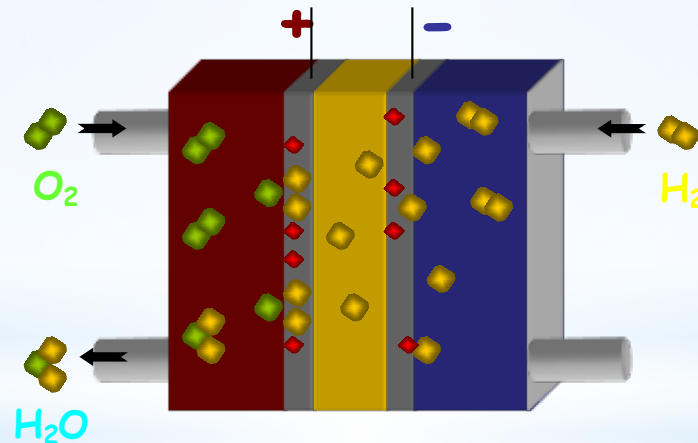


Author  
Hans-Dieter Hansen  
WG 80/AE-7AFC Chairman  
Presenter  
Dieter Klemm  
September 16, 2015  
Lampoldshausen



# EUROCAE/SAE Working Group 80/AE-7AFC

## Hydrogen Fuel Cells in Civil Aviation

### Summary of Activities



The European Organisation for Civil Aviation  
Equipment *L'Organisation Européenne pour  
l'Équipement de l'Aviation Civile*

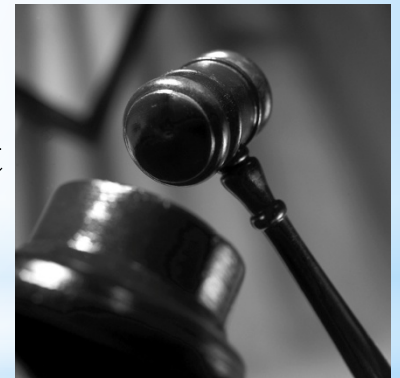


## **Department of Transportation (DOT) statement regarding Hydrogen Federal Register / Vol. 72, No. 3 / Friday, January 5, 2007 :**

There is nothing in the FAA regulations that would explicitly prohibit the use of new technologies utilizing hydrogen. However, many FAA regulations in Parts 21, 23, 25, 27, 29, 31, 33, 34 and 36 provide aircraft and aircraft part certification requirements.



To the extent an applicant were to seek approval of an aircraft that utilizes hydrogen, as a fuel or in some other way, the applicant would have to comply with the applicable aircraft certificate requirements, just like any other applicant.



Likewise, an operator of an aircraft with new technologies using hydrogen would have to comply with operational requirements in parts 91, 119, 121, 125, or 135, just like any other operator.



The European Organisation for Civil Aviation  
Equipment L'Organisation Européenne pour  
l'Équipement de l'Aviation Civile



## WG80/AE-7AFC Actual Working Group Membership







The European Organisation for Civil Aviation  
Equipment *L'Organisation Européenne pour  
l'Équipement de l'Aviation Civile*



## **WG80/AE-7AFC Scope of the Working Group**

### **Purpose of the Work**

Development of minimum standards to support qualification and certification of hydrogen fuel cell systems in the various intended applications for civil large (Part 25) aircraft.

### **Objectives and Scope of WG-80**

WG-80 founded in December 2008 operates as a joint EUROCAE/SAE working group with SAE AE-7A to develop guidelines to support the use of hydrogen (beginning with gaseous one) and oxygen supplied PEM fuel cell systems for civil aircraft applications.

### **Out of Scope**

Performance requirements such as power and reliability are outside of the scope of this working group.



The European Organisation for Civil Aviation  
Equipment *L'Organisation Européenne pour  
l'Équipement de l'Aviation Civile*



## **WG80/AE-7AFC Current Areas of Major Activities**

### **Short Term Activities(Closed)**

- Development of safety guidelines related to the issues around fuel cell systems integration onboard civil aircraft.
- Review of existing power system function and installation/safety requirements and review of these requirements against fuel cell characteristics. (e.g. fire detection and extinguishing)
- Consideration of hydrogen interaction with materials e.g. embrittlement.

### **Documents already been published (March 2013)**

Joint EUROCAE/SAE guidelines for the integration of PEM fuel cell systems on board aircraft, in the form of an Engineering Document (ED 219)/Aerospace Information Report (AIR/ 6464 ).



The European Organisation for Civil Aviation  
Equipment *L'Organisation Européenne pour  
l'Équipement de l'Aviation Civile*



## **WG80/AE-7AFC Current Areas of Major Activities(cont.)**

### **Medium Term(Ongoing)**

Currently the group develops a Minimum Aviation System Performance Specification(MASPS)/Aviation Standard Document(AS), which defines the technical guidelines for the safe development, testing, integration, validation and certification of Proton Exchange Membrane (PEM) fuel cell systems (FCS), including GH2 storage, GH2 distribution and integration of appropriate electrical systems into the aircraft”.

### **Further on the group did:**

- A review of fuel cell technology maturity related to airworthiness requirements
- A consideration of future onboard electrical applications, which could be supported by fuel cells.



## WG80/AE-7AFC Current Areas of Major Activities(cont.)

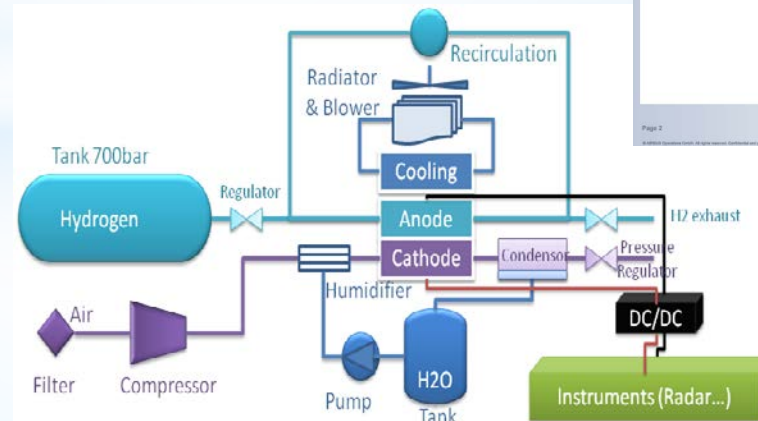
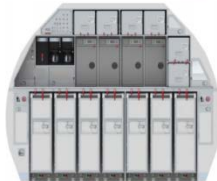
Three target applications(based on gaseous hydrogen) have been selected as examples to help developing the aircraft integration aspects.

- 1.) Zodiac's Fuel Cell powered Galley Application
- 2.) Dassault's Medical Application
- 3.) Airbus with it's Fuel Cell Emergency Power System.

### Fuel Cell Combined Galley & Lavatories

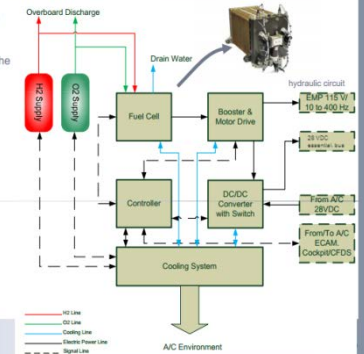
#### Challenges to be addressed :

- Hydrogen storage
- Air compressor (O<sub>2</sub> supply mean),
- Heat release, collection, dissipation and re-use
- System architectures and location in aircraft.



### FCEPS proposal

Replacement of RAT + CSMG by FCEPS powering  
- EMP and the  
- DC & AC essential bus through the stat. Inverter





The European Organisation for Civil Aviation  
Equipment *L'Organisation Européenne pour  
l'Équipement de l'Aviation Civile*



## **WG80/AE-7AFC Current Areas of Major Activities(cont.)**

### **Long Term(starting in 2016)**

The preparation of a Minimum Aviation System Performance Specification & Aviation Standard Document(AS), which defines the technical guidelines for the safe development, testing, integration, validation and certification of Proton Exchange Membrane (PEM)\* Fuel Cell Systems (FCS), by considering LH2 fuel storage, LH2 fuel distribution, onboard reforming and material based storage of hydrogen.

\*Other fuel cell technologies are in place, e.g. Solid Oxide Fuel Cell (SOFC) which is not to focus yet!





The European Organisation for Civil Aviation  
Equipment *L'Organisation Européenne pour  
l'Équipement de l'Aviation Civile*



## **WG80/AE-7AFC Current Areas of Major Activities(cont.)**

In the future, development of detailed airworthiness codes (CS 25/FAR 25) for the certification of fuel cells systems on board civil aircraft will be required.

### **Note:**

A FAA Aviation Rulemaking Committee (ARC) for new energy storages will start its work in September this year. The committee charter has been approved by the FAA council recently. It includes the consideration of safety items regarding batteries, ultra capacitors and other energy devices. However the focus will be on fuel cells with a specific view to the storage and distribution of hydrogen on board passenger aircraft.

### **Meeting arrangements**

The meetings take place in both, the US and Europe. Two to three meetings per year are planned with a duration of two to three days each.

### **WebEx conferences**

Frequent WebEx conferences take place to coordinate the work between European and US participants.



The European Organisation for Civil Aviation  
Equipment *L'Organisation Européenne pour  
l'Équipement de l'Aviation Civile*



# Questions?