

Technical Advisory Committee of the Nuclear Risk Research Center  
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May 27, 2017

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**SUBJECT: CURRENT STATUS OF FIRE PRA RESEARCH ACTIVITIES**

Dear Dr. Apostolakis:

During the seventh meeting of the Technical Advisory Committee of the Nuclear Risk Research Center (NRRC), May 22-26, 2017, we met with representatives of the NRRC staff and their contractor to discuss the current status of the Fire Probabilistic Risk Assessment (FPRA) research activities. The purpose of the presentation was to discuss the NRRC's approach and to get early feedback on the suitability of the proposed activities and the resulting near-term and long-term products.

### **CONCLUSIONS AND RECOMMENDATIONS**

1. The scope of the proposed guidelines (i.e., what needs to be done) is consistent with the state of practice FPRA guidance available internationally.
2. Due to the acknowledged changes in the NRRC guidance compared to that provided in NUREG/CR-6850, potential changes to the fire frequency and heat release rate estimates, and the first use of these methods in Japan, a full and integrated pilot application of the proposed guidelines should be conducted before they are issued for general use.
3. The proposed fire frequency and fire severity enhancement activities are very important. The guidance document should provide cautions against premature screening of the fire events. Additionally, the updated fire frequency and fire severity estimates should be compared to and contrasted with similar estimates suggested by other internationally recognized guidance documents (such as the updated estimates in NUREG/CR-6850, Supplement 1), and justifications for all significant differences should be provided.

## **BACKGROUND**

Fire hazard has been recognized to be a major challenge to safe operation of nuclear power plants. As a result, for many years both prescriptive and risk-informed methods have been used to minimize the risk of fires. The use of a risk-informed approach in the U.S., as part of the transition to a fire protection program based on NFPA-805, has been recognized by both industry and the NRC to have resulted in significant safety improvements. However, those efforts have also demonstrated that the FPRA methods, as delineated in the 2005 version of NUREG/CR-6850, include many conservatisms that result in unrealistic characterization of the fire risk. As a result, NRC and EPRI have taken advantage of documents produced through the NFPA-805 Frequently Asked Question (FAQ) process to (1) update the NUREG/CR-6850 guidance in a number of areas, including fire heat release rate (HRR) and fire frequency estimates and (2) are continuing work on additional enhancements.

In consideration of this experience, the NRRC is working on improving methods and providing additional guidance and refinements for conducting FPRA in Japan. Our briefing on these activities included a discussion of the following topics:

1. Fire PRA Guide Development
2. Fire Event Frequency for Japanese NPPs
3. Current status of recommendations from TAC meeting #3

This letter report provides our observations and recommendations on the first two topics.

## **DISCUSSION**

The following observations and comments are based on the summary overview material presented during our meeting and our discussions of that material with the NRRC staff and their consultants.

### ***Fire PRA Guide Development***

It was explained that the Japanese utilities plan to perform an internal FPRA as part of their future state-of-the-practice PRAs. This FPRA will be used in a yet to be developed risk-informed decision making process for safety improvements, as well as risk-informed operational decision making. To support consistent conduct of these studies, NRRC is developing a fire PRA guide that will assist in developing realistic FPRAs. It was also stated that, although NUREG/CR-6850 will be used as a starting platform for developing this guideline, the NRRC is changing the breakdown of the NUREG/CR-6850 structure. The presentation included the proposed changes to the structure, but limited information was presented on the technical content of the guidance. These changes include a phased approach (Phase A and Phase B), as well as changes to the order of tasks to be performed compared to the steps provided in NUREG/CR-6850. The stated objective of the proposed changes is to improve the efficiency of conducting a FPRA. One example of a reorganized task is development of a Fire-Induced Plant Response Model (NUREG/CR-6850, Task 5).

However, based on the discussions during the presentation, it was not clear how the proposed changes would result in the desired outcome (i.e., improve efficiency). Additionally, we are concerned that such a change from a well-established and exercised practice may result in unintentional complexity and inefficiency, and may not be warranted. However, we acknowledge that the briefing material presents only a rather high-level concept, and we encourage the NRRRC team to provide more details when the approach is fully developed. Considering these changes and the fact that these methods have never been used in Japan, a full pilot application should be conducted to assess the practicality and reasonableness of the proposed guidance, as well as other related work such as improvements of the fire frequency and HRR estimates.

### ***Fire Event Frequency for Japanese NPPs***

It was reported that the NRRRC intends to use fire event frequency data from the Nuclear Information Archives (NUCIA) database, which contains records of the Japanese nuclear power plant operating experience. We were also informed that NRRRC plans to conduct confirmatory interviews and research to develop supplemental plant-specific fire event data and fire frequency estimates. A relatively detailed description of the proposed guidelines for the fire event analysis, including the data in NUCIA and an event screening approach, was presented. Systematic examination of the operating experience in Japan is highly beneficial. However, it is difficult to assess the reasonableness of the outcome without a detailed review of the fully developed guidelines, the quality of the data provided in NUCIA, and the content of the confirmatory activities. Additionally, it seems that the proposed screening approach may incorrectly remove some events from the database. That practice could result in fire event frequency estimates that are not consistent with actual operating experience. For example, screening criteria that are based on selected plant locations and specific systems do not seem consistent with criteria that are used to compile similar fire event data in other countries.

It would be very beneficial for NRRRC to fully brief us on the proposed fire event data collection methods and screening criteria before they are implemented throughout the industry. Additionally, the updated fire frequency and fire severity estimates should be compared to and contrasted with similar estimates suggested by other internationally recognized guidance documents (such as the updated estimates in NUREG/CR-6850, Supplement 1), and justifications for all significant differences should be provided.

Sincerely,



John W. Stetkar  
Chairman

## REFERENCES

1. "Current Status of the Fire PRA Research Activities," NRRC Staff Presentation to NRRC Technical Advisory Committee, May 23, 2017 (confidential).
2. 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.
3. U.S. Nuclear Regulatory Commission and Electric Power Research Institute, "Fire Probabilistic Risk Assessment Methods Enhancements," NUREG/CR-6850, Supplement 1, EPRI 1019259, September 2010.
4. National Fire Protection Association, "NFPA 805: Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants", 2001 Edition, February 2001.
5. Electric Power Research Institute, "Fire PRA Methods Enhancements: Additions, Clarifications, and Refinements to EPRI 1019189," EPRI 1016735, Interim Report, December 2008.