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| **FAQ Number** | **13-0004** | **FAQ Revision** | **0a** |
| **FAQ Title** | **Clarifications on Treatment of Sensitive Electronics** | | |


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**Purpose of FAQ:**

The purpose of the FAQ is to clarify the treatment requirements for solid state and sensitive electronics.

**Details:**

**NRC document needing interpretation (include document number and title, section, paragraph, and line numbers as applicable):**
None

**Circumstances requiring guidance interpretation or new guidance:**
New guidance

**Detail contentious points if licensee and NRC have not reached consensus on the facts and circumstances:**
None

**Potentially relevant existing FAQ numbers:**
None

**Response Section:**

**Proposed resolution of FAQ and the basis for the proposal:**

## INTRODUCTION

The purpose of Fire PRA FAQ 13-0004 is to provide supplemental guidance for application of the damage criteria provided in Sections 8.5.1.2 and H.2 of NUREG/CR-6850 for solid-state components.

## BACKGROUND

Sections 8.5.1.2 and H.2 of NUREG/CR-6850 provides guidance that includes damage criteria for solid-state control components. The discussion provided in NUREG/CR-6850 Appendix S, Section S.2 refer to this criteria in the context of sensitive electronics but only for the purposes of treatment of fire propagation between two adjacent electrical cabinets which suggests that the concern is limited to heating due to sources where only a small air gap exists.

The guidance in NUREG/CR-6850 includes various discussion related to sensitive electronics but never defines the meaning or scope that is intended. Specific thermal damage criteria for sensitive electronics are not provided in NUREG/CR-6850. Instead, Appendix H provides a modified damage threshold for solid state control components. There is no readily available consistent industry definition of sensitive electronics or temperature sensitive electronics. The general industry definition of solid state control component would be any electrical/electronic component with no moving parts and would include semiconductors, conductors, and insulators.

The current interpretation of the damage criteria in NUREG/CR-6850 is based information and discussions in Appendix H.

> *This appendix provides damage and/or ignition criteria for targets typically considered in nuclear power plant fire scenarios.*

The information in the appendix focuses almost exclusively on cables. Section H.2 notes that for major components, such as motors and valves that are typically designed for a 40$^{o}$C ambient and have winding insulation systems that are rated for 155$^{o}$C operating temperatures, their fire vulnerability is based on their associated cabling rather than the component itself. So such equivalent relief is provided for sensitive or solid state electronics.

## DISCUSSION

The following is provided as additional guidance for identifying the scope of plant equipment to be treated using the lower damage threshold specified in Section H.2 of NUREG/CR-6850.

- Electro-mechanical devices are not considered sensitive electronics.
- Integrated circuits employing any of the variants of pin-grid arrays should be treated as sensitive electronics unless they satisfy the item below.

- Sensitive electronic components that are mounted inside a control panel (cabinet) such that the cabinet walls, top, front and back doors shield the component from the radiant energy of an exposure fire may be considered qualified up to the damage threshold for thermoset cables, provided that:
    - The component is not mounted on the surface of the cabinet (front or back wall/door) where it would be directly exposed to the convective and/or radiant energy of an exposure fire.
    - The presence of louvers or other typical ventilation means to not invalidate the guidance provided for here.

The proposed treatment for components mounted inside a control panel (cabinet) is based on qualitative judgment that is supported by fire modeling analyses. In general, any component that should be evaluated using the lower damage threshold specified in Section H.2 of NUREG/CR-6850 is likely to be located within a ventilated panel (cabinet) or some other robust enclosure. The presence of that robust enclosure essentially shields the component from direct radiant exposure. Consequently, the actual exposure temperature would be based on the temperature response of the enclosure to the incident heat flux and the thermal response of the air within the enclosure.

The fire modeling analysis used ~~the~~ Fire Dynamics Simulator (FDS) to measure the heat flux and temperatures within a metal cabinet exposed to a fire. The objective of the study was to determine whether conditions within a panel (cabinet) would remain below the damage threshold specified in Section H.2 of NUREG/CR-6850 when the exterior surface was subjected to a heat flux equal to or ~~equal~~ exceeding ~~to~~ the generic screening damage threshold for thermoset cables. The specific fire that was considered had a heat release rate of 317kW. The fire was placed such that its ~~nearest edge~~centerline was 1 meter ~~at a distance~~ from the panel (cabinet) surface. This distance is typical of a horizontal ZOI ~~of~~for thermoset cables.

FDS simulations for this study found that the ~~incident~~ heat flux and temperature experienced by components within the enclosure ~~were substantially~~remained below that specified in Section H.2 of NUREG/CR-6850, while ~~.~~ the exterior surface experienced a heat flux exceeding the generic screening damage threshold for thermoset cables. These results support the recommendation that a~~n~~ ~~incident~~ heat flux for thermoset cables can be used as a conservative surrogate for assessing the potential for thermal damage to solid-state and sensitive electronics within an electrical panel (cabinet).