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FROM: Joseph L. Birmingham, Project Manager
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SUBJECT: TRANSMITTAL OF STAFF COMMENTS ON A FIRE TESTING PROPOSAL FROM THE NUCLEAR ENERGY INSTITUTE

By letter dated April 21, 2000, the Nuclear Energy Institute (NEI) submitted a document titled "Industry Integrated Methods for Addressing Circuit Failure Issues." This document, in part, provided a fire testing proposal for post-fire safe shutdown circuit analysis.

The staff has reviewed the fire testing proposal and its comments are attached. These comments are the primary comments/questions from the Plant Systems Branch fire protection section. The staff expects to review future drafts of the proposed test plan as they are developed. These comments are being forwarded to NEI so they might be considered by NEI and the Electrical Power Research Institute and their fire testing laboratory contractor in advance of the summer testing sequence.

Attachment: As stated
Cc: See list
Project No. 689

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Staff comments on, "Industry Integrated Methods for Addressing Circuit Failure Issues"

The staff has reviewed, "NEI Preliminary Proposal - Fire Testing of Cables and Circuits - Revision A." The document is a "Preliminary Proposal" and as such, provides limited information on exactly "what" will be tested, "how" the testing will be performed, and "how" acceptance will be determined. The staff requests that NEI submit the detailed test plans for this project for NRC review and comment should the project evolve into an actual test program. Based on the preliminary information, the staff provides the following questions/comments.

1. The test proposal only mentions one type of cable, cross-linked polyethylene (XLPE), insulated conductors with a chlorosulfonated polyethylene (CSPE, commonly referred to as Dupont Hypalon) jacket. Both the insulation and jacket are thermosetting materials and as such would be expected to perform better than thermoplastic materials when exposed to a thermal insult. Will the test plan include the full range of insulation materials such as thermoplastics?

2. The proposal states under information desired, "Differentiate between shorts to ground and wire-to-wire shorts." Will open circuits be noted? Past research has demonstrated that multiple insulated conductors will short within the cable prior to the conductors shorting to the external ground plane outside the cable or to conductors in an adjacent cable. What is expected to be gained in this test? Will the test array include variables such as grounded and un-grounded cables? Shielded cables? Shielded conductors or drains? Will different insulation/jacket combinations be evaluated?

3. The proposal specifies a "Fire Energy - BTU/hr " of 20 kW and a temperature of 600 °C (1,112 °F) How will these conditions be achieved, monitored and recorded? Will the testing involve exposing the cables to a variable fire source for macroscopic effects or will the testing use a scientific controlled approach, using an air oven, such as described in UL Subject 1724 Appendix B? Will the testing start at the ambient temperature of the test laboratory, or a typical NPP, or will the cables rated temperature be used as a starting point?

4. The proposal does not specify the age of the cables used for testing (i.e., pretest conditioning, - none.) Will new or aged cable be used for the testing? If new cable is used, does this bound aged cable already in service at NPPs for a number of years? If aged cable are used, how will the cables be aged and what age will the cables be?

5. The proposal does not describe the location of the cable being tested in the cable tray. If the testing is to randomly place the cables in an arbitrary loaded cable tray, how will this be bounding for installed plant configurations? (i.e., will the cable under consideration be on the top, in the middle, or on the bottom of the cable tray? Each location introduces different challenges. For example, if the cable is located on the bottom, it will be subjected to the weight of the cables located above it and the loads placed on the cable tray rungs. A cable in the center of a full tray will be shielded from the heat flux of the fire, and a cable on top of a fully loaded tray will not have the weight of cables above it while being thermally shielded from a fire below it. How will this be addressed?

Attachment

6. The proposal states 120 VAC or 170 VDC for control circuits in an open circuit (i.e., no current flow). Some BWR DC systems operate at 250 V. How is the proposal bounding? Will the testing evaluate the different failure modes between grounded and ungrounded systems?

7. The proposal states 40 VDC provided by a limited current source of 0.5 to 1.0 amps. Many NPP instruments operate within a 4 to 20 milliamp range. Typically instruments become inoperable based on current leakage long before cable failure due to shorts. How will this testing determine when and under what conditions these sensitive instruments become inoperable?

8. The proposal specifies that power circuits shall be 480 VAC line-to-line. How does this test bound higher level voltages such as 6.9kV? Would the higher voltages have a greater potential to short? In view of the size and capacity of a typical NPP electric power load, why is a “light bulb” an appropriate load on a 480V cable? Would it be more appropriate to use a larger current drawing end device to replicate actual conditions?

9. The proposal states that parameters monitored will be the voltage and current. How will current be monitored if the circuits are open as stated in the proposals’ load burden section?

10. The proposal describes how ends of the cables shall be terminated. In the 1986 Sandia National Laboratories report, “Transient Fire Environment Cable Damageability Test Results: Phase I,” Wheelis describes a problem with placing the connections in the thermal environment. He referred to this problem as “end effects” and eliminated them from his test program. How will this testing prevent “end effects?” Cable splices and connections may prove to be the weakest link in the cable run. How will this test program address splices and connections/terminations such as those in junction/splice boxes? How will the test results be used for cables installed in conduit, or free air drops?