircraft Division)

Fire Barrier for Battery Packs – Guillaume Guery (Saint Gobain)

P3 HAFEX – Development and Qualification of a Halon-alternative 5BC Handheld Fire Extinguisher for Commercial Aircraft with 2BTP – Joachim Scholz (P3 Aviation GmbH)

8th Triennial International Aircraft Fire and Cabin Safety Research Conference – R. Hill (FAATC)

The conference will be held October 24-27, 2016, at the Tropicana Hotel in Atlantic City, New Jersey, USA. There is no conference registration fee. The conference is open to anyone with an interest in the topics that will be presented. Online conference registration and hotel reservation rates and details are available on the FAA Fire Safety website at www.fire.tc.faa.gov. The preliminary conference schedule will be available on this website sometime in June 2016.

The October 24-27, 2016, Conference mentioned above will take the place of the fall 2016 Systems Working Group meeting. No fall 2016 Systems Working Group meeting will be held.