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MEMORANDUM TO: Joseph G. Gitter, Director  
Division of Risk Assessment  
Office of Nuclear Reactor Regulation

FROM: Richard P. Correia, Director /RA/  
Division of Risk Analysis  
Office of Nuclear Regulatory Research

SUBJECT: TRANSMITTAL OF JOINT NRC-RES/EPRI WORKING GROUP  
TECHNICAL RECOMMENDATIONS ON FIRE-INDUCED  
CIRCUIT ANALYSIS

The purpose of this memorandum is to transmit technical recommendations from the Office of Nuclear Regulatory Research (RES) and Electric Power Research Institute (EPRI) joint working group on fire-induced electrical circuit failure. In a draft user need, your staff requested RES conduct this joint effort to provide technical input to support resolution of outstanding circuit analysis issues. The recommendations may be useful in supporting technical content revisions to Regulatory Guide (RG) 1.189, Revision 2, "Fire Protection for Nuclear Power Plants," and RG 1.205, Revision 1, "Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants." The recommendations could also be useful to consider if there are revisions to NEI 00-01, Revision 2, "Guidance for Post-Fire Safe Shutdown Circuit Analysis" (Agencywide Document Access and Management System (ADAMS) Accession No.ML091770265), proposed by the Nuclear Energy Institute.

The Joint Assessment of Cable Damage and Qualification of Effects from Fire (JACQUE-Fire) program was broken down in to three phases. In phase 1, a Phenomena Identification and Ranking Table (PIRT) exercise was conducted, which identified and ranked the parameters that influence hot short-induced failure modes of electrical control circuits damaged by fire conditions, and provided technical positions on several long standing fire protection circuit issues. Results from this PIRT exercise are documented in Volume 1 of NUREG/CR-7150 (EPRI 1026424), published in October 2012.

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In phase 2, an expert elicitation process was followed to estimate the conditional probabilities of the hot short-induced spurious operation failure mode of the control circuits and its duration, given fire-induced cable damage. The expert elicitation builds on the work of the 2002 EPRI expert elicitation, recent testing, as well as the work completed by the PIRT panel. The results of this program are documented in Volume 2 of NUREG/CR-7150 (EPRI 3002001989) issued in May 2014 and provided support in updating the methodology in NUREG/CR-6850 in the area of failure mode likelihood analysis.

In phase 3 of the JACQUE-Fire program, insights gained from the expert elicitation (Volume 2), reconciled any differences, and provides clarifications to add supporting technical basis to improve guidance and add clarity in the area of post-fire safe shutdown circuit analysis. The technical recommendations transmitted with this memo document were developed in this third phase. Additionally, the working group has reviewed the preliminary results from the recently completed current transformer (CT) testing conducted by Brookhaven National Laboratory. Based on the testing insights, literature, and discussion, the working group has also made a recommendation on the applicability of considering a secondary fire resulting from an open circuit of a CT. A technical report will document the CT testing program and the joint RES/EPRI report NUREG/CR-7150 (Volume 3) will document the working groups' consensus recommendations for treatment of the CT along with the other recommendations made in the enclosed documents.

This memo transmits the joint working group's finalized recommendations that have applicability to the revision of guidance documents such as RG 1.189, RG 1.205, and NEI 00-01. These clarifications and recommendations are enclosed and cover six topics, namely:

- 1) Clarification of proper polarity: Clarifies the circuit failure mode interactions that should be identified as a "proper polarity hot short."
- 2) Hot short duration for ac and dc circuits: Provide prescriptive limits for the duration of a hot-short induced spurious operation of a single component or signal.
- 3) Technical recommendations for multiple spurious operation (MSO) evaluations: This enclosure provides recommendations related to the number of fire-induced circuit failures of a specific type that need to be considered when addressing MSOs.
- 4) Implementation guidance of the PIRT results: This enclosure documents the working group's suggested revisions to draft Appendix J of NEI 00-01.
- 5) Technical basis for implementation guidance of the PIRT results: This enclosure provides the technical justification for the circuit failure type classifications used in the Implementation Guidance of the PIRT results (Item 3 above).
- 6) Technical considerations for designing valve control circuits that include shorting switches.

The final results of phase three will be published in Volume 3 of NUREG/CR-7150. The Volume 3 report will provide the detailed documentation and basis for how these results were developed.

Please contact Gabriel Taylor or Shivani Mehta of my staff if you require any additional information.

Enclosures:  
As stated

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Enclosures:  
As stated

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