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General Comment

Comments on Draft NUREG 1921

Attachments

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Subject: Comments on Draft NUREG-1921 (EPRI 1019196)
Docket ID: NRC-2009-0550

Dear Mr. Lesar:

On behalf of the Human Reliability Analysis (HRA) Tools Users Group, thank you for the opportunity to submit the attached comments on draft NUREG-1921 (published concurrently as EPRI 1019196). These comments were invited by a Federal Register Notice published December 11, 2009.

The HRA Tools Users Group is comprised of 28 organizations under the sponsorship of the Electric Power Research Institute (EPRI). Membership of the Users Group includes nearly every utility that operates a nuclear power plant in the U.S. The purpose of the Users Group is, working through EPRI, to develop and refine practical methods for HRA, create tools to facilitate the use of these methods, and to promote consistency and quality in the results that are obtained.

NUREG-1921 is an important resource in providing the guidance needed to complete human reliability analyses in support of probabilistic risk assessments (PRAs) being conducted to address the risk of fire at nuclear power plants. It is clear, however, that there are areas in which further development, revision, and clarification of the guidance in NUREG-1921 is necessary to make it effective in meeting the needs of those who need to use it. The attached comments address these areas in what is intended to be specific and constructive ways.

After the guidance is revised, we believe that it is essential that it be tested through a full-scale pilot application. It would be a mistake to put this guidance into widespread use without such a demonstration and without adjusting the guidance to account for the lessons learned.

We recognize that some of these comments will require more than minor revision to the content of NUREG-1921, and that the pilot application would take additional time. It is important to both the NRC and the nuclear industry that this guidance is made available in a timely manner to support ongoing fire PRAs and those that are just getting underway. It is more important, however, to ensure that the guidance provided is adequate and effective. We therefore urge both the NRC and EPRI to adjust plans as necessary to account for these activities.

If you have questions or require clarification about any of the comments, please don't hesitate to contact me (Zouhair.Elawar@aps.com or 623-393-5328) or Stuart Lewis, the EPRI Project Manager for the HRA Tools Users Group (slewis@epri.com or 865-966-8014).

Respectfully,

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Enclosure: Comments on NUREG-1921

COMMENTS ON NUREG-1921
EPRI/NRC-RES FIRE HUMAN RELIABILITY ANALYSIS GUIDELINES

HRA TOOLS USERS GROUP

Members of the HRA Tools Users Group have performed an extensive review of draft NUREG-1921. Many of the members represent organizations that would expect to use these guidelines in support of plant-specific probabilistic risk assessments (PRAs) for fire. These comments therefore reflect areas in which improvements are needed to make the guidance clearer and more effective from the perspective of end users.

General comments regarding the nature and content of the guidelines are provided first, followed by more specific comments. Reviewers also noted many instances in which editorial changes were needed to clarify wording or to correct errors. Except where these editorial changes were necessary to make the guidance adequately clear, these editorial comments are not provided here. It is expected that large parts of the report may be further revised, and careful editing should be done at that time.

General Comments

1. The guidance in this report constitutes a very comprehensive treatment of HRA in the context of fire scenarios. The guidance should not be considered to be final until it has been subjected to a thorough pilot application.

2. There is a substantial amount of useful and interesting information presented in the report. The guidance presented in the report could be made much more useful if it were more clearly identified as such. In some cases, that would be aided by relegating some of the background information to secondary sections or to appendices. As it is currently written, the guidance is often buried in detailed discussions of various issues.

3. The amount of effort required for qualitative analysis, and in particular for the feasibility assessment, does not seem commensurate with the concepts of screening and scoping analyses. Clear guidance should be provided regarding the qualitative analysis that should be completed for each level of quantification.

4. The usefulness of the guidance would be significantly enhanced if there were a clearer gradation relative to the capability categories from the ASME/ANS PRA Standard. As it is written, the guidance seems generally to go beyond what would be needed to satisfy Category II requirements.

5. Section 8 provides a discussion of uncertainty analysis. This section is generally not very helpful with respect to the treatment of uncertainty for fire HRA, and contains somewhat confusing information. This section should be re-written to provide a clearer discussion of the important sources of uncertainty and corresponding guidance for addressing these sources in the fire HRA. More detailed comments and examples are provided in the specific comments for this section.

Specific Comments

Section 2 – Fire HRA Framework

2-1 Item 1 under Section 2.2 is representative of a number of places in the report in which the concepts of "human actions" and "human failure events" are used in a confusing manner. In this item, the real reference should be to identify relevant actions, for which human failure events may need to be subsequently defined and evaluated. This confusion leads, for example, to later references to "determining the feasibility of HFEs", which makes no sense. It should also be noted that, while the rest of the items in this list refer to activities that comprise the fire HRA process, the list under item 1 is of different types of HFEs (or actions), not steps in the process.

Section 3 – Identification and Definition

3-1 There seems to be a disconnect between the manner in which actions and HFEs are identified and the way in which the fire PRA actually evolves. The HRA is not a separate, independent analysis. Rather, the HRA is conducted in the context of the fire scenarios and the manner in which those fire scenarios are incorporated into the fire PRA. Restructuring of Section 3 should be considered with that relationship clearly in mind.

Section 3 – Identification and Definition

3-1 Table 3-1 presents possible undesired actions that might result from spurious indications under certain circumstances. These entries are not very illuminating, since there are multiple instruments (which might allow screening, according to the guidance provided in Section 3.5.2).

Section 4 – Qualitative Analysis

4-1 Much of the guidance presented in this section is embedded in detailed discussions. It would be very helpful to users if the guidance were made more definitive and presented in a clearer fashion. Some of the background discussion, while of potential value, may better be reserved for an appendix to avoid further diluting the actual guidance.

4-2 Much of the discussion of performance shaping factors (PSFs) in Section 4.3 does not lead to actual guidance for making use of the information. Some of these PSFs are taken into account in the scoping approach, and more are addressed explicitly or implicitly in the detailed approaches. Others, however, don't appear to be addressed at all. If there is important, relevant guidance that should be considered in evaluating and incorporating these PSFs, this guidance should be provided. Otherwise, the discussion is of limited usefulness.

4-3 Much of the discussion of timing in Section 4.3.2 centers on demonstrating feasibility. Much of the feasibility assessment is discussed in other parts of the report as well. From the standpoint of simplification and usability, it is recommended that this discussion not be repeated, but rather that the discussion clearly address the level of detail in this task appropriate for the three tiers of quantification approaches.

Section 5 – Quantification

5-1 The application of screening values for HFEs carried forward from the internal-events PRA distinguishes between scenarios in which there might be limited distraction due to spurious alarms and indications (set 1) and those in which such distractions might be present (set 2). It is not clear why there should be such a distinction for long-term actions, relevant well after the fire is likely to have been suppressed.

5-2 Guidance for performing a scoping analysis calls for performing a very detailed assessment of feasibility and timing that would seem to go well beyond what would ordinarily be expected for a scoping approach. Careful thought should be given to defining a more limited qualitative analysis that will still support a scoping-type analysis.

5-3 The report acknowledges in a footnote that there is a need for further consideration of walk-throughs vs. talk-throughs. For a scoping analysis, a talk-through of the relevant scenario should be adequate. It may be that additional guidance regarding what constitutes an appropriate talk-through would be useful.

5-4 The discussions of demonstrating feasibility and determining timing should highlight further that existing information from, for example, previous feasibility demonstrations and the establishment of job performance measures, should be used to the extent that they are available. This will help to limit the perception that extensive new demonstrations would be needed to support a scoping analysis.

5-5 Section 5.2.10 should start with a clearer definition of what constitutes "primary cues or instruments affected by the fire" and the implications with respect to what sorts of EOOs or EOCs might result. Some of this is information can be found in this section, but some is not provided explicitly.

5-6 To some degree, cumulative conservatisms seem to result from the manner in which time margins are defined and used in the scoping analysis. For example, complex actions result in a penalty that the time margin must be 200%. The time required for cognition and execution should, however, already reflect longer times for complex actions.

5-7 The use of the time margin leads to specific results that do not seem consistent with a reasonable scoping assessment. For example, lookup item E in Table 5-2 applies to cases in which the action takes place in the main control room (MCR), execution is not complex, and there is no smoke or other hazardous element in the MCR. The probability of failure is limited to 0.25 for cases in which there is a time margin of at least 100%, and 1.0 for cases in which the time margin is less than 100%.

5-8 There is an apparent inconsistency with regard to consideration of complexity in the cognitive and execution phases for the scoping analysis. Complexity during cognition is not addressed explicitly, but rather appears to be addressed implicitly through the response time. Complexity in execution is addressed explicitly in the flowcharts, although the execution time would (presumably) be longer for complex actions as well (see comment 5-6 above).

5-9 Some of the scoping HEPs in Table 5-2 are presented to three significant digits. This implied level of precision is not warranted for HRA in general, and seems particularly inappropriate for a scoping analysis.

Section 6 – Recovery

6-1 This section has very little information that is specific to fire HRA. The content does not warrant including this as a separate section.

Section 7 – Dependency Analysis

7-1 Section 7 should be restructured. Section 7.1 is entitled "Qualitative Dependency Analysis", but in fact it provides what quantitative guidance there is for detailed modeling. In fact, the approach is intended to be applied to both actions assessed using the scoping approach and those evaluated using the detailed EPRI methods. At the end of Section 7.1, it is noted that ATHEANA treats dependencies differently.

7-2 The discussion in Section 7.1 appears to be directly associated with the treatment of dependencies in the EPRI HRA Calculator. No guidance is provided that is specific to fire HRA. It would seem appropriate to point out considerations associated with the availability of adequate cues, operating crew, etc., that might be somewhat unique to fire scenarios.

7-3 Section 7.2 provides a brief discussion of the treatment of dependencies for screening and scoping analyses. The discussion of screening analyses should be stated more positively such that it starts with a determination that the combined actions are feasible for the scenarios of interest, and then asserts that no further adjustment to account quantitatively for dependence is needed (once feasibility is confirmed).

Section 8 – Uncertainty Analysis

8-1 Section 8.1 contains an introduction to concepts associated with uncertainty analysis. The discussion of these concepts does not contribute to formulating guidance relating to the assessment of uncertainties in fire HRA and is poorly written. Moreover, some of the discussion of the various terms and considerations is confusing or misleading. For example, Section 8.1.1 purports to address the distinction between uncertainty and randomness, but only identifies the nature of randomness. In addition to being of little value to the guidance, the intent is unclear. Another example relates to the discussion of parameter uncertainty. Section 8.1.3.1, jumps directly from a high-level discussion of uncertainty concepts and a brief definition of parametric uncertainty to a discussion of error factors as the means of characterizing statistical variation in estimates of human error probabilities (HEPs). The discussion does not explain why this is the case, nor point out that the parameters used to characterize uncertainties in HEPs, at least in some cases, attempt to address modeling uncertainty as well. The discussion does not point out that the error factor is unique to the lognormal distribution, or discuss why the lognormal is the appropriate. It also needlessly presents the relationships among various parameters of the lognormal distribution.

This section should be re-written to provide clear (and appropriate) guidance for the treatment of uncertainties in fire HRAs. The companion reports NUREG-1855 and EPRI 1016737 should be reviewed for more useful guidance in this area.

8-2 The proposed treatment of uncertainty for the screening analysis is entirely inappropriate. If the results are, indeed, of a screening nature, they are not representative of any measure of central tendency. They should not be treated as the mean values of a lognormal distribution. Any consideration of uncertainty associated with scenarios in which screening values are applied should be focused on sensitivities.

8-3 In Section 8.2.2, the notion that the point estimates from the scoping analysis correspond to median values is introduced for the first time. Nothing in the discussion of the scoping analysis in Section 5 suggests that that is the case. Indeed, on p. 5-11 the statement is made that "Conservative HEPs are also assigned to help bound the uncertainties". Thus, constructing a probability distribution about a scoping result is inappropriate as well.

8-4 The justification for the THERP error factors does not need to be repeated in this report; it adds nothing to the discussion.

Appendix A – Fire PRA Standard and the Fire HRA Guidance

A-1 Some of the supporting requirements for which related guidance is provided in NUREG-1921 are not addressed in Table A-2. This table should be reviewed to assure that it provides a proper mapping. Making the guidance clearer will aid in this process.

Appendix B – Fire Event Review

B-1 The experience summarized in Appendix B reflects only three relatively severe events, from which a broad set of conclusions is drawn. This experience does not reflect that associated with many smaller fires that both have occurred and that are evaluated in fire PRAs. It seems likely that such elements as the conservatisms in the scoping approach (including the assessment of time margin and feasibility) and in the perception of fire stress are influenced by this skewed view of response to fires offered by this limited experience base.

Appendix C – Detailed Quantification of Post-Fire HFEs Using EPRI Methods

C-1 The references to standard requirements should be updated to relate to the current version of the ASME/ANS standard.

C-2 The discussion of the value for σ in Section C.6.4.1 is an example of an area in which more definitive guidance would be far more useful to the analyst. Much more specific criteria for when to apply upper-bound values is needed. Note 5 to Table C-14 is particularly unhelpful; if values for the bounds are to be provided for response type CP3, they should be identified as carefully as possible, rather than presented as placeholders, with a caution to users.

C-3 The upper and lower bounds are presented in EPRI TR-100259 as the 90^{th} %-tile bounds (95^{th} and 5^{th} %-tiles, respectively). That appears to be how they are treated in NUREG-1921 as well, but they are characterized as the 80^{th} %-tile values in Table C-14. What is the rationale for this treatment?

C-4 The concept of fire stress needs to be considered further. It is not clear that fires in general present such severe conditions relative to other accidents that they require a unique assessment of the impact of stress. The only guidance regarding when to apply this factor is when two or execution PSFs are negative, or when communications are impeded. There may, in fact, be conditions that result in a higher effective workload because of distractions due to numerous alarms and spurious indications (not necessarily directly related to the action of interest). This, however, would primarily relate to cognitive response. Execution stress should be increased beyond moderate or high only for particularly severe scenarios. The rationale for a fire-stress multiplier should be documented more fully, and more explicit guidance for its use should be provided.

Appendix D – Detailed Quantification of Post-Fire HFEs Using ATHEANA

D-1 There is far less explicit or useful guidance provided for ATHEANA than is the case for the EPRI methods discussed in Appendix C. The implication is that ATHEANA is discussed to make the report more comprehensive, but that the perception (probably accurate) is that ATHEANA won't actually be used in the fire PRAs.