UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

May 1, 20000

MEMORANDUM TO: Cynthia A. Carpenter, Chief
Generic Issues, Environmental, Financial
and Rulemaking Branch
Division of Regulatory Improvement Programs, NRR

FROM: Joseph L. Birmingham, Project Manager
Generic Issues, Environmental, Financial
and Rulemaking Branch
Division of Regulatory Improvement Programs, NRR

SUBJECT: SUMMARY OF APRIL 13, 2000, MEETING BETWEEN THE NUCLEAR REGULATORY COMMISSION STAFF AND THE NUCLEAR ENERGY INSTITUTE

On April 13, 2000, staff members of the Nuclear Regulatory Commission (NRC) met with representatives of the Nuclear Energy Institute (NEI) and industry to discuss NEI's draft of their probabilistic post-fire safe shutdown fire-induced circuit failure analysis methodology. Meeting attendees are listed in Attachment 1. Handouts used by NEI during the meeting are included in Attachment 2.

Leon Whitney and Eric Weiss (NRC) began the meeting by stating that the purpose of the meeting was to discuss NEI's draft probabilistic post-fire safe shutdown fire-induced circuit failure analysis methodology. This opening statement was followed with introductions of those in attendance. David Modeen and Fred Emerson (NEI) then began a discussion by identifying the industry objectives and summarizing the industry actions since the last meeting. They described the NEI probabilistic methodology and its intended application, and indicated that the methodology was to be part of an "integrated" industry approach (i.e., the NEI method used the Boiling Water Reactors Owners Group (BWROG) deterministic methodology as a guidance document "template"), but that the deterministic BWROG methodology would remain a "stand-alone" document.

NRC asked how the various pieces of the methodology were integrated with the BWROG document. This question was resolved by NEI committing to prepare a flowchart showing how the two methodologies were intended to be used in an integrated manner, possibly to be included with the completed draft methodology to be provided to the staff approximately one week after the meeting.

NEI stated that the planned EPRI summer 2000 "circuit failure characterization" fire test specifications and parameters would be provided in advance to NRR and RES for comment. NEI also stated that its planned expert panel solicitation on circuit failure probabilities would be of reduced scope due to funding constraints and Federal Advisory Committee Act restrictions.

NEI stated that their probabilistic methodology centers on separately identifying both equipment combinations of concern and cable circuits of concern. The equipment combinations of concern would be those that present "significant" (immediate, direct and unrecoverable) plant

transient events. In addition, in Appendix G of the NEI methodology, there is to be consideration of those events which only "interfere" with post-fire safe shutdown (using a 10 E-6 room and a 10 E-7 plant-wide core damage frequency threshold).

NEI presented a screening formula of the major factors involved in determining the risk significance of potential fire-induced circuit failures. NEI presented a series of screening actions based on the factors in the screening formula which could be performed to determine if the risk of a potential circuit failure was significant. Additional details of the screening formula and screening actions are contained in Attachment 2.

NEI finished their presentation with a discussion of the planned schedule for continuing development of the methodology. The current schedule is for resolution, including NRC staff approvals, by 1st quarter of 2001. A possible impact on that schedule is that, currently, participation of a pilot plant is not known to be available before early 2001.

NRC asked clarifying questions about the screening formula and the screening actions. NRC reiterated a desire for a flowchart identifying how the methodology was to be implemented in an integrated manner. Following NEI's response to NRC's questions the meeting was adjourned.

Subsequent to the meeting, NEI mailed a package of the requested documents to NRC. The cover letter for this package is attached as Attachment 3 and describes the documents that were sent.

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

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Cc: See list
Project No. 689

cc: Mr. Ralph Beedle
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and Chief Nuclear Officer
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Mr. Anthony Pietrangelo, Director
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Meeting Attendees

Name	Organization	Phone Number
Eric Weiss	NRC/NRR	301-415-3264
Leon Whitney	NRC/NRR	301-415-3081
Ronaldo Jenkins	NRC/NRR	301-415-2985
See-Meng Wong	NRC/NRR	301-415-1125
J. S. Hyslop	NRC/NRR	301-415-3078
Nathan Siu	NRC/RES	301-415-6380
Roy Woods	NRC/RES	301-415-6622
Joe Birmingham	NRC/NRR	301-415-2829
John Hannon	NRC/NRR	301-415-1992
Fred Emerson	NEI	202-739-8086
David Modeen	NEI	202-739-8084
David Parker	Southern Co.	205-992-5010
Tom Gorman	PPL, Corp.	610-774-7762
Charles Willbanks	NUS Info	301-258-1865
Altheia Wyche	SERCH Licensing	301-228-6401
Donald Ferraro	Winston & Strawn	202-371-5838
Edward Bradley	Tenn Valley Authority	423-751-8253
Paul Oullette	EPM, Inc.	508-875-2121

An Industry Approach to the Resolution of Fire-Induced Circuit Failure Issues

Dave Modeen and Fred Emerson
NEI
April 13, 2000

NEI

Contributors

- BWR Owners Group
- EPRI
- NEI Circuit Failures Issue Task Force
- NEI Fire Protection Working Group

NEI

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Topics

- Industry circuit failure resolution method and status
  - Overall industry method
  - BWROG guidance document
  - Circuit failure characterization
  - Probabilistic methods
  - Pilots
  - Schedule
- Multiple high impedance faults

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Objectives of Industry Method

- Place issues in context of overall risk significance
- Document a circuit failure analysis method and basis that is understood and accepted by NRC and industry
- Resolve circuit failure issues identified by NRC
- Demonstrate usefulness of risk-informed methods to resolving fire protection issues

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Industry Method

- Actions since last meeting
  - NEI guidance document created
    - NEI 00-01 "Generic Guidance for Post-Fire Safe Shutdown"
    - BWROG guidance document used as 'template'
    - Placeholders for work in progress
  - Probabilistic analysis methods improved
  - Draft of circuit failure characterization completed
    - Peer review in progress
  - Cable failure testing plans well underway
  - Pilot candidate identified

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Application

- Intended to be used:
  - If plant has known circuit analysis issues
  - If plant has not addressed circuit analysis issues fully
- Not intended to be used:
  - To re-examine existing circuit analysis
  - If plant's method of addressing circuit analysis issues has been accepted by the NRC

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Integrated Industry Approach

- Industry method for circuit analysis integrates
  - Deterministic methods from BWROG guidance supplemented with PWR considerations
  - Cable failure characterization
  - Probabilistic elements for fire initiation, growth, mitigation and plant recovery options

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Industry Method Summary

- BWROG guidance document "template"
  - Existing draft of NEI 00-01 is work in progress
  - Changes (in progress) intended to provide seamless integration of deterministic and probabilistic approaches
    - Application to all plants
    - Reflection of PWR systems
    - Appendix B (IN 92-18) *
    - Appendix C (Hi/Lo pressure interface) * (continued)

* Changes from current BWROG appendix to be based on EPRI circuit failure characterization

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Industry Method Summary

- BWROG guidance document "template"
  - Changes include
    - Appendix E (MHIF) *
    - Appendix F (manual actions) *
    - Appendix G - revision to up-front generic screening method
    - Appendix H (new) - circuit failures of concern
    - Appendix I (new) - plant-unique risk assessment approach to mitigating identified issues (presented as outline of industry method in January 2000)

* Changes from current BWROG appendix to be based on EPRI circuit failure characterization

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BWROG Guidance Document

- NEI recommends
  - Continuing NRC review and SER for BWROG guidance document
  - Separate review and approval for NEI 00-01
    - Review and SER of BWROG document will be directly useful in NRC review and approval of NEI 00-01

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EPRI Circuit Failure Characterization

- Draft report completed by EPRI contractor
  - Peer review in progress
  - Preliminary view: some fraction of circuit failures can be ruled out based on cable location and residual resistance from damaged cable insulation
  - Existing test results have limited value
  - Further testing essential

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EPRI Circuit Failure Characterization

- Current testing plans
  - Near-term testing in conjunction with planned U.S. utility tests is very likely
  - Longer term confirmatory testing possible at international test facility
  - Testing goals and specifications have been drafted
  - Continued input from NRC needed

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EPRI Circuit Failure Characterization

- Circuit failure probability development
  - To be developed by expert panel solicitation
  - To be based on existing and future test results
  - NRC does not plan to participate on panel
    - NRC recommendations for industry panel are welcome
      - Procedure
      - Potential participants

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Probabilistic Methods

- Improvements since last meeting
  - Independence of parameters better supported
  - **Δ CDF thresholds for both individual fire areas (E-7), and total for all fire areas (E-6) with failure combinations of concern, are determined**
  - Fire size parameter more clearly defined
  - Supporting criteria for Table 1 developed (Tables 2 and 3)

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Probabilistic Methods

- Improvements since last meeting (continued)
  - Better methods for determining effectiveness of suppression
  - Conditional core damage probability calculation revised to reflect only equipment not previously credited for safe shutdown
  - Up-front screening method under development based on revised Appendix G
  - Used as one mitigation technique for potential circuit failures

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Screen Five

- Steps
  - Determine conditional core damage probability considering availability of alternate equipment (P_{CCD})
    - Use internal events PSA model
      - Area fire frequency is initiating event
      - Use appropriate event tree
      - Failure probability for damaged components is 1.0
  - $\Delta CDF = F_f * P_E * P_{SA} * P_{AS} * P_{DM} * P_{CCD} < 1E\text{-}7$ (E-6)?
    - If so, screen out if SM and DID considerations permit

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Screen Six

- Use accepted fire modeling techniques to refine F_f
- $\Delta CDF = F_f * P_E * P_{SA} * P_{AS} * P_{DM} * P_{CCD} < 1E\text{-}7$ (E-6)?
  - If so, screen out if SM and DID considerations permit

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Further Plant Actions

- Evaluate further actions to address results of screening analyses
- Document analysis

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Pilot Evaluations

- Goals
  - Support plant-specific goals
  - Evaluate usefulness of industry method
  - Provide insights which allow some potential failure modes to be screened out generically
- One candidate plant identified
  - Early 2001 window for pilot would affect overall schedule
  - Other candidates being sought to support existing schedule

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Schedule

- See Gantt chart
- May be impacted by schedules for
  - Testing
  - Pilot(s)

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Multiple High Impedance Faults

- Should no longer be an issue of concern
  - BWROG Appendix E
  - EPRI circuit failure characterization work
- Recommending closing issue in parallel with remaining work on NEI 00-01
  - Industry will develop position paper
  - Recommend meeting with NRC in June - July to present industry conclusions and supporting information
  - Reflect final conclusions in NEI 00-01 Appendix E

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Summary

- Industry integrating BWROG guidance, EPRI circuit failure characterization, and probabilistic fire analysis in NEI 00-01
  - Using BWROG document as template
  - Characterization criteria drafted; being peer reviewed
  - Testing required
  - Improvements to probabilistic methods
- Current resolution schedule - by 1st Quarter 2001
  - May be impacted by testing and pilot(s)

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David J. Modeen
DIRECTOR, ENGINEERING
NUCLEAR GENERATION DIVISION

April 21, 2000

Mr. John Hannon
Chief, Plant Systems Branch
Division of Safety Systems and Analysis
Office of Nuclear Reactor Regulation
One White Flint North
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: Industry Integrated Methods for Addressing Circuit Failure Issues

PROJECT NUMBER: 689

Dear Mr. Hannon:

As you requested at our meeting on April 13, 2000, we enclose the following documents related to the industry method to address fire-induced circuit failures:

- NEI 00-01, Revision A (Draft), "Generic Guidance for Post-Fire Safe Shutdown Analysis"
- A flow chart summarizing the process intended to be followed in carrying out the method
- The proposed industry schedule for completing the method
- The proposed parameters for industry tests to characterize fire-induced circuit failure phenomena

As we discussed during the April 13 meeting, these documents should be considered works in progress, with an overall completion schedule of March 2001. We plan to provide NRC staff with updated drafts of these documents on a quarterly basis as the elements of the industry method evolve. While we do not seek formal comments on these draft materials, any comments you provide, especially on NEI 00-01 and the proposed test parameters, are welcome and will be considered as we move forward.

The structure of the industry method in NEI 00-01 is similar to the BWROG guidance document GE-NE-T43-00002-00-02, "Generic Guidance for BWR Post-Fire Safe Shutdown Analysis." This is done for two reasons: (1) to use the detailed deterministic circuit analysis guidance in the BWROG document that is generally applicable to all plants, and (2) to facilitate NRC staff review of both documents. However, there are significant differences. The terminology in NEI 00-01 is applicable to the industry as a whole, it improves the state of knowledge of how circuits might fail in the event of fire, and incorporates probabilistic methods for determining the safety significance of potential circuit failure issues.

The enclosed schedule for completing the industry guidance and resolving the circuit failure issues assigns a few tasks to NRC. In doing so, we do not presume to dictate NRC priorities and resources. Rather, it is only an attempt to capture the significant tasks and interfaces. We welcome feedback on those as well as any others you might suggest.

We recommend continued NRC staff review of the BWROG document and resolution of issues related to that document. These review efforts will support BWROG goals and be directly applicable to eventual review of NEI 00-01. To facilitate NRC staff review of NEI 00-01, we will provide you a document that details the differences between the two reports by May 31.

Please call me at 202-739-8084 if you have further questions.

Sincerely,

David J. Modeen

FAE/
Enclosures

c: Mr. Joe Birmingham, U.S. Nuclear Regulatory Commission
Mr. Eric Weiss, U.S. Nuclear Regulatory Commission
Mr. Mark Cunningham, U.S. Nuclear Regulatory Commission
Dr. Nathan Siu, U.S. Nuclear Regulatory Commission
Mr. Glenn Warren, BWROG Chairman
Mr. Tom Gorman, BWROG Appendix R Committee Chairman