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MORE-ELECTRIC AIRCRAFT EMC ISSUES

1 INTRODUCTION

It is widely accepted that more-electric aircraft (MEA) systems will offer significant benefits for an aircraft, particularly for large civil aircraft, in terms of weight, reliability and operating costs. MEA systems involve reducing or eliminating hydraulics and replacing them with electrical equivalents. This implies changes to both electrical power generation and distribution.

Of direct relevance to this Subcommittee is the likelihood of distribution at higher currents, probably higher voltages, and variable frequency supplies.

This document raises several issues in relation to MEA systems. It should be noted that these should be considered during trade-off studies in order to make complete and rational decisions which fully include the weight, cost and volume penalties of MEA systems compared to traditional systems.

2 CABLE SEGREGATION RULES

Presently well established cable segregation rules for cabling in aircraft would need to be re-visited to cope with a range of relatively high power circuits for primary and secondary flight controls that would generate surges. Existing rules have been derived over many years, but are based on engineering judgement rather than science or modelling. Any future rules would still need to be simple to apply by computer-aided design engineers, but take account of factors such as higher currents, fibre optic data cables, segregation of circuits for redundancy and battle damage, and concentration of circuits at connectors.

Rectangular bundling of ribbon cables to maintain precise segregation may be a favoured approach which could give EMC consistency, weight saving and enable robotic terminations.

Cable segregation is being considered initially as a separate item and developments are circulated in document ASSC/215/2/30.

3 CABLE LOOM DESIGN TOOLS

Cable loom design would become more critical in a more-electric aircraft. There is presently an absence of reliable tools to provide an easy assessment of alternative designs, various design tools such as CRIPTE and MHARNESS have been used on some projects. These design tools require a highly specialised understanding of the modelling procedures to set up the correct simulation of the cabling to predict the induced current and voltage levels.

4 SYSTEM FREQUENCY MANAGEMENT

EMC installation of variable frequency power cabling is a risk factor in system frequency management (eg interaction with linear variable differential transformer excitation; traditionally chosen to have a frequency which is not harmonically related to 400 Hz). Power frequencies could normally be expected to range from about 380 to 800Hz. Such frequencies could be expected to affect trade-offs by having an impact on cable segregation and harnesses.

5 SOLID STATE POWER SWITCHING

EMC and nuclear radiation protection of solid state high power switching is a high risk area and very little research has been undertaken. There are reports of some problems which have been experienced by the French railways and affect the electric traction units. These effects have been attributed to cosmic radiation. Solid state power control is being used on all loads (28V and 270V) in the F-22 and a new generation of controller is being developed for the C130J.

6 EMC SPECIFICATIONS AND PROTECTION

The present EMC specifications for transients, surges and droops may need to be re-examined. Transient emission levels may need to be relaxed. Existing filters and transient protection devices may not be adequate for the high powers and voltages produced in more-electric aircraft.

7 LOW FREQUENCY INTERFERENCE

Low frequency magnetic field emissions and susceptibility may need to be re-examined. Low frequency fields may affect displays (monitor offset and wobble). Some types are more likely to be affected than others. DC fields may affect compass accuracy, magnetic sensors and Hall-effect devices.

8 EARTH RETURN DESIGN

Present earth-return design philosophies, particularly in airframes with carbon fibre skins, will need to be re-examined, especially with high power loads at remote areas of aircraft. The present requirement is for a 1300 mm^2 aluminium conductor in any major aircraft section of a typical fast jet to provide an earth return. This may have to be increased for more-electric aircraft, which would affect trade-offs. There seems to be a fundamental difference in typical helicopters, however, where returns are all wired back.

9 HEALTH AND SAFETY ISSUES

There are some health and safety concerns over high-level fields for crews, passengers and maintainers which should be considered.

10 COTS EQUIPMENT

Carry-on commercial-off-the-shelf equipment such as aeromedical units carried in military transport aircraft may need special qualification in more-electric aircraft. Potential manufacturers' changes to deal with obsolescence also need to be considered.