International Aircraft Systems Fire Protection Working Group
Toulouse, France
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Federal Aviation Administration
Fire Safety Branch
http://www.fire.tc.faa.gov
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)

1. Determine Battery Size Category:
   - Cat I: <2 Wh
   - Cat II: 2 ≤ Wh < 20
   - Cat III: 20 ≤ Wh < 200
   - Cat IV: Wh ≥ 200

2. Is Battery Size Cat I?
   - Yes: Battery is exempt from DO-311A
   - No

3. Determine Battery Venting Category:
   - A: No emissions allowed to escape
   - B: Emissions allowed to escape from designed venting provisions
   - C: Emissions allowed to escape; no designed venting provisions

4. Battery Passed UL 1642, 2054 or IEC 62133 with test report provided?
   - Yes: Battery is exempt from DO-311A
   - No

5. Treat as Size Cat II

6. Determine Required Tests based on Cat II, III or IV

7. Determine Pass/Fail Criteria for Tests based on Venting Cat A, B or C
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
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 H$_2$ fuel cell system
  – H$_2$ 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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