

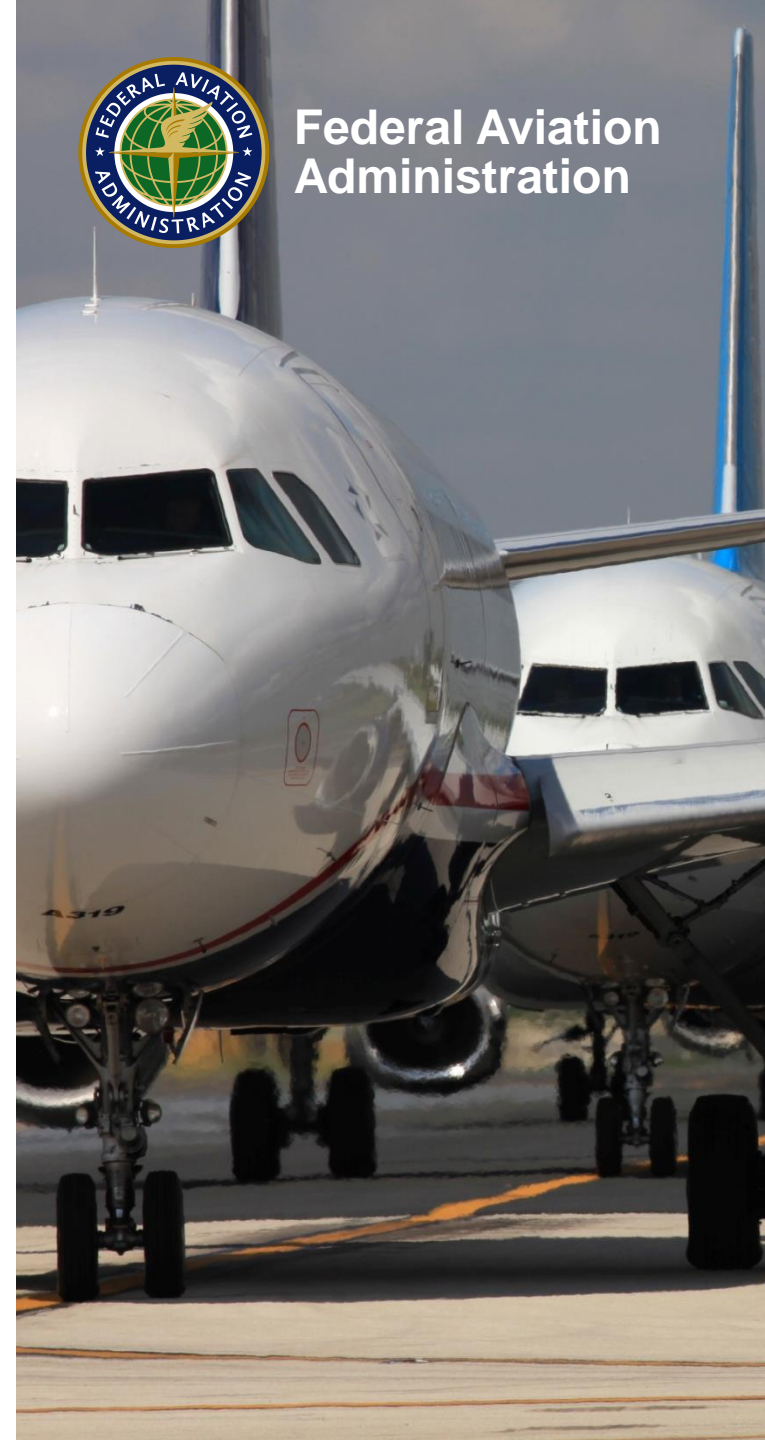
Battery & Fuel Cell Industry Working Group Updates

International Aircraft Systems Fire
Protection Working Group
Toulouse, France
May 18 – 19, 2016

Steve Summer
Federal Aviation Administration
Fire Safety Branch
<http://www.fire.tc.faa.gov>



Federal Aviation
Administration



Industry Working Groups

- **Batteries**

- RTCA SC-225 – Rechargeable Lithium Batteries and Battery Systems
- RTCA SC-235 – Non-Rechargeable Lithium Batteries

- **Fuel Cells**

- EUROCAE/SAE WG80/AE-7AFC – Hydrogen Fuel Cells
- FAA Energy Supply Device ARC



RTCA SC-225: Rechargeable Lithium Batteries & Battery Systems

- **Committee formed 3/2011 to provide certification guidance for rechargeable lithium batteries and battery systems that are permanently installed in aircraft**
- **Points of Contact:**
 - Chair: Richard Nguyen (Boeing)
 - Secretary: Stephen Diehl (Boeing)
 - DFO: Norm Pereira (FAA)
- **Members include representatives from battery and cell manufacturers, avionics manufacturers, Aircraft operators, pilot and flight attendant associations, regulatory and other government agencies, and other related industry associations**



Batteries – RTCA SC-225 (Rechargeable)

- **Committee submitted DO-311A to the PMC in June, 2015**
 - Integrates coverage for all sizes of batteries.
 - Incorporates the latest understanding of lithium battery technology, battery testing and installation guidance including special condition, means of compliance issue papers and recommendations from NTSB.
- **PMC rejected initial document for use as a minimum operational performance standard for a TSO, citing format/editorial issues and requesting a review of the categorization of batteries and the incorporation of design requirements**

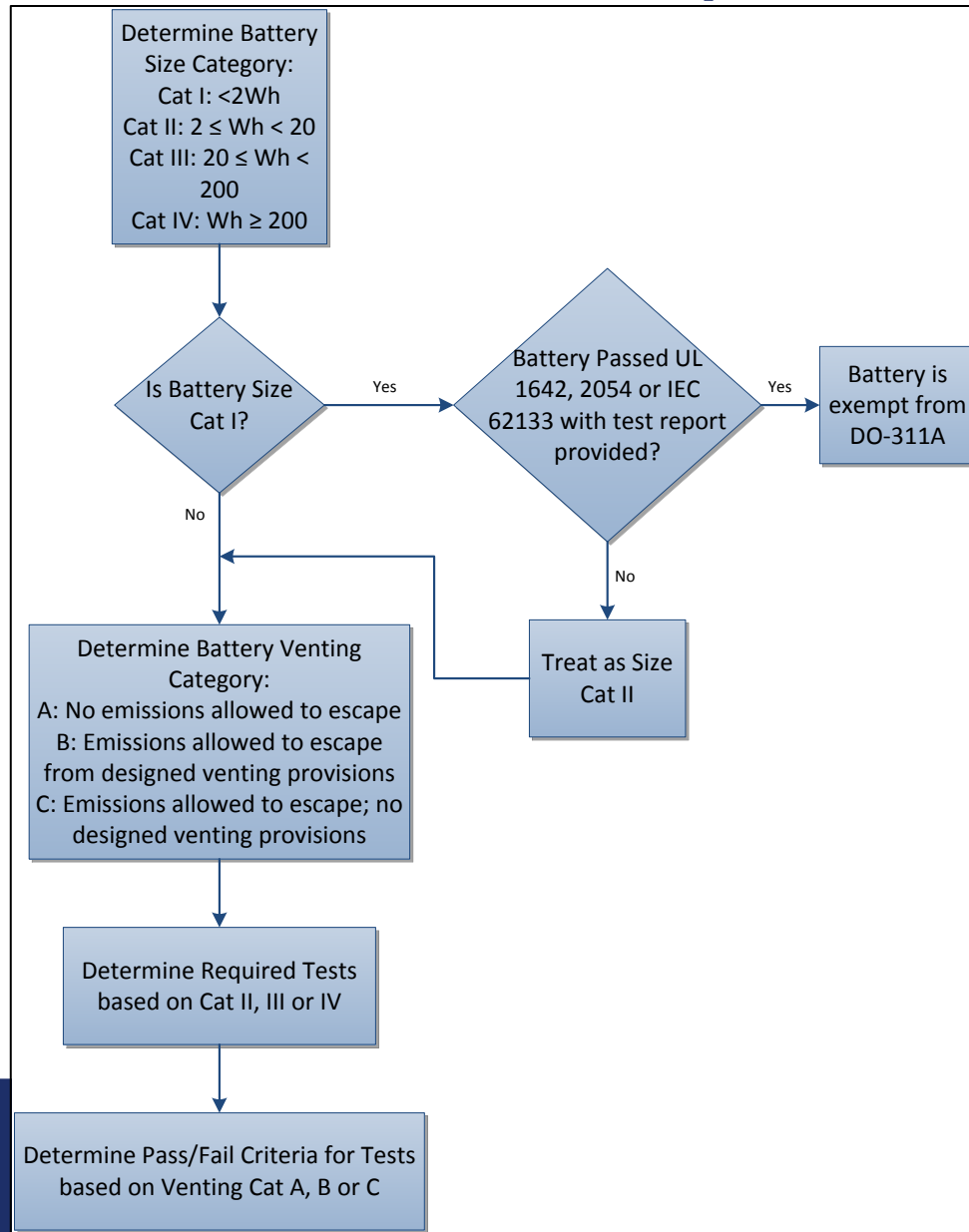


Batteries – RTCA SC-225 (Rechargeable)

- **Group is currently working to address these issues with hopes to submit a revised final document to PMC in June or September 2016.**
- **Batteries are now separated into four different size categories**
- **Tests are categorized as performance or safety tests.**
 - All battery size categories must perform safety related tests.
 - Performance based tests are conducted based on category type
- **Additionally, batteries are categorized by venting methodology**
 - Pass/Fail criteria is dependent on venting type



Batteries – RTCA SC-225 (Rechargeable)



RTCA SC-235: Non-Rechargeable Lithium Batteries & Battery Systems

- **Committee formed 06/2015 to revise RTCA DO-227, to provide guidance for non-rechargeable lithium batteries that are permanently installed in aircraft.**
- **Points of Contact:**
 - Chair: John Trela (Boeing)
 - Secretary: Jeff Densmore (Radiant Power)
 - DFO: Norm Pereira (FAA)
- **Members include representatives from battery and cell manufacturers, avionics manufacturers, Aircraft operators, pilot and flight attendant associations, regulatory and other government agencies, and other related industry associations**



Batteries – RTCA SC-235 (Non-Rechargeable)

- Document structure and requirements have been finalized
- Group is currently working on draft test procedures
- Group has focused on a definition of thermal runaway that gives measurable indicators. Certain test procedures and pass/fail criteria will be based on exhibiting thermal runaway has been achieved.
- Discussions ongoing regarding thermal runaway initiation methods



Batteries – RTCA SC-235 (Non-Rechargeable)

- **Current SC-235 thermal runaway definition:**
 - A thermal runaway results from the initiation of an irreversible exothermic chemical reaction within the cell causing an uncontrollable release of internal electrical and chemical energy resulting in a rapid and accelerating temperature rise to a peak, with an accompanying collapse of cell voltage, and the chemical decomposition of metallic Lithium.
- **Planned completion of document – April 2017**



Fuel Cells – SAE AE-7AFC

- **Committee formed 12/2008 to provide design, integration and certification guidance for hydrogen supplied fuel cell systems on board transport category aircraft**
- **Points of Contact:**
 - Co-Chairperson: Hans-Dieter Hansen (ZAL/Airbus)
 - Co-Chairperson: Joe Breit (Boeing)
 - Secretary: Tony Fallon (Parker Aerospace)
- **Members include representatives from fuel cell manufacturers, engine/power system manufacturers and integrators, aircraft manufacturers, regulatory & other government agencies, & other related industry associations (e.g. gas suppliers)**



Fuel Cells – SAE AE-7AFC

- **Short-term:** Development of safety guidelines related to the issues around installation of fuel cells on board aircraft and storage in the airport environment; consolidation of existing power system requirements and review of fuel cell performance against baseline requirements.
- **Medium Term:** Review of fuel cell technology maturity related to aviation requirements; definition of future on board electrical applications, which could be supported by fuel cells.
- **Long-Term:** Development of detailed specifications for safety assessment and certification of fuel cells on board aircraft.



Fuel Cells – SAE AE-7AFC

- **SAE AIR-6464 – Aircraft Fuel Cell Safety Guidelines**
 - Provides comprehensive reference and background information pertaining to the installation of Proton Exchange Membrane (PEM) hydrogen fuel cells on-board aircraft for the purposes of supplying auxiliary power rather than using separate ground power systems.



Fuel Cells – SAE AE-7AFC

- **Currently working on a MASPS/AS Document to more generally cover installation of any PEM H₂ fuel cell system**
 - H₂ storage and distribution
 - Oxidant sources, storage and distribution
 - Fuel cell module
 - Balance of plant
 - Thermal management
 - Controller system
 - Sensors
 - Electrical power conditioning and storage



Fuel Cells – Energy Supply ARC

- **Aviation Rulemaking Committee formed by FAA to provide a forum for aviation community to provide recommendations to the FAA**
 - Determine appropriate airworthiness standards and guidance, identify hazards and determine design and operational principals to safeguard against these hazards
 - ARC covers all energy supply devices but is heavily focused on PEM and SOFC Hydrogen Fuel Cells
- **Points of Contact Are:**
 - Co-Chairperson: Massoud Sadeghi (FAA)
 - Co-Chairperson: Joe Breit (Boeing)

http://www.faa.gov/regulations_policies/rulemaking/committees/documents/index.cfm/committee/browse/committeeID/457



Fuel Cells – Energy Supply ARC

- **25 Participants, from government and industry**
- **Approximately ½ of the participants are also members of the WG80/SAE AE-7 AFC**
- **Initial kickoff meeting was held 9/21-9/23**
- **Group split the effort into five tasks:**
 - Define types of fuel cell devices to be studied
 - Hazard analyses and mitigation
 - Rulemaking support
 - Cost/Benefit Analysis
 - Program management/Final reporting



Fuel Cells – Energy Supply ARC

- **Each subteam has formed an initial draft of their respective sections.**
 - Document is focusing on PEM and SOFC fuel cells
 - Respective hazards, mitigation means, and potential regulatory gaps have been identified
- **Initial compilation and reformatting of each subsection into a single document has been completed.**
- **Document review/editing within the group continues.**



Fuel Cells – Energy Supply ARC

- **Objective is to have a Final Recommendation Report completed by April 2017**
 - Explanation of hazards, mitigation strategies, applicable airworthiness standards, guidance and other information required to address safety issues associated with hydrogen fuel cell applications on board commercial aircraft



Questions?

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