Cargo Compartment Halon Replacement Advisory Group - CCHRAG -

Activities Overview

Triennial Fire & Cabin Safety Research Conference
Oct 28-31, 2019 - Atlantic City

CCHRAG Context

ICAO UNITING AVIATION
A UNITED NATIONS SPECIALIZED AGENCY

Representation

International Coordinating Council of Aerospace Industries Associations

Authority

CCHRAG
Cargo Compartment Halon Replacement Advisory Group

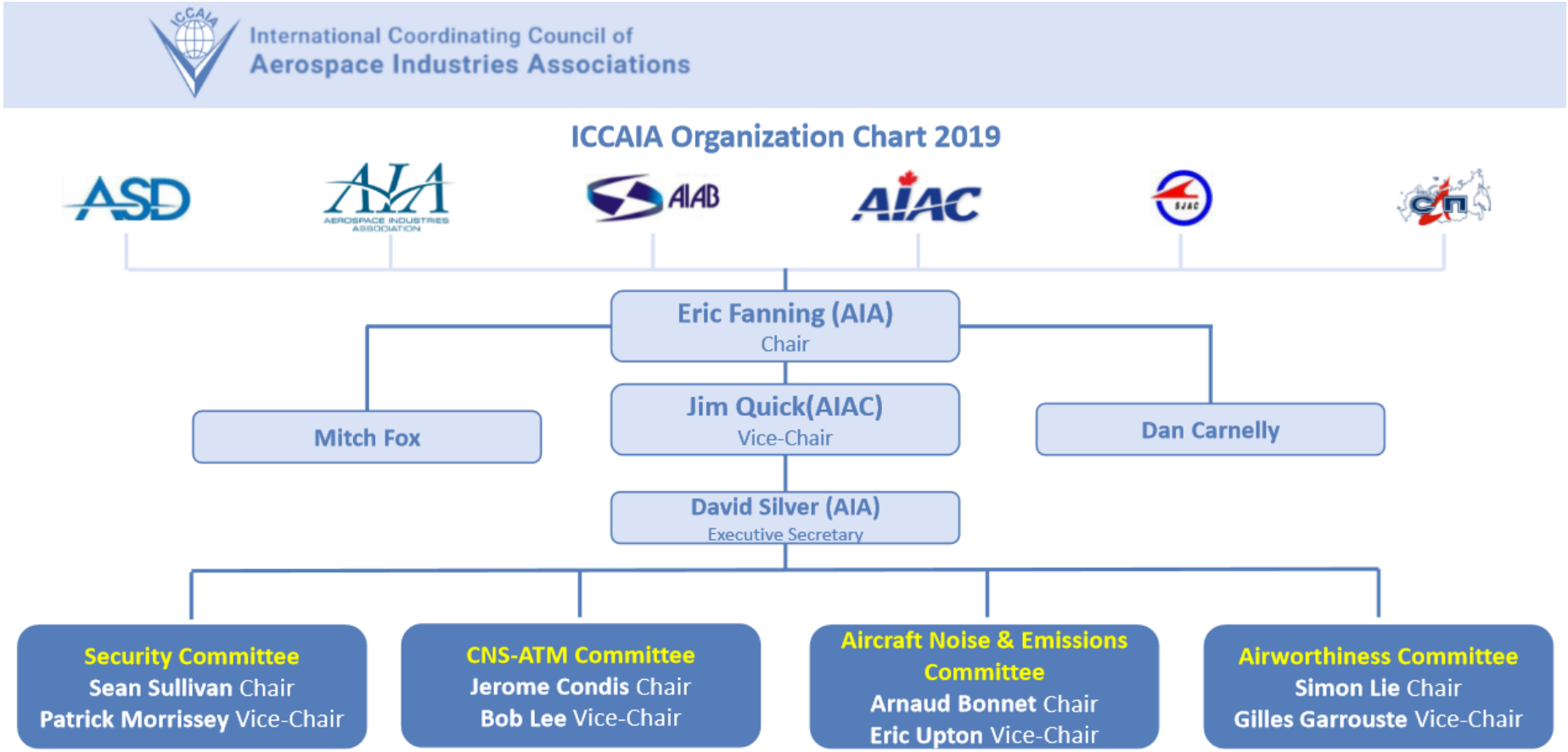
Members

ASD AeroSpace and Defence Industries Association of Europe
AIA AEROSPACE INDUSTRIES ASSOCIATION
AIAB ASSOCIAÇÃO DAS INDÚSTRIAS AEROESPACIAIS DO BRASIL
AIAC
SJAC
CAL

Member Member Member Member Member

AIRBUS BOEING EMBRAER BOMBARDIER MITSUBISHI AIRCRAFT CORPORATION

ICCAIA Organization



Halon replacement solution requires collaboration

- ICCAIA Cargo Compartment Halon Replacement Advisory Group (CCHRAG) (2013)
  - Airbus, Boeing, Bombardier, Embraer, Mitsubishi
  - Recommended cargo halon replacement deadline for new TC applications after 2024 (2015)
- ICAO supported questionnaire on halon replacement technologies (2017)
- CCHRAG queried stakeholders for interest in participating in Technical Assessment

Technical Assessment identified potential solutions

- Technical Assessment supports CCHRAG Work Plan deliverable to report status of cargo halon replacement solutions to ICAO

- Responses received in June 2018
  - 8 Participants with 9 potential halon replacement solutions
  - Chemical manufacturers, fire protection suppliers, and aircraft system suppliers
  - Technologies include chemical agents, inerting systems and new/novel equipment
  - Varied stages of development

Technical Assessment Report

Executive Summary

- CCHRAG is optimistic that a solution will be available to meet the ICAO deadline.
  - Assuming further development by the participants and timely government approvals
- If a candidate system has not been demonstrated to be application ready one year before the 41st Session of the ICAO Assembly, ICCAIA will indicate the potential consequences with respect to the 2024 deadline.

Technical Assessment Criteria Categories

8 Key Criteria over five categories from questionnaire were selected for Technical Assessment

Category	Criteria	Com
Fire Fighting Performance	Cup burner fire extinction/suppression concentration established (ISO, NFPA)	
	Other Industry Standards met (UL, ANSI, NFPA, etc.)	
	FAA MPS testing concentration determined	
	Test method determined to demonstrate compliance with paragraph 25.851(b)(2)	
Physical	Agent & System Weight is less than or equal to Halon system	
	Agent & Systems Size is less than or equal to Halon system	
	Long & short range applicability	
	Clean agent (gaseous) - no clean up required	
	Boiling Point	
	No damage to aircraft materials after agent discharge	
	Freezing point is less than normal operating conditions	
	Freezing point is less than minimum operating/storage conditions	
	Decomposition temperature is greater than fire conditions (or HF formation and thermal decomposition products are under the dangerous toxic level for humans)	
	Not thermally conductive	
	Not electrically conductive	
	No aircraft hydromechanical interfaces required (e.g. bleed air, fuel tank inert gas, etc)	
	Operational impacts have been identified & mitigated	
	System (knockdown & metered) available whenever airplane is powered	
Production	Currently used in other industries and/or applications	
	Supply chain established	
	Agent readily available	
	Agent modification not needed for aircraft application	
	Risks for system adaptation is mitigated or low	
Environmental, Health & Safety	Not a Montreal Protocol listed ODS	
	Not a Kyoto Protocol listed GHG	
	Not GHS-listed Hazardous material	
	US EPA SNAP approved	
	US EPA TSCA Inventory listed	
	EU REACH Registered, Authorised, and/or Restricted	
	Not a PBT, POP, or endocrine disrupter	
	Present on other regulatory lists	
	US OSHA Regulated	
	Not a Carcinogenic, mutagenic, repro-tox substance (CMR)	
	Cardiac sensitization: LOAEL, NOAEL is less than or equal to Halon 1301	
	Oral, inhalation, dermal toxicity is less than or equal to Halon 1301	
Schedule	Current TRL is greater than 3	
	Aviation Authority Certification experience	

Category: FIREFIGHTING PERFORMANCE

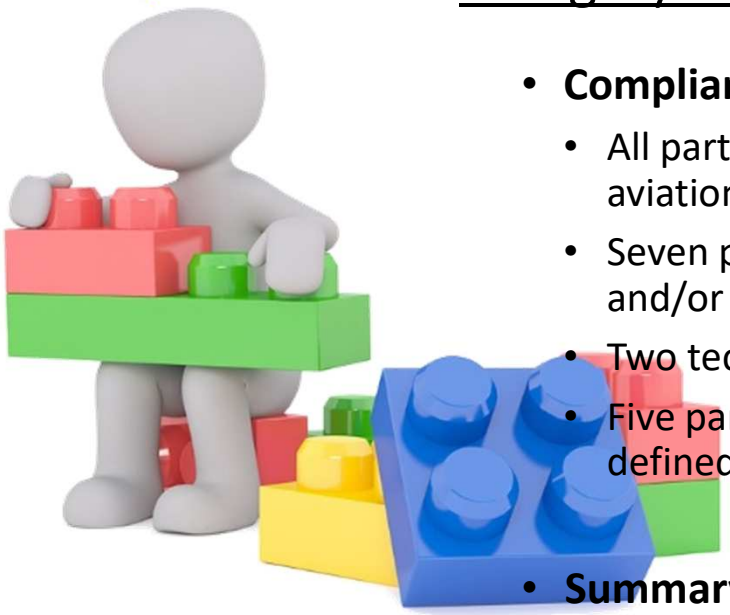
- **Key Criteria**
  - **Cup burner fire extinction/suppression concentration established**
    - CCHRAG concludes that interest has been demonstrated by conducting preliminary tests.
  - **FAA MPS testing concentration determined**
    - It is essential more agents successfully complete MPS testing by 2020 to reduce risk.
  - **Test method determined to demonstrate compliance w/ 14CFR paragraph 25.851(b)(2)**
    - Regulatory agencies will need to confirm specific test methods well in advance of implementation
- **Summary**
  - Ensuring performance on an aircraft under extreme conditions may pose significant challenges to the system design and aircraft integration requirements.
  - Continued technology development is needed to guarantee successful certification.

Category: PHYSICAL PROPERTIES OF EXTINGUISHING AGENT

- **Key Criteria**
  - **Agent & System Weight is less than or equal to Halon system**
    - The CCHRAG concludes that a weight increase cannot be avoided for any of the halon replacement solutions presented. The development challenge is to find the lowest weight solution.
  - **System (knockdown & metered) available whenever airplane is powered**
    - The group recommendation is that a halon replacement system should be independent from other aircraft systems. Until more reliable inerting systems with improved availability (no warm-up time required) have been developed, these systems remain nonviable.
  - **Clean agent (gaseous) - no clean up required – corrosion free**
    - Participants that proposed non-gaseous agents identified the need for further investigation. This especially holds true for agents other than pure water.
    - CCHRAG assesses that gaseous agents are preferable in the context of potential damage to aircraft materials.

Category: PHYSICAL PROPERTIES OF EXTINGUISHING AGENT (cont'd)

- **Summary**
  - CCHRAG anticipates that for most non-gaseous agents, there will be a need for additional maintenance efforts within the compartment after agent discharge.
  - System architectures and correlated operational impact might differ for different aircraft models.
  - CCHRAG assesses that halon replacements will most likely require increase in weight.



Category: PRODUCTION

- **Compliances**
  - All participants indicated that their solutions are currently in use in other, non-aviation, applications.
  - Seven participants stated that supply chain has been established for the agents and/or technology.
  - Two technologies are not readily available for aircraft cargo fire suppression.
  - Five participants stated that risk mitigation for system adaptation is yet to be defined.
- **Summary**
  - CCHRAG group concludes that the solutions assessed are in various states of production readiness.
  - No information was collected on timing to establish aerospace-specific production capability and/or a roadmap/plan to establish supply chain support and logistics is unknown at this time. Therefore, CCHRAG is unable to assess production schedule readiness.

Category: ENVIRONMENTAL, HEALTH & SAFETY

- CCHRAG's assessment was that full compliance will take time and resources.
- Some of the technologies appear to meet human health and safety criteria, but appear to have environmental trade-offs.
- CCHRAG believes most of the solutions still have multiple environmental and health impacts that are yet to be evaluated.

Category: SCHEDULE

- **Key Criteria**
  - **Current Technology Readiness Level is greater than Discovery Phase, TRL3**
    - All but one of the participants stated that their solutions have reached TRL3, confirming proof of concept.
    - Technical solutions based on nitrogen inerting are stated to be beyond TRL3/4, which is proven by successfully passed minimum performance standard tests and use in other applications
    - Other gaseous fire suppression systems are currently undergoing minimum performance standard testing.

- **Summary**
  - CCHRAG assesses that this criteria is achievable but further development is needed to meet the necessary timeframe.

SUMMARY

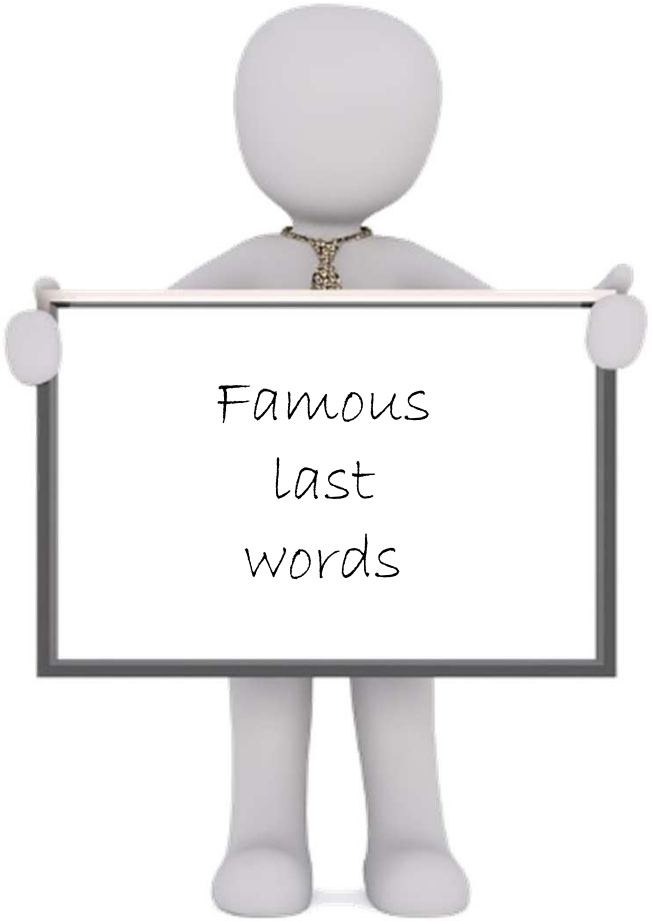
Key Criterion	Conclusion	Remarks
Cup burner fire extinction/suppression concentration established (ISO, NFPA)	**Achievable**	
FAA MPS testing concentration determined	**Achievable with conditions**	More agents must pass to reduce risk of not meeting 2024 deadline
Test method determined to demonstrate compliance with paragraph 25.851(b)(2)	**Achievable with conditions**	Specific test methods need to be confirmed
No damage to aircraft materials after discharge	**Achievable**	
System (knockdown & metered) available whenever airplane is powered	**Achievable with conditions**	In case that the system relies on other aircraft systems, the required amount of agent supply might not be available during certain flight phases.
Agent & System Weight is less than or equal to Halon system	**Not Achievable**	A weight increase cannot be avoided for any of the halon replacement solutions presented. A consequence is an increased CO2 emission caused by higher fuel burn.
Clean agent (gaseous) - no clean up required	**Achievable**	
Current TRL is greater than 3	**Achievable**	

ICCAIA CCHRAG Technical Assessment Timeline

January 9, 2019	**Core CCHRAG finalized draft Technical Assessment (TA)**
January 10, 2019	CCHRAG Chair distributed draft TA to Participants
January 25, 2019	Participants responded with comments on draft TA
February 8, 2019	CCHRAG Chair consolidated comments & distributes to Core CCHRAG
February 11, 2019	Core CCHRAG reviewed consolidated comments
February 18, 2019	CCHRAG Chair sent out Stakeholder Review meeting notice
February 26, 2019	CCHRAG Chair distributed revised draft TA to Participants
March 7, 2019	**CCHRAG conducted review with Stakeholders**
March 12, 2019	Stakeholder feedback received
April 24, 2019	**ICCAIA begins review of Final draft TA & Information Paper (IP)**
May 15, 2019	CCHRAG Chair presents IP/TA summary at IASFPWF Meeting
June 28, 2019	ICCAIA review of IP/TA complete
July 1, 2019	**Core CCHRAG shares IP/TA with ICAO**
July 31, 2019	Core CCHRAG collects feedback from ICAO
Aug-Sept 2019	Core CCHRAG prepare for ICAO General Assembly
Sept-Oct 2019	**CCHRAG Chair present IP/TA @ ICAO General Assembly**

Take away

Work cooperatively and efficiently such that progress remains on track to support the ICAO 2024 deadline.



Questions & Answers

Thank you!

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