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Mr. John Hannon
Chief, Plant Systems Branch
Office of Nuclear Reactor Regulation
Mail Stop O11-A11
U. S. Nuclear Regulatory Commission
Washington, DC, 20555-0001

**SUBJECT:** NEI 00-01, Draft Revision D

**PROJECT NUMBER: 689**

Dear Mr. Hannon:

We are providing with this letter Draft Revision D of NEI 00-01, *Guidance for Post-Fire Safe Shutdown Analysis* as Enclosure 1. This revision updates Draft Revision C to reflect:

- NEI responses to NRC comments on Draft Revision C of NEI 00-01 (see our letter of September 11, 2002)
- Results and conclusions of a detailed EPRI analysis of the results of the EPRI/NEI circuit failure testing carried out in the first half of 2001
- Results and conclusions from the expert panel development of spurious actuation probabilities as reported in EPRI Report 1006961
- Results and conclusions of two pilot evaluations of NEI 00-01 methods
- A revised analysis of Multiple High Impedance Faults based on the EPRI circuit failure tests and other tests

We believe that NEI 00-01 Draft Revision D provides a risk-informed approach to resolving circuit failure issues. We have demonstrated in the pilot evaluations that the use of these methods is an effective means, based on established safe shutdown and fire PRA analysis principles, of determining whether fire-induced spurious actuations, or combinations thereof, are risk significant and warrant additional licensee attention. We expect a licensee who determines that such an issue is risk significant to take appropriate action to address the issue within the context of the licensees' Corrective Action Program. We expect a licensee who determines that such an issue is not risk significant to request an exemption or deviation if the issue is clearly within his licensing basis, or take no further action except documentation if it is not.

We therefore request a review and approval of the guidance in this document as an acceptable method for a licensee to address fire-induced circuit failure issues at his facility. This approval should reflect the acceptability of these methods for current deterministic licensing bases, or licensing bases created within the context of NFPA 805. We further

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request that inspection guidance and training reflect the acceptability of these methods, and we will support as needed the NRC development of this revised guidance.

**Exclusions from Licensee Consideration**

In addition to serving as a risk-informed method for plant-specific resolution of circuit failure issues, this guidance document provides bases to support the following exclusions from licensee consideration on a generic level:

1. Multiple simultaneous spurious actuations for any thermoset or armored multiconductor cable involving a single component with current limiting devices such as Control Power Transformers (CPTs).

2. Single spurious actuations for the following scenarios:

   - Any thermoset cable exposed to a fire less than 450 kW for less than 15 minutes
   - Armored cable with fuses
   - Cable to cable fire-induced spurious actuations for armored or thermoset cable
   - Any fire that can be shown to be less than:
     - 680 °F for thermoset cable
     - 400 °F for thermoplastic cable
     - 570 °F for armored cable
   - 3-phase hot shorts for any component including high/low pressure interfaces
   - DC motors
   - AOVs and PORVs that return to the desired position with power removed

3. Multiple High Impedance Faults (MHIFs).

4. Open circuits as an initial fire-induced failure mode.

Justification for each of these positions is provided in Enclosure 2.

**General Applicability**

The risk significance determination methods in Section 4 of this document can easily be applied to the resolution of fire protection issues unrelated to fire-induced circuit failures. The method reflects the appropriate probabilistic parameters addressing the elements of fire-induced plant consequences, including:

- Fire initiation
- Fire growth
- Fire mitigation through detection and suppression
- Fire-induced damage to components and equipment
- Effects of damaged equipment on core damage

Because of this, the method can easily be applied to other fire protection issues with minor changes in parameters and provides an integrated view of risk significance. Possible uses include:

- Phase II SDP
- Exemption and deviation requests

- GL 86-10 evaluations
- Corrective Action Program issue prioritization

**Issue Closure**

We look forward to your final comments on this document and acceptance of this method for resolving circuit failure issues in a risk-informed manner. When any remaining staff issues are resolved, we will issue Revision 0 of NEI 00-01 and conduct an industry workshop (with appropriate staff participation) on the use and applicability of NEI 00-01 when NRC approves it.

If you have questions, please contact Fred Emerson at 202-739-8086 or fae@nei.org, or me.

Sincerely,

Alex Marion

FAE/maa
Enclosure

c: Ms. Suzanne Black, U. S. Nuclear Regulatory Commission
Mr. Eric Weiss, U. S. Nuclear Regulatory Commission

**Enclosure 2**

## Justification Summary for Exclusion from Licensee Consideration

### Exclusions

1. Multiple simultaneous spurious actuations are not credible for any of the following scenarios:

    - Any thermoset or armored multiconductor cable with conductors only for a single component with current limiting devices such as CPTs.

      *Since most multiconductor cables involve only one component, multiple simultaneous spurious actuations would require cable-to-cable, or external cable, hot shorts. For thermoset cable, the EPRI fire tests showed no cases of spurious interactions from hot shorts in external cables. The presence of current limiting devices such as CPTs reduces further the likelihood of hot shorts in favor of shorts to ground. Further supporting information includes the availability of at least 30 minutes to interdict the fire for thermoset or armored cable.*

2. Single spurious actuations are not credible for the following scenarios:

    - Any thermoset cable exposed to a fire less than 450 kW for less than 15 minutes:

      *The EPRI fire tests showed no cases of spurious actuations in thermoset cable in less than 14 minutes. The heat release rates ranged from 70 to 450 kW.*

    - Armored cable with fuses:

      *The expert panel concluded that the probability of spurious actuations (given cable damage) for armored cable with electrically protected conductors was less than 1 E-2. Considering the other factors in the NEI 00-01 risk equation, it is very unlikely that the delta CDF for this scenario will be greater than 1 E-7. Spurious operations of electrically protected armored cable is therefore considered extremely unlikely, with at least 30 minutes to interdict the fire.*

    - Cable to cable (external) spurious actuations for armored or thermoset cable:

      *The presence of armor makes it extremely unlikely that cable-to-cable hot shorts will occur. For thermoset cable the EPRI fire tests showed no cases of spurious interactions from hot shorts in external cables. The presence of current limiting devices such as CPTs reduces further the likelihood of hot shorts in favor of shorts to ground. Further supporting information includes the availability of at least 30 minutes to interdict the fire for thermoset or armored cable.*

    - Any fire that can be shown to be less than:

      - 680 degrees F for thermoset cable
      - 400 degrees for thermoplastic cable
      - 570 degrees for armored cable

*The expert panel concluded that there would be little or no electrical activity below these temperatures.*

- 3-phase hot shorts for any component including high/low pressure interfaces:

  *See discussion for #4 below.*

- Spurious actuations in DC motors:

  *See discussion for # 5 below.*

- AOVs and PORVs that return to the desired position with power removed:

  *The forthcoming EPRI report on its circuit failure testing concludes that the duration of hot shorts is short enough to preclude adverse consequences from spurious actuations in AOVs and PORVs where eventual removal of the hot short will return the valve to its desired position.*

3. Multiple High Impedance Faults (MHIFs) are not credible:

   *NEI 00-01 Appendix B.2 provides an analysis demonstrating that the probability of MHIFs is sufficiently low that this phenomenon does not pose a credible threat to post-fire safe shutdown if the plant meets the following criteria:*

   - *Power supply operates at a nominal AC or DC voltage greater than 110 volts*
   - *Electrical coordination between supply-side overcurrent protective devices and load side overcurrent protective devices of concern*
   - *For 120 VAC and 125 VDC power supplies, a minimum selectivity ration of 2:1 between the supply side protective devices and the load side protective devices of concern*
   - *Electrical system capable of supplying the necessary fault current for sufficient time to ensure predictable operation of the overcurrent protective devices in accordance with their time-current characteristics*
   - *Each credited overcurrent protective device (a) be applied within its voltage, current, and interrupting capacity ratings, and (b) be listed or approved by a nationally recognized test laboratory to the applicable product safety standard*
   - *Proper operation ensured by appropriate testing, inspection, maintenance and configuration control*
   - *Electrical system associated with the power supply in question conforms to a recognized grounding scheme*

   *More details on these criteria are found in Appendix B.2 of NEI 00-01.*

4. Three-Phase Hot Shorts For High/Low Pressure Interfaces:

   *Generic Letter 86-10 indicates that licensees do not have to consider three-phase hot shorts for any components other than high/low pressure interfaces. The reason given for this exclusion is that the consequences of a three-phase hot short for these interfaces are great enough to outweigh the low probability of this event.*

*The results of the EPRI testing indicate that the overall likelihood of a spurious actuation from an external cable hot short is .01 for thermoset cable and .1 for thermoplastic cable, given cable damage. Because the three phases have to short together in the appropriate sequence, the likelihood of a three phase hot short is no higher than the product of three single-phase external cable hot shorts; this is 1E-6 for thermoset cable and 1E-3 for thermoplastic cable. Using the guidelines in Section 4 of NEI 00-01, it requires only an additional factor of .1 for thermoset cable for the issue to be screened out using probabilistic methods. In fact, most scenarios will result in this probability of three-phase hot shorts being 1E-10 or less for thermoset cable.*

*While failure of a high-low pressure interface is a high consequence event, it makes little sense to spend unnecessary resources to prevent a scenario with such an extremely low probability.*

*Further supporting information is provided in Appendix B.1 of NEI 00-01.*

5. Spurious actuations in DC motors:

   *Similar to the discussion of 3-phase hot shorts above, consequential spurious actuations in DC motors require a very selective, and very unlikely, combination of failures to occur. Further supporting information is provided in Appendix B.1 of NEI 00-01.*

6. Open circuits as an initial fire-induced failure mode:

   *The tests showed no cases of open circuits. While fire-induced open circuits are possible, it was clear from the tests that hot shorts or shorts to ground will be the initial failure mode.*