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Process management for avionics - Atmospheric radiation effects - Part 5: Guidelines for assessing thermal neutron fluxes and effects in avionics systems (IEC/PAS 62396-5:2007,IDT)

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IEC-PAS 62396-5 has been processed by IEC technical committee 107: Process management for avionics.

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Draft PAS	**Report on voting**
107/58/NP	107/70/RVN

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IEC/PAS 62396 consists of the following parts, under the general title *Process management for avionics – Atmospheric radiation effects:*

- Part 2: Guidelines for single event effects testing for avionics systems
- Part 3: Optimising system design to accommodate the Single Event Effects (SEE) of atmospheric radiation
- Part 4: Guidelines for designing with high voltage aircraft electronics and potential single event effects
- Part 5: Guidelines for assessing thermal neutron fluxes and effects in avionics systems

PROCESS MANAGEMENT FOR AVIONICS – ATMOSPHERIC RADIATION EFFECTS –

Part 5: Guidelines for assessing thermal neutron fluxes and effects in avionics systems

1 General

The purpose of this PAS is to provide a more precise definition of the threat that thermal neutrons pose to avionics as a second mechanism for inducing single event upset (SEU) in microelectronics. There are two main points that will be addressed in this PAS: 1) a detailed evaluation of the existing literature on measurements of the thermal flux inside of airliners and 2) an enhanced compilation of the thermal neutron SEU cross section in currently available SRAM devices (more than 20 different devices). The net result of the reviews of these two different sets of data will be two ratios that we consider to be very important for leading to the ultimate objective of how large a threat is the SEU rate from thermal neutrons compared to the SEU threat from the high energy neutrons (E >10 MeV). The threat from the high energy neutrons has been dealt with extensively in the literature and has been addressed by two standards ([2][1] in avionics and [1] in microelectronics on the ground).

The two ratios that this PAS considers to be so important are: 1) the ratio of the thermal neutron flux inside an airliner relative to the flux of high energy (> 10 MeV) neutrons inside the airliner and 2) the ratio of the SEU cross section due to thermal neutrons relative to that due to high energy neutrons. These ratios are considered to be important because with them, once we know what the SEU rates are from the high energy neutrons for an avionics box, a topic which has been dealt with extensively, such as [1], then the additional SEU rate due to thermal neutrons can be obtained with these ratios. Thus, given the SEU rate from high energy neutrons, multiplying this by the two ratios gives the SEU rate from the thermal neutrons. The total SEU rate will be the combination of the SEU rates from both the high energy and thermal neutrons.

The process for calculating the SEU rate from the thermal neutrons is shown in the following set of equations, (1) to (5).

SEU Rate (Hi E, Upset/dev·h)

$$\Phi_{\mathrm{Hi}}\,(\text{neutron flux} = 6000\ \mathrm{n/cm^2hr}) \times \sigma(\text{Hi E, SEU X-Sctn. cm}^2/\text{dev}) \tag{1}$$

SEU Rate (thermal neutron, Upset/dev·h)

$$= \text{SEU Rate (Hi E)} \times \frac{\Phi_{\mathrm{therm}}(\text{neutron flux})}{\Phi_{\mathrm{Hi}}(\text{neutron flux})} \times \frac{\sigma(\text{therm SEU X-Sctn.})}{\sigma(\text{Hi E SEU X-Sctn.})} \tag{2}$$

Ratio-1

$$= \frac{\Phi_{\mathrm{thermal}}(\text{neutron flux})}{\Phi_{\mathrm{Hi}}(\text{neutron flux})} \tag{3}$$

Ratio-2

$$\frac{\sigma(\text{therm SEU Cross Section})}{\sigma(\text{Hi E SEU Cross Section})} \tag{4}$$

1 Numbers in square brackets refer to the bibliography.

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