December 11, 2013

MEMORANDUM TO: Hossein G. Hamzehee, Chief
PRA Licensing Branch
Division of Risk Assessment
Office of Nuclear Reactor Regulation

FROM: Garrett A. Newman, Reliability and Risk Analyst ***/RA/***
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SUBJECT: SUMMARY OF NOVEMBER 14, 2013 CATEGORY 2 MEETING REGARDING FIRE PROBABILISTIC RISK ASSESSMENT FREQUENTLY ASKED QUESTION 13-0002 – MODELING OF MAIN CONTROL ROOM ABANDONMENT ON LOSS OF HABITABILITY

On November 14, 2013, the U.S. Nuclear Regulatory Commission (NRC) staff held a Category 2 public meeting with the nuclear industry and the Nuclear Energy Institute (NEI) to discuss fire probabilistic risk assessment (FPRA) Frequently Asked Questions (FAQ) 13-0002 – Modeling of Main Control Room (MCR) Abandonment on Loss of Habitability (LOH). To advance the discussions on the FAQ, the industry provided the following documents to the NRC staff prior to the meeting:

- MCR Abandonment General Screening Criteria for Section 2-2, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML13232A281)
- Attachment A - Examples of Complexity for MCR Abandonment Action, (ADAMS Accession No. ML13232A245)
- Attachment B - MCR Abandonment Screening HRA [Human Reliability Analysis] Examples (ADAMS Accession No. ML13232A302)
- FPRA-FAQ 13-0002 (Control Room Abandonment on Loss of Habitability) (ADAMS Accession No. ML13249A249)

Moreover, the NRC staff provided the following document to the industry prior to this public meeting:

- NRC's Recommendations for MCR Abandonment HRA - Loss of Habitability (ADAMS Accession No. ML13311B388)

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- NUREG-1921 Based Event Tree for Loss of Habitability (ADAMS Accession No. ML13311B459)

A summary of the topics discussed at this meeting is provided below:

- The NRC staff began the meeting by expressing its desire to move forward on the issue of modeling MCR abandonment in a consistent manner. Finalizing guidance will assist the staff in reviewing license amendment requests (LARs) and the industry in submitting LARs and responding to requests for additional information (RAIs).

- The NRC staff noted that MCR fires can be significant to FPRAs and abandonment due to LOH is a part of the MCR analysis. The NRC staff has issued RAIs when licensees apply a 0.1 human error probability (HEP) to their abandonment analysis without sufficient justification. The industry started FAQ 13-0002 to clarify the expectation for modeling of MCR abandonment since further guidance than NUREG-1921 is needed to address the multitude of remote shutdown configurations in nuclear power plants (NPPs). The scenarios evaluated in this FAQ are limited to loss of habitability, and exclude loss of control.

- The NRC gave a brief overview of the methodology used to generate the provided document, “NRC's Recommendations for MCR Abandonment HRA - Loss of Habitability,” hereafter referred to as NRC Recommendations Paper. The NRC used a number of the industry examples from the reference documents as a springboard to formulate the NRC position. The industry provided comments on the NRC Recommendations Paper. The industry stated that they generally agreed with the approach taken in the NRC Recommendations Paper with a number of areas for discussion. The NRC also provided “NUREG-1921 Based Event Tree for Loss of Habitability” prior to the meeting. In keeping with above, the industry indicated that these event trees did not did not go far enough to provide the sought after clarification.

- The industry began a discussion on the base case representing a 0.1 HEP presented by the NRC. NRC established this base case, as a first step, to identify the particular shutdown configuration which would surely meet the 0.1. Industry made the point that the base case was actually an ideal remote shutdown configuration. Industry was concerned that the base case conditions might be interpreted as the minimum requirements for meeting a 0.1 HEP, despite NRC’s identification of relaxations to the base case that would still constitute a 0.1 HEP. In response to industry’s questions along this line, the staff agreed that the requirements for the base case might well merit an HEP of less than 0.1, subject to verification by a detailed HRA. The NRC staff agreed to strengthen the language in the paper to reflect that the base case is a starting point from which relaxations may be made, and not the minimum conditions to meet an HEP of 0.1

- The NRC allowed that additional relaxations to the base case could be identified by industry, given adequate justification. NRC indicated that the relaxations in the NRC Recommendations Paper could not be attributed to relaxations of the baseline criteria on a one to one basis, but were rather developed with particular examples in mind and thus capture its views in a more integrated manner. The industry was concerned with the sentence – “For all of the above relaxations, ALL other plant conditions and action

characteristics specified in the base case must be met for it to be an acceptable relaxation." NRC did say there was a limit to the number of relaxations that could be taken. In order to determine that the overall relaxations were acceptable for a particular application, industry needed to do an integrated assessment on all relaxations to ensure that there are no unintended consequences.

- One particular relaxation was discussed in length. The industry provided comments on the NRC's proposed relaxations from the base case. In particular, there was much discussion on item 1 under section 4.2 of NRC Recommendation Paper. Industry indicated that the "locations" criterion was not a good measure. Different plants organize operator actions via procedures differently. Some plants have one operator doing essentially all actions required for a specific location. Another plant organizes operator actions by function, rather than by location. Industry proposed that other criteria such as the number of operators or functions might be better. The staff stressed the importance of travel time between locations and the correct order of actions. The industry took an action to propose revised wording and examples for this relaxation. Along these lines, the NRC and industry discussed whether command and control represents a "countable" local action.

- Furthermore, the NRC and industry discussed the amount of coordination necessary to make gross or coarse control of plant equipment. The industry took an action to propose a new relaxation for such actions.

- With regards to cognition and complexity and main control room abandonment, the NRC was under the impression that industry's position was that cognitive complexity only existed in the decision to abandon the control room. After much discussion, industry recognized that NRC's point that all actions should be examined for both cognitive and execution complexity contributions. For example, a procedure to execute an action may reference multiple cues prior to taking certain actions, and the process of identifying and using such cues involves cognition (which may be complex or "simple" depending on the cues, procedural guidance, and other factors). On the other hand, industry pointed out that a procedure for a field operator may consist of an independent set of straightforward steps that require minimal cognition. NRC's position in this discussion was that the HRA approach must recognize that complexity can play a role in the success or failure of both cognition and execution. Also, there are times when the contributions from cognition and execution (along with any concerns for complexity) are distributed between command-and-control (or in-control room) operators and field operators, respectively.

- The NRC and industry also discussed workload impacts on cognitive complexity. Specifically, plant employees, such as radiation protection technicians, interrupting the senior reactor operator (SRO) in command and control can contribute to cognitive complexity, in particular, if coordination or time-sequencing of actions under his command and control is required. Administrative and/or physical barriers can be used to reduce this aspect of complexity.

- The NRC also noted that the industry introduced a new timing concept in their examples different from the "time margin" identified in NUREG-1921. In this vein, the NRC and

industry discussed the proposed minimum time margin for required actions. The NRC proposed a relative time margin of two in their Recommendations Paper, as opposed to an absolute time margin in industry's examples. NRC, through discussion with industry, acknowledged there may be instances of highly-trained actions where less time margin than two is appropriate (e.g., emergency operating procedure [EOP] memorized immediate actions such as reactor coolant pump [RCP] tripping, opening reactor trip breaker(s), turbine trip, inadvertent safety injection [SI]). Licensees would need to provide additional information on the reliability of the action to qualify for a smaller time margin. As a part of that discussion, NRC pointed out that an extra time cannot compensate for any condition. The industry agreed to develop examples of actions and conditions which would warrant a smaller time margin than two. NRC agreed to work on the guidance after receiving industry's examples. An alternative to the NUREG-1921 factor of two as a screening factor was raised based on NUREG-1852, Appendix B, expert results.

- The industry discussed feasibility. The NRC noted that the industry approach in Attachment B seemed to mix feasibility and reliability, whereas feasibility is a standalone test. Both parties agreed that feasibility is adequately defined, and does not need to be revisited as a part of this FAQ.

- The industry and NRC discussed the binning approach discussed in the proposed revision to FAQ 13-0002. The industry stated that the binning approach followed accepted HRA practices. The industry's approach bins scenarios based on the conditional core damage probability (CCDP) of the equipment plant state before abandonment, but does take into account the HEP of abandonment. The industry maintained that this CCDP is indicative of the difficulty of the actions required to stabilize the plant. A low, moderate, and high CCDP of one are proposed in this binning approach. The staff indicated that this discussion needed to be bolstered if kept, or discarded if the whole approach does not add value and could be justified on the grounds of good HRA practices.

- Along these lines, NRC indicated that it has issued an RAI which distinguishes between scenarios for main control room abandonment. The meeting participants acknowledged in this meeting they were trying to understand the shutdown configuration which would qualify for the lowest HEP. NRC staff indicated that a very complicated shutdown scenario represented by a CCDP of one is another prong of the RAI which needs to be addressed; however, this scenario would be relatively easy to define. NRC acknowledged that the group needed to make progress on identifying and characterizing an intermediate probability which could characterize a complicated shutdown which warranted credit, yet less credit than the uncomplicated shutdown scenario being worked at this meeting. The middle range is difficult to establish and may rely on quantitative and qualitative considerations which would give NRC confidence of the applied probability. Another meeting would likely be needed to address the intermediate probability.

- The NRC and industry briefly discussed training requirements for local actions to control plant equipment. The NRC stated that simulator training would be ideal, but a job

performance measure or walkdown can be sufficient as long as the operator is familiar with the expected plant response.

- The NRC staff introduced the issue of short-term actions needed to protect and establish electrical power to prevent long-term core damage. The industry agreed to propose an approach to dealing with these issues.

- NRC described its viewpoint on local control of multiple plant parameters, especially those for which there is a dependency between the parameters via plant response/behavior (e.g., reactor coolant system [RCS] injection and auxiliary feedwater [AFW] flow or steam generator [SG] level control). In addition, NRC explained how additional communication and coordination is required for control of multiple plant parameters (especially now that these actions are not performed at the same location with a common procedure and supervision). NRC explained why the relaxations identified were acceptable and, more particularly, why the example involving control of multiple plant parameters needed to involve only one local control action, another control action at the alternate shutdown panel (ASD), and command-and-control in the ASD. The industry agreed with the NRC on the distinctions described regarding local control of plant parameters.

The NRC and industry developed a list of action items as a result of the meeting. A schedule for completion will be developed separately. Regarding the NRC Recommendation Paper, the following action items resulted.

1. (NRC) Revise discussion for ideal case to indicate this is an anchor for deviations, not a minimum requirement for 0.1 HEP.

2. (Industry) Add discussion/examples for Section 4.2 entitled Acceptable Relaxations on the criterion “limited number of multiple locations,” allowing the use of a feasibility study to support your arguments (Relaxation 1).

3. (Industry) Provide suggested relaxation for communications for coarse control of plant equipment (e.g., simple “open valve” or “close valve” commands versus continuous communication needed to control SG level within a certain range) (consider using Example Plant A from the NRC Recommendations Paper).

4. (Industry) Regarding workload and associated cognitive complexity, provide justification for allowing the operator responsible for command-and-control (e.g., SRO) to also perform actions at the ASD (Relaxation 6).

5. (Industry) Propose list of actions that meet time margin less than 2. Note: Action 5 relates to the amount of justification needed to justify actions with a time margin less than 2 (e.g., EOP memorized immediate actions such as RCP tripping, opening reactor trip breaker(s), turbine trip, inadvertent SI) (Relaxation 7).

6. (Industry) Propose refinements to NRC Recommendations Paper and recommendations for inclusion in FAQ.

7. (Industry) Supplement discussion on minimal cognition (e.g., cues, preemptive actions, procedures) to support contribution of cognition to HRA, including that related to complexity.

8. (Industry) Recommend electric power establishment relaxation approaches.

With regards to FAQ 13-0002, the following actions were identified.

1. (NRC) Provide comments on FAQ.

2. (Industry) Add detail to binning discussion to address NRC comments or remove. (Note that the removal of the discussion implies that the discussion in total does not add value to describing the quantification approach and relies solely on good HRA practices).

Meeting notice and agenda for this public meeting is available at ADAMS Accession No. ML13302C165.

A list of meeting attendees is enclosed with this memorandum.

Enclosure:
As stated

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Enclosure:
As stated

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ADAMS Accession No. ML13343A180

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FIRE PROBABILISTIC RISK ASSESSMENT
FREQUENTLY ASKED QUESTION 13-0002

LIST OF ATTENDEES

November 14, 2013

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Stakeholders

P. Amico (Hughes Associates, Inc.)
J. Julius (Scientech)
A. Bittlemann (EPM)
D. Miskiewicz (EPM)
V. Anderson (Nuclear Energy Institute)
A. Lindeman (Electric Power Research Institute)
M. Presley (Electric Power Research Institute)
K. Gavin (Appendix R Solutions)
K. Kohlhepp (Scientech)
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G. Loignon (V.C. Summer)*
W. McDevitt (AREVA)*
B. Meyer (PROS)*
A. Ratchford (RDS)*
D. Shoemaker (PSEG)*

*participated via phone

Enclosure