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U.S. Department of Transportation Dockets
Docket No. FAA-1999-6411
400 Seventh Street SW
Room Plaza 401
WASHINGTON DC 20590.

22 March 2000

Dear Sir or Madam

SUBJECT: DOCKET NO. FAA-1999-6411, NOTICE NO. 99-18

BAE SYSTEMS Power and Control Limited offers the following comments on Docket Number FAA-1999-6411, Notice No. 99-18, "Transport Airplane Fuel Tank System Design Review, Flammability Reduction, and Maintenance and Inspection Requirements; Proposed rule. "

Introduction

These comments are offered from the perspective of aircraft fuel pump design and production.

This proposed rulemaking would demand safety reviews of existing fuel tank systems to determine that the designs preclude the existence of ignition sources within the airplane fuel tanks, and if the current designs do not meet these requirements, the development of design changes necessary to the fuel tank system to meet these requirements. Fuel pump design and construction will play a significant part in the overall system safety condition and so it is felt that commentary from this function may be of value.

As the design of fuel pumps has evolved through the result of service experience and general advances in technology, safety features have been developed and incorporated into designs even though explicit requirements are not necessarily captured in regulatory material or engineering specifications.

Safety as a Pump Design Feature

The service history items relating to fuel system safety listed in the NPRM and the draft Advisory Circular 29.981-1X have been noted and their inclusion in advisory material is generally to be welcomed. The lessons learned should be applied as appropriate and as a matter of course with the introduction of any new aircraft fuel pump design in the future.

There is concern however, that the use of steel impellers is included as a particular design feature that would result in the degradation of the safety of the system. We are not aware of any firm and clear evidence to show that the use of steel components in a fuel pump contributes to a degradation of the system safety by virtue of the material

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properties. The selection of material for each component of a pump is a critical design decision and great care is taken to ensure that the materials used are the most appropriate for each individual item by itself and as a part of the overall design. To suggest that established pump design processes and principles, including the choice of materials, that have proved reliable and safe over many years be overturned without firm evidence is not likely to be in the best interests of overall system safety. If firm evidence exists for the case that the particular type of steel alloys used in fuel pumps may, in combination with themselves or other materials, have a potential for causing ignition, then we believe that this should be referred to in the advisory material.

The airframe mounted low pressure fuel pumps in transport category aircraft are generally **rotodynamic** devices rotating at high speed and driven by electric induction motors. The use of an induction motor limits the power transmitted to the shaft as the motor will stall at high power requirements, and this reduces some danger of friction heating. However a pump shaft rotating at speeds of up to **12000 rpm** results in the inherent risk of an ignition source being generated if a failure occurs within the pump assembly. This risk can be **minimised** by certain design features, verified by tests that have been developed over time. With the rotational energy involved it is, and will remain, impossible to guarantee with absolute certainty that there will be no possible single failures that could cause an ignition source due to contact between moving parts.

Features such as the incorporation of inlet line flame traps and flame suppressant devices can be considered, but these introduce consequential failure conditions which may present a greater risk of system failure than the original risk being addressed. Such examples of this are the blockage of filters due to icing or contaminant build up and degraded performance at altitude.

Regulation of Maintenance Activity

Assembly and repair are considered in detail during the design process such that the safety of the equipment is not compromised if work is carried out in accordance with the **CMM**. However, experience shows that different processes and materials are sometimes **utilised** by third party repair businesses that are **unauthorised** by and possibly even unknown to the equipment manufacturer. This may result in service problems that would be unforeseen by the original equipment manufacturer, and possibly a reduced level of safety. It does not seem reasonable to expect a survey of the safety of fuel system designs to take into account the effect of **unauthorised** and therefore unforeseeable maintenance activities. There may be features of the design that are critical to the safe operation of the equipment but which are not obvious to a third party. Regulations should be considered which would ensure that maintenance action carried out by parties not **cognisant** of the safety consequences of their procedures do not **jeopardise** the safety of aircraft in service.

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Re: DOCKET NO. FAA-1999-6411, NOTICENO. 99-18

Fuel System Safety

The overall design of fuel systems has evolved along different lines with different aircraft manufacturers but the level of system safety can be anticipated to be comparable, and the safety that has been designed into current systems represents well-developed and mature principles. It is unusual to demand and perhaps impossible to guarantee a probability of zero for any single failure. There must therefore be concern that the imposition of changes to systems as a consequence of a requirement to absolutely inhibit a single failure, which in general operation would not itself be a hazard, may introduce, perhaps by complication or reduced capacity, more danger to the fleet than is removed.

A concern with older aircraft is that any detail changes highlighted by a safety review may lead to an unforeseen adverse system level impact due to the age of the designs and consequent lack of system design continuity.

Yours faithfully
BAE SYSTEMS Electronics Limited



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