UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

May 17, 2012

Mr. R. W. Borchardt
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: DRAFT FINAL NUREG-1921, (EPRI REPORT 1023001), "EPRI/NRC-RES FIRE HUMAN RELIABILITY ANALYSIS GUIDELINES"

Dear Mr. Borchardt:

During the 594th meeting of the Advisory Committee on Reactor Safeguards, May 10-12, 2012, we completed our review of Draft Final NUREG-1921 (EPRI Report 1023001)[1], "EPRI/NRC-RES Fire Human Reliability Analysis Guidelines." Our Reliability and PRA Subcommittee also reviewed this matter during meetings held on June 1, 2009, April 20, 2011, and September 21, 2011. During these meetings, we had the benefit of discussions with representatives of the NRC staff, the Electric Power Research Institute (EPRI), and their contractors. We also had the benefit of the documents referenced.

CONCLUSIONS AND RECOMMENDATIONS

1. NUREG-1921 provides useful guidance for consistent evaluation of human reliability in probabilistic fire analyses that are being performed to support the transition to risk-informed performance-based fire protection programs that meet the requirements of 10 CFR 50.48(c). It should be issued.

2. NUREG-1921 contains comprehensive guidance for the qualitative evaluation of human performance and methods to define human failure events. That guidance should be integrated into the staff's on-going efforts to develop human reliability analysis (HRA) methods in response to Staff Requirements Memorandum SRM-M061020 and then extended to include explicit quantification of timing uncertainties.

3. Guidance for the evaluation of human performance during complex scenarios that involve multiple spurious operations, conflicting information about plant status, and fire damage that may divert operator attention is constrained by the pre-defined scope of the fire probabilistic risk assessment (PRA) models that are addressed in NUREG-1921. Improved guidance for more comprehensive and integrated evaluations of these challenging plant conditions should be included in the methods being developed under SRM-M061020.

[1] Hereinafter referred to as NUREG-1921 for brevity

4. The NUREG-1921 guidance for scoping analyses is useful for the intended purpose to improve efficiency and consistency in PRAs that support the transition to risk-informed performance-based fire protection programs. The applied performance shaping factors, decision models, and technical bases for the recommended human error probabilities should be reexamined as part of the work in response to SRM-M061020.

BACKGROUND

NUREG-1921 was developed to clarify guidance and delineate consistent methods for the evaluation of human performance during fire-induced event scenarios in a PRA. The stated intent of these methods is to satisfy Capability Category II requirements from the 2009 addenda to the ASME/ANS Standard for PRA. It is expected that a primary application of this guidance will be to support fire risk assessments that are currently being performed by several licensees during their transition to risk-informed performance-based fire protection programs that meet the requirements of 10 CFR 50.48(c).

DISCUSSION

There is a need for practical and timely guidance for the consistent assessment of personnel performance in PRAs that support risk-informed fire protection license amendments. Our review of NUREG-1921 was framed in the context of on-going efforts by the staff and EPRI to develop more comprehensive and fully integrated HRA methods in response to Commission direction in SRM-M061020. Within that broader context, NUREG-1921 provides an important interim synopsis of current state-of-the-practice methods that will help HRA practitioners complete their assessments of fire risk and will aid the staff in their reviews of those assessments.

The more comprehensive HRA methods that are being developed in response to SRM-M061020 should apply to the evaluation of personnel performance during all plant operating modes and during event scenarios that are initiated by a broad variety of causes, including fires and other external hazards. Therefore, we expect that key elements of the NUREG-1921 methods and guidance for human response during fire scenarios will be examined further, refined or modified as necessary, and integrated into that larger effort.

NUREG-1921 clarifies high-level guidance in National Fire Protection Association Standard 805 and NUREG/CR-6850 for the evaluation of human performance during fire scenarios, and it expands that guidance for consistent implementation by HRA practitioners. It also contains comprehensive guidance for the qualitative evaluation of human performance and methods to define human failure events in the PRA models. This guidance is a prerequisite for completeness and consistency in the HRA. NUREG-1921 describes three levels of the HRA process: (1) initial screening, (2) intermediate scoping, and (3) detailed quantification. The guidance is consistent with current state-of-the-practice HRA methods, extended to include focused consideration of special conditions that may apply during fire scenarios (e.g., local actions, responses to spurious indications, main control room abandonment, etc.). Application of these methods should improve consistency in the on-going PRA evaluations of human reliability during fire scenarios. NUREG-1921 should be issued.

The NUREG-1921 guidance for the qualitative evaluation of human response scenarios, assessment of the feasibility of proposed actions, development of scenario-specific timelines, and characterization of uncertainties in personnel response times is comprehensive and well developed. It should be integrated into the guidance and methods that are being developed in response to SRM-M061020 and then extended to include explicit quantification of the timing uncertainties.

The NUREG-1921 guidance is specifically intended to satisfy the requirements for Capability Category II analyses under the ASME/ANS PRA Standard for fire risk assessment. Those requirements introduce constraints that affect both the scope and level of detail in the HRA methods, guidance, and analyses. For example, NUREG-1921 contains guidance for the evaluation of personnel responses during scenarios that involve fire-induced spurious signals. However, the reference ASME/ANS Standard limits the extent of fire damage that must be evaluated to meet Capability Category II requirements. The HRA guidance for scenarios that involve fire-induced spurious signals is then based on the presumption that at least one set of equipment and indications required to achieve and maintain safe shutdown conditions are not damaged by the fire, and the operators can use the available undamaged instrumentation and their procedures to reliably determine the plant status. Thus, the NUREG-1921 guidance does not fully address personnel performance during scenarios when fire damage may affect multiple divisions of instrumentation, protection and control signals, and main control room displays.

NUREG-1921 acknowledges that current state-of-the-practice HRA methods do not adequately address human response during potentially complex scenarios that may involve multiple spurious operations and fire damage that affects several main control room indications. Many current HRA methods do not address fire-induced failures of equipment or support systems that are not explicitly modeled in the PRA. Failures of these systems can distract the operators' attention away from performing the desired PRA-modeled responses. Actual fire events have shown that complex damage scenarios can produce confusing information about the plant status; introduce conflicting priorities; and cause delayed, incorrect, or improper decisions that affect personnel performance. These issues are noted and addressed qualitatively in NUREG-1921, but they are not explicitly included in the guidance for screening, scoping, or detailed quantification. Improved guidance and quantitative methods for the evaluation of human performance during scenarios that involve extensive fire damage, multiple spurious operations, and other challenging plant conditions that can divert operator attention from focused PRA actions should be developed as part of the efforts under SRM-M061020.

The intent of the scoping analysis methods and guidance that are described in NUREG-1921 is to eliminate the excessively conservative human error probabilities (HEPs) that were developed during initial screening assessments by applying a process that requires less time and effort than a detailed HRA. The scoping analysis flowcharts, decision criteria, and recommended HEP numerical values provide internal consistency for these intermediate assessments. Therefore, they are useful as practical simplifications for the on-going fire risk assessments. However, these methods and the technical bases for the recommended HEPs have not been

thoroughly examined or substantiated within the context of the broader scope of human performance evaluations and HRA methods that are being developed in response to SRM-M061020. For example, the selected performance shaping factors, flow sheet branching logic and decision criteria, and specific numerical HEPs may not be fully consistent with the evolving integrated analysis framework. These interim scoping methods should be carefully reexamined as part of that larger effort.

We look forward to our continuing interactions with the staff during the development of these comprehensive HRA methods.

Sincerely,

/RA/

J. Sam Armijo
Chairman

REFERENCES

1. U.S. Nuclear Regulatory Commission and Electric Power Research Institute, "EPRI / NRC-RES Fire Human Reliability Analysis Guidelines," NUREG-1921, EPRI 1023001, March 2012 (ML120790453).

2. Staff Requirements Memorandum M061020, November 8, 2006 (ML063120582).

3. ASME/ANS RA-Sa-2009, Addenda to ASME/ANS RA-S–2008, "Standard for Level 1 / Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," American Society of Mechanical Engineers, New York, NY, February 2009.

4. National Fire Protection Association (NFPA) Standard 805, "Performance-Based Standard for Fire Protection for Light-Water Reactor Electric Generating Plants," 2001 Edition, National Fire Protection Association, Quincy, MA.

5. U.S. Nuclear Regulatory Commission and Electric Power Research Institute, "EPRI / NRC-RES Fire PRA Methodology for Nuclear Power Facilities," NUREG/CR-6850, EPRI 1011989, September 2005 (ADAMS Accession Nos. ML052580075 and ML052580118).

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Letter to R.W. Borchardt, Executive Director for Operations, from J. Sam Armijo, ACRS Chairman, dated May 17, 2012

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