Proposed Special Condition on installation of Supercapacitors

Applicable to Large Aeroplanes Category

Issue 1

Introductory note:

The hereby presented Special Condition to the EASA Certification Basis shall be subject to public consultation, in accordance with EASA Management Board decision 12/2007 dated 11 September 2007, Article 3 (2.) of which states:

"2. Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means of compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least 3 weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency."

Statement of issue

There is very little experience regarding the operational characteristics, failure modes / effects, and maintenance requirements associated with equipment incorporating Supercapacitor technology. They are considered to differ significantly from that of nickel cadmium (Ni-Cd) and lead acid rechargeable batteries currently accepted for application on large aeroplanes.
Safety concerns related to specific aspects of Supercapacitor technology and their installation are foreseen to potentially affect safe operations of the aircraft and require that appropriate design considerations be taken and maintenance procedures established to ensure availability of electrical power from devices incorporating Supercapacitors when required.

Considerations in respect of corrosive, explosive or toxic fluids or gases emitted by Supercapacitor electrolyte, their accumulation and effects on surrounding structures or adjacent essential equipment must be considered in the same way as for Ni-Cd batteries under CS 25.1353 (c) (3) and (4).

However, the EASA has determined that the existing requirement set is inadequate and, on the basis of 21A.16B, a Special Condition is proposed to establish appropriate airworthiness standards for Supercapacitor installations on Large Aeroplanes and to ensure, as required by CS 25.601, that these installations do not have hazardous or unreliable design characteristics.

Supercapacitor Systems and Installation – Special Condition F-XX

Proposed Special Condition

The intent of this Special Condition is to establish appropriate airworthiness standards for Supercapacitors embodied in a large aeroplane and to ensure, as required by CS 25.601, that these installations do not have hazardous or unreliable design characteristics.
The Special Condition adopts the following requirements as a means of addressing these concerns:

(1)	The Supercapacitor installation must be designed to preclude the occurrence of self-sustaining, uncontrolled increases in temperature or pressure.	
(2)	No explosive or toxic gasses emitted by any Supercapacitor in normal operation or as the result of any failure of the charging or monitoring system, or Supercapacitor installation not shown to be extremely remote, may accumulate in hazardous quantities within the aeroplane.	
(3)	Supercapacitors installations must meet the requirements of CS 25.863(a) through (d).	
(4)	No corrosive fluids or gasses that may escape from any Supercapacitor may damage surrounding structure or any adjacent systems, equipment or electrical wiring, of the airplane in such a way as to cause a major or more severe failure condition in accordance with CS 25.1309 (b).	
(5)	Each Supercapacitor installation must have provisions to prevent any hazardous effect on structure or essential systems that may be caused by the maximum amount of heat that can generate during a short circuit of the Supercapacitor installation or any of the individual Supercapacitors.	
(6)	Supercapacitor installations must have a system to control the charging rate of the Supercapacitors automatically so as to prevent any Supercapacitor overheating or overcharging condition. In addition, If such a condition can exist:	
	(i)	An Supercapacitor temperature sensing and over-temperature warning system should be provided with a means for automatically disconnecting the Supercapacitor from its charging source in the event of an over-temperature condition or,
	(ii)	An Supercapacitor failure sensing and warning system with a means for automatically disconnecting the Supercapacitor from its charging source in the event of Supercapacitor failure.

(7)	Any Supercapacitor installation whose function is required for safe operation of the aeroplane, must incorporate a monitoring and warning feature that will provide an indication to the appropriate flight crewmembers, whenever the capacity of the Supercapacitors have fallen below levels considered acceptable for dispatch of the aeroplane.
(8)	Supercapacitor installations shall have a means to prevent from insufficient charging the Supercapacitor.
(9)	The Instructions for Continued Airworthiness required by CS 25.1529 must contain maintenance requirements for measurement of Supercapacitors' performance at appropriate intervals to ensure that Supercapacitors whose function is required for safe operation of the aeroplane will perform their intended function as long as the Supercapacitors are installed in the aeroplane. The Instructions for Continued Airworthiness must also contain maintenance procedures for Supercapacitors in spares storage to prevent the replacement of Supercapacitors whose function is required for safe operation of the aeroplane, with Supercapacitors that have experienced degraded capability or damage.

In the absence of relevant experience, the Special Condition is generic in nature and does not differentiate between different types of Supercapacitor chemistry or intrinsic safety features of the components used. It is envisaged that some adaptation might be undertaken in the future to tailor the Supercapacitor requirements if experience deems this necessary.