September 13, 2007

MEMORANDUM TO: Alex R. Klein, Acting Branch Chief
Fire Protection Branch
Division of Risk Assessment
Office of Nuclear Reactor Regulation

FROM: Charles Moulton, Fire Protection Engineer ***/RA/***
Fire Protection Branch
Division of Risk Assessment
Office of Nuclear Reactor Regulation

SUBJECT: SUMMARY OF AUGUST 17, 2007, CATEGORY 1 MEETING ON FREQUENTLY ASKED QUESTION 07-0035, HIGH ENERGY ARCING FAULTS IN BUS DUCTS EXPERT PANEL

On August 23, 2007, the U.S. Nuclear Regulatory Commission staff held an expert panel meeting with stakeholders and the public to discuss National Fire Protection Association Standard 805 Frequently Asked Question (FAQ) 07-0035. The topic of this FAQ is High Energy Arcing Faults (HEAFs) in bus ducts.

Bus Duct HEAF Expert Panel Discussion Summary

Mr. Steve Nowlen, a prime author of NUREG/CR-6850/EPRI 1011989, opened the discussion by indicating that, NUREG/CR-6850/EPRI 1011989 (Appendix M) points out that fire-induced damage, including ignition, from HEAFs due to bus ducts can occur. Although NUREG/CR-6850/EPRI 1011989 report did not specifically provide bus duct high-energy arcing fault frequencies, he asserted that it was the intention of the authors to include bus ducts as HEAF ignition sources. Historical data indicated that HEAFs could occur both at midpoint connections between buses and at the end devices where the buses terminated (e.g. transformer, switchgear).

Mr. Nowlen relayed the recommendation from Dan Funk, another author of NUREG/CR-6850/EPRI 1011989 and an electrical engineering expert, to classify the different types of bus ducts as follows:

(1) Cable duct – a continuous cable run enclosed by a metal enclosure,
(2) Non-segmented bus duct – a short, continuous single bus duct with both ends terminated at end devices, and
(3) Segmented bus duct – a bus duct consisting of bus bars (and ducts) bolted together at “midpoint” terminations to form longer lengths. The segmented bus ducts are further broken down into:
    (a) Hydrogen-cooled isolated-phase bus ducts, and
    (b) All other natural convection or forced-air cooling bus ducts

These two types of segmented bus ducts are suggested since the HEAF effects and zone of influence (ZOI) are drastically different. Hydrogen-cooled segmented bus ducts

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are susceptible to a 360$^{o}$ spherical explosion, while all other segmented bus duct explosions tend to propagate downward (perhaps conically) with debris of molten metal.

The panel agreed that HEAFs could occur anywhere in a bus duct due to poor connections, vibrations, contaminants, insulation breakdowns, etc. In addition, for types (1) and (2), the effect of a HEAF is almost certain to manifest at the end device due to magnetism and physics. For type (3), a HEAF will seek out and be manifested at a weak spot, usually a midpoint or end termination. Since HEAFs manifested at end terminations most likely have been counted as transformer, switchgear, or electrical panel fires, the only remaining potential HEAF sources, that have not been counted, are at the midpoint terminations (junctions) of segmented bus ducts. As such, the expert panel recommends that bus duct junctions be counted, and a new plant-wide bus duct HEAF frequency be developed by the authors of NUREG/CR-6850/EPRI 1011989 for use in probabilistic risk assessment calculations. The existing ignition source frequencies for HEAFs in the end devices would remain as is.

The panel determined that, in most cases, the bus duct junctions are readily accessible and identifiable by the bolted segments of the ducts. Therefore, as a first cut, the panel recommends that the analyst count all above-floor bus duct junctions and transition points. For plants that have an insignificant number of bus ducts, or cannot readily access the majority of the installed bus ducts, adjustments will have to be made to the plant-wide ignition frequency.

Issues that were raised for discussion but cannot be resolved by the panel due to lack of information or supporting data are:

1. Does the presence of bus ducts make HEAFs at end devices more likely?
2. Can any credit be taken for maintenance of bus ducts?
3. Industry does not use the terms “segmented” and “non-segmented” when referring to bus ducts. This may cause confusion with the commonly used terms “segregated” and “non-segregated”.
4. The probability of HEAFs in bus duct to cause secondary fires.

For the next step, the panel suggests the industry perform a bus duct inventory of their plants. In parallel, the NUREG/CR-6850/EPRI 1011989 authors should draft a proposed method for counting and calculating the effects of HEAFs in bus ducts as a draft first response to FAQ 07-0035.

A list of meeting attendees is enclosed with this memorandum.

Enclosure:
As stated

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**NATIONAL FIRE PROTECTION ASSOCIATION STANDARD 805**
**FREQUENTLY ASKED QUESTION 07-0035 EXPERT PANEL**
**LIST OF ATTENDEES**

August 17, 2007

**U.S. Nuclear Regulatory Commission Staff**

C. Moulton
J. Hyslop
P. Lain
R. Gallucci
T. Dinh

**OTHER**

A. Mossa (Westinghouse)*
B. Bradley (NEI)
D. Miskiewicz (Progress)*
D. Henneke (General Electric)*
F. Wyant (SCI)*
K. Zee (ERIN)*
R. Anoba*
S. Nowlen (SNL)

*participated via phone

ENCLOSURE