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Office of Administration
Mail Stop TWB-05-B01M
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: BWROG Comments on "NUREG–1921 (EPRI 1019196), EPRI/NRC–RES Fire Human Reliability Analysis Guidelines, Draft Report for Comment," Docket ID NRC-2009-0550

ATTENTION: Michael T. Lesar
Chief, Rulemaking and Directives Branch (RDB)
Division of Administrative Services
Office of Administration
Mail Stop: TWB–05–B01M
U.S. Nuclear Regulatory Commission
Washington, DC 20555–0001

In the Federal Register notice of December 11, 2009, the NRC requested comments on the subject draft NUREG. The BWR Owners' Group (BWROG) is providing for your consideration comments on this draft NUREG.

If you have any questions concerning this letter, please do not hesitate to contact me or Fred Emerson, the BWROG Project Manager (910-819-5615).

Sincerely,

Frederick P. "Ted" Schiffley, II
BWR Owners' Group Chairman

cc: M. Crowthers, BWROG Vice Chairman
M. Honcharik, NRR
C. Nichols, BWROG Program Manager
BWROG Primary Representatives
BWROG IRIR Committee

Enclosure: Comments on Draft NUREG-1921

E-RIDS = ADM-03
Add: K. Hill (klh)

SUNSI Review Complete
Template = ADM-013

Comments on Draft NUREG-1921
(Proposed EPRI/NRC-RES Fire Human Reliability Analysis Guidelines)

The following table provides BWROG comments on draft NUREG-1921 (jointly published as EPRI TR-1019196). Subsequent reference to this draft will be denoted by NUREG-1921.

Summary:

The Joint EPRI/NRC-RES Fire HRA Guidelines in draft NUREG-1921 (EPRI TR-1019196) are intended to provide an improved HRA method over the previous methods included in NUREG/CR-6850 (EPRI TR-1011989). The overall approach with screening, scoping and detailed HRA is provided as a framework for Fire PRA HRA as the industry continues to expand its use of Fire PRA. However, this draft document should not be issued for use at this time. While there is a great deal of information in this document that is useful, it does not provide clear, practical guidance on the performance of a fire HRA, and as such is difficult to use in its current form. In particular, the scoping analysis is extremely detailed and resource intensive beyond what is reasonable for a true scoping analysis.

In addition, the document contains many errors as indicated by the large number of comments provided below. Individually, most comments represent minor issues with the document; however, collectively, the large number of comments indicates that the usefulness of this method may be impacted if many of the comments are not addressed.

In addition to the large number of less significant comments contained in the table below, we have summarized three major comments that should be addressed prior to the document being finalized:

1) The use of time margins in the document needs to be modified, based on the following issues:

    a. Use of safety margins for a best estimate analysis such as PRA should not be included in the HRA approach. Time margins, as implemented, provide "a safety margin against potentially poor performance of expert judgment in predicting the amount of time required..." [See Appendix H.2 for additional information]. Implementation includes requiring a time margin of 200% (a factor of 3 ratio between available time and performance time) for many HFEs and a 100% time margin for other HFEs. Given that with a time margin of 0%, the action has basically a 50% success rate, this implementation to ensure safety margin results in extreme over- conservatism in the analysis.

    b. Time margins, as implemented, double count various factors in the Scoping HRA. For a complex action or an action requiring SCBA use, the performance time will already include time delays for the multiple actions required, multiple operators involved and other complexities.

However, in the HEP tables (5-2 to 5-5), time margins are implemented such that no credit is given for actions with time margins less than 100% or 200%, depending on the action. Complex actions are therefore impacted in the analysis by increased performance time, higher HEPs, and a minimum time margin; all implemented from the same cause. As a result, the HEPs are often set to 1.0 for cases where the action is likely reliable and feasible.

c. Given that the performance times used for deterministic feasibility analysis are based on conservative estimates, and the HRA will typically use the deterministic estimates as a starting point for analysis, the time estimates (performance time, time windows, etc) should be based on best estimate times, not worst case.

2) The use of a 60-minute suppression time assumption for the scoping HRA introduces an extreme conservatism into the analysis that should not be introduced when trying to approach realism in the analysis (in comparison to screening). Based on FAQ 50, the average fire is extinguished within 10 minutes, with approximately 87% of fires extinguished within 30 minutes and 98% of fires extinguished in 60 minutes. Use of the 60-minute suppression time results in a factor of 10 change in the HEP for similar actions before or after the fire is extinguished. Given that most fires are out within 10 minutes, and 87% are out within 30 minutes, this factor of 10 would have little justification except for actions within the first 10 minutes. As a result, a 30-minute estimate would still be relatively conservative and is recommended for this analysis.

3) The "Fire Stress" PSF =10 does not include clear criteria for applying the factor of 10. Even the example scenarios in Appendix C do not apply the fire stress PSF. If the factor is necessary, then we recommend stating the conditions under which it should be applied, and give specific examples. Additionally, it appears that for most Fire HEPs, the Fire Stress PSF is not applicable. As such, the guidance should be clear as to when moderate or high stress should be applied.

NUREG-1921 EPRI/NRC-RES Fire Human Reliability Analysis Guidelines **Detailed Comments on Draft Report**			
Comment Number	**Page**	**Section**	**Comment**
1	V	Forward	In paragraph 3, the Forward mentions publishing the HRA guidelines rather than delay the document to resolve any inconsistencies. However, these inconsistencies were resolved several years ago with the issuance of the 2008 Combined Standard. Additionally, there were no technical changes in combining the ANS Fire Standard with the ASME PRA standard, and minimal changes in Addendum B. Please remove this discussion in the Forward and refer to the HRA method satisfying the combined standard, Addendum A. See also section 2.1 of the HRA guidelines discussions on the standard, Appendix A, and other references to the standard.
2	XXV	Acronyms	We recommend using a single acronym for ISLOCA (See also ISL in the acronyms), Abnormal Operating Procedure (see also Abnormal Procedure in the acronyms), MCR (see also CR used in 4.3.1, 4.3.3, 4.3.10, etc as ex-CR).
3	XXV	Acronyms	We recommend adding CRAB (control room abandonment) to the acronyms.
4	XXV	Acronyms	We recommend removing any acronyms not used, such as: BOPCO, ATWT, COPS, DAS, DEC, ECA, ELOCA, etc.
5	Entire Document	Reference Section(s)	We recommend placing all document references either in one place or at the end of each section.
6	1-1	1.1	We recommend removing the first sentence (RI/PB discussion) since it does not appear to be discussed further or provide any useful background.

NUREG-1921 EPRI/NRC-RES Fire Human Reliability Analysis Guidelines Detailed Comments on Draft Report			
Comment Number	**Page**	**Section**	**Comment**
7	1-1	1.2.2.1	In the third paragraph, it is mentioned that EPRI conducted interviews and collected fire response procedures. This review does not appear to be documented in the report. Please either indicate where this is documented and expand on the findings, or remove the discussion.
8	1-5	1.3	The statement under Fire Detection HFEs, "...and in other areas, the frequency of roving fire watch is considered to determine detection probability" is inaccurate. In most areas, the fire detection system and the operator response to the alarm determine the detection probability. When the automatic detection system is unavailable, then the roving fire watches are used and credited as stated. However, this is the less common usage.
9	1-5	1.3	Please also refer to the revision to the NUREG/CR-6850 approach in the Fire Suppression HFE, including the FAQ or the upcoming supplement to NUREG/CR-6850.
10	2-1	2.2	The intent of Section 2.2 is not clear. It appears that the section introduces the general Fire HRA approach, but the continual referral to NUREG/CR-6850 methods confuses the approach. For example, under "Identification and Definition" the section mentions this step is unchanged from NUREG/CR-6850, but does not describe what the step is. Under Qualitative Evaluation, the description mentions several factors ("included in identification in many methods," "proven important," etc), but does not mention what has been added. For "Quantitative Evaluation" a description is provided, but only screening and scoping analysis are discussed, not detailed HRA. For "Recovery..." no description is provided. Finally, not all of the Figure 2-1 steps are described in the paragraphs preceding the figure (documentation).

NUREG-1921 EPRI/NRC-RES Fire Human Reliability Analysis Guidelines Detailed Comments on Draft Report			
Comment Number	**Page**	**Section**	**Comment**
11	2-6	Figure 2-2	Please provide a "Key" to identify the difference between solid black lines and dashed red lines in the Figure. Also, note that the Fire HRA will take input from the Fire-Induced Risk Model, the Cable Selection (detrimental actions, etc), and numerous other steps not shown connected with the HRA blocks through solid black lines.
12	2-7	2.4	Item 1: The Fire HRA methods are likely useful for shutdown Fire PRAs also. As such, the limitation in Item 1 is not valid. We recommend considering that the crew diagnosis time is part of the HRA, that the crew response to cause a trip is in the procedure, and that the fire brigade modeling is included in the PSFs. See also Section 4.2,1, Paragraph 1 and other locations where a trip is assumed for all HFEs.
13	2-7	2.4	Items 1 and 3: The assumption for 10-minute detection doesn't appear valid. First, whether or not the brigade responds quickly does not change the fact that Fire HRA is applied. Note that many fires are not initially detected, but are determined to occur following equipment failure (see non-suppression methods). If the detection time is 20 minutes, this just goes into the timeline. In Assumption 3, the assumption that the action is independent of the fire and fire impacts is not correct.

NUREG-1921 EPRI/NRC-RES Fire Human Reliability Analysis Guidelines Detailed Comments on Draft Report			
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14	2-7	2.4	Item 3: In Section 1 above, the guidance states that the HRA analyst may need to work with the Fire PRA and Fire Modeling experts to determine the scenario of interest, including timing. This in fact occurs when detailed scenario analysis is performed. The assumption that the HFE action time is independent of the fire is not valid, nor is the last part of the assumption that the fire impacts have very little if any effect on the operator performance (the whole procedure tries to model the PSFs affecting operator performance). The fire impacts, including any possible order of fire damage, are the cause of the operator action being required. For example, if the PORV block valve fails first, and the PORV spuriously opens, the operator response would be different than for a PORV spuriously opening first (possible operator action to close the block valve before damage). Please correct the wording in item 3.
15	3-1	3.1	Pages 3-1, 3-4 and numerous other locations refer to Fire procedures, while Pages 3-2, 5-4, Appendix F, G.2 refer to "fire emergency procedures" (FEPs), which appears to be a more standardized term. We recommend changing "fire procedures" to "fire emergency procedures," and adding FEP to the list of acronyms. However, the term "fire procedure" can be used, if corrected on p. 5-4, and in Appendix F and Appendix G.
16	3-2	3.2	In the first sentence, the identification of safety injection does not appear to be either complete or correct. Internal events actions are those in response to a plant initiating event or reactor trip. This may include a safety injection, FW overfeed, loss of letdown, spurious pressurizer heater actuation, PORV/SRV opening, and numerous other possible events. In most cases, the actions occur post-trip, but not always. We recommend rewording the first sentence to either be more general, or provide a more complete list of possible plant events (both BWR and PWR).

NUREG-1921 EPRI/NRC-RES Fire Human Reliability Analysis Guidelines Detailed Comments on Draft Report			
Comment Number	**Page**	**Section**	**Comment**
17	3-2	3.2	Use of the acronym NOP is not standard, since operating procedures are called OPs.
18	3-2	3.2	2nd Paragraph. HEPs may not have been quantified for all HFEs, if the HEP is set to 1.0 for screening. We recommend removing this from the second sentence. See Paragraph 4 for an accurate discussion on this.
19	3-3	3.2	Step 3. We recommend changing "will" to "may" in the last sentence. Conservative HEPs may still be OK for the Fire HEPs in some cases.
20	3-4	3.2	At the bottom of Step 3, it says that actions not in the internal events PRA needed to be added to the model. However, at this point in the procedure, no new actions should be added. These new actions should be added as a result of fire damage, as defined in Section 3.3 below. We recommend removing this discussion and moving the example to Section 3.4.
21	3-4	3.3	Fire Response Operator Actions are not typically called manual actions. Only the local actions (ex-control room) are referred to as manual actions. Also, under NPFA 805, these are called recovery actions.

NUREG-1921 EPRI/NRC-RES Fire Human Reliability Analysis Guidelines Detailed Comments on Draft Report			
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22	3-4	3.3.1	2nd line: Fire response actions are typically defined in the Fire-Induced Risk Model Development, not during the Fire Modeling Task. Please correct this sentence. Also, for Fire Response Actions to mitigate the effects of equipment damaged by a fire, these actions (since they are in the Fire Emergency Procedures) are first identified in the Fire Safe Shutdown Program. Once the need for the actions is identified, the actions are added to the Fire procedures, which are modeled here under the Risk Model Development. Under NUREG/CR-6850 Fire Modeling, the FPRA may identify fire scenarios where the HFE is needed/modeled. But the initial identification of the HFE is based on the fire procedures, developed from the SSA (also note: under NFPA 805, SSA is called NSA – Nuclear Safety Analysis). Recommend adding a discussion that most of the HFEs are likely already identified and included in the FEPs.
23	3-5	3.3.1	The examples of Fire HFEs on page 3-5 should include at least one Control Room Action and control room abandonment to the ASP/RSP.
24	3-5	3.3.1	The definition should be revised. At this point, in defining the HFE, we do not know the fire damage to instrumentation, etc. We can, however, review the required instrumentation, timing, cues, success criteria, etc. The Fire Impact evaluation is not performed until the Fire PRA model is developed and applied to each fire scenario.
25	3-5	3.3.1	NRC should mention that a number of actions in the Fire Procedures would not necessarily need to be modeled in the FPRA. For example, the procedure may have an action in response to a possible Multiple High-Impedance Fault, which is assumed improbable in NUREG/CR-6850. Other actions are intended to protect cold shutdown equipment, which may not be required for the FPRA end state.

NUREG-1921 EPRI/NRC-RES Fire Human Reliability Analysis Guidelines Detailed Comments on Draft Report			
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26	3-5	3.3.2	NRC should include in the examples a closure of the PORV block valve in anticipation of a PORV spurious operation. This action is performed by a number of utilities in response to single spurious operation concerns, and can be effective if the PORV and Block Valve control cables are separated. NRC should also indicate that pre-emptive actions are typically performed following either the detection of a fire (fire alarm goes off) or confirmation of a fire locally (operator sees flame or significant smoke), depending on the procedure. As such, the action is intended to occur prior to significant fire damage. This can become important later, since these actions may not be feasible for high-energy arcing fault fires, where cable damage could be immediate.
27	3-6	3.3.3	Actions in this section are the same as in 3.3.1; operator response to fire damage. Whether it is additional credit for something originally failed in the model or as a result of a newly identified action, the HFE is for responding to fire damage. We recommend removing this separate category of events.
28	3-7	3.3.5	2nd Paragraph: We recommend changing "automatic" to "fixed," since if the system is automatic, the system would not need operator response to actuate.
29	3-7	3.4	By calling the approaches listed in 3.4 "steps", it appears as if they are performed in series. However, the "steps" are basically different approaches for how to systematically identify HFEs. As such, we recommend changing "Step" to "approaches."
30	3-7	3.4	Step 1: All three steps require operator interviews to confirm the expected plant response. These interviews should be moved up above the step or added to all steps.

NUREG-1921 EPRI/NRC-RES Fire Human Reliability Analysis Guidelines Detailed Comments on Draft Report			
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31	3-9	3.5	Last paragraph on page 3-9: It is inaccurate to say "operators are trained to respond only to..." We recommend removing "only" since operators respond to all alarms, within the priority and framework of the EOPs, AOPs, etc.
32	3-9	3.5	Many of the undesired operator actions are actually in the alarm response procedures (See Section 3.5.2, Step 2), not EOPs. We recommend referring to these procedures, which are used in parallel with the EOPs.
33	3-10	3.5	Under "Cue Parameters" it is stated that multiple spurious indications are less likely. We recommend also stating that in the PRA standard, CCII does not require looking at multiple spurious indications resulting in undesired operator actions (See Section 3.5.2, Step 1).
34	4-2	4.2.2	We recommend adding a sentence or two about fire modeling and the effect on timing. In many cases, the timing would be affected by the time to damage equipment. For example, if the fire damages a switchgear at time zero (say a high energy arcing fault), causing a trip, but the operator action would not be needed until the 4th tray above the switchgear is damaged; the time to damage the tray is determined by fire modeling. This timing would be part of the response time, either in determining the time when the cue occurs (if the operator action only occurs when the tray is damaged) or the time available. This discussion would also be applicable to Section 4.3.2.
35	4-3	4.2.4	Chapter 4 is developed for qualitative evaluations. However, the last sentence in 4.2.4 states to set the HEP to 1.0. We recommend changing this to a qualitative statement. See also 4.2.8, second paragraph.

NUREG-1921 EPRI/NRC-RES Fire Human Reliability Analysis Guidelines Detailed Comments on Draft Report			
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36	4-4	4.3.1, and Appendix A.	NUREG/CR-6850 and the standard do not agree on the area of requiring tracing for redundant instrumentation. The original exception of tracing and modeling fire damage for indications where multiple and diverse instruments are available, was removed from the standard prior to release. As such, the standard requires one to validate that even if there is multiple and redundant instruments, one train remains free of damage. Given the confusion on this issue, and the fact that NUREG/CR-6850 still retains the exception, it would be helpful to mention the issue in Section 4.3.1, when discussing redundant and diverse indications (following the paragraph starting NUREG-1792). This should also be mentioned in Appendix A.

NUREG-1921 EPRI/NRC-RES Fire Human Reliability Analysis Guidelines Detailed Comments on Draft Report			
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37	4-11	4.3.2	Last Paragraph: The points made in section 4.3.2 above the last paragraph are generally valid, when applicable; for example, actions requiring physical strength are affected by differences between crews, actions in an area with smoke are affected by the smoke, etc. However, many actions can be walked through and timed where the action is not greatly affected by the influences discussed. A local start of an EDG, when the action does not require travel through fire-affected areas, can easily be walked through with adequate timing. In general, most actions are not greatly impacted by these issues, since most actions are not impacted by physical strength differences, require travel through smoke-filled areas, require SCBAs, require climbing over obstacles, etc. As such, the indication here and in other parts of the document that a time margin is "required" in order to demonstrate feasibility is inaccurate, conservative, and does not provide best-estimate results for the PRA. In traditional feasibility estimates, all crews are tested to determine the range of response times. Impacts on the walk through to possible delays such as those discussed in Section 4.3.2 are estimated and added to the response times. Feasibility is determined if the time for all crews is better than the time required. As such, the response times consider time delays and variation in crews in the evaluations. Adding an additional consideration of time margin to the traditional method provides too much conservatism, and results in inaccurate estimates of when the crew would not be successful. We recommend changing the last paragraph to: "A good demonstration for feasibility needs to consider the above factors in estimating the time to perform actions."
38	4-12	4.3.3	Last sentence on 4-12, starting with "For fire HRA, item b..." This in incorrect, since in the case of fire, some of the indications may be affected, but the credited indications or cues should be demonstrated as unaffected. Please correct this.

NUREG-1921 EPRI/NRC-RES Fire Human Reliability Analysis Guidelines Detailed Comments on Draft Report			
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39	4-13	4.3.3	4.3.3, paragraph starting "For internal events HRA...": We recommend removing the last line. The first part of the sentence is reasonable (training can improve the PSF), but the last sentence assumes that all fire procedures are poor, that time is limited, etc. In many cases, the procedures, training, cues, etc. are similar to those credited for internal events PRAs. It is clear that the process should identify these issues as a possible problem, but the method should not assume these are always poor.
40	4-13	4.3.3	Last Paragraph: We recommend changing ... "there are typically no clear decision criteria..." to "there may not be clear decision criteria..." In fact, the problem is more complex than stated; since there are often criteria from a damage standpoint, such as loss of either all SG cooling or all RCS injection. However, it may not be clear to the operators when this occurs. Also, the criteria for smoke abandonment may not be clear, so leaving when the equipment is operating but the operators cannot see may be a difficult decision. We recommend expanding the discussion here.
41	4-14	4.3.4	Last paragraph: Although the number of locations visited will increase the complexity, for the first locations visited, the complexity may not be affected. One would expect the first action to be relatively reliable in comparison to later actions. Additionally, if an action is actually multiple actions in multiple locations, the complexity is greatly increased. These factors are not well discussed in this paragraph.
42	4-15	4.3.5	The last paragraph mentions the new "higher level of stress" that may be considered for a fire. However, the main body of the report does not discuss this further. Only in Appendix C do we see the new higher level of stress (a factor of 10 versus 5 for high). Additionally, there is no discussion in the main part of the report on when this is used. Please add this discussion. Note also that this higher stress factor should not be applied to all Fire HEPs, since, as discussed in numerous locations in the document, the stress may not be any worse than a typical HFE for internal events.

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43	4-17	4.3.10	Some items such as 4.3.10 provide useful items for consideration, but no method is detailed on how to evaluate such aspects, especially in cases where the attribute can be either positive or negative depending upon the situation. Additionally the last paragraph on page 4-17 discusses the point that crew status discussion may be held, but then again no method in calculating the HRA value is provided to credit this very beneficial effort. We recommend that NRC provide added detailed discussion of how to quantitatively include these attributes
44	5-3	5.1.1.1	In Paragraph 2, the method appears to indicate that if the action is long-term and is not impacted by the fire at this point, you can use the internal events PRA value. However, this does not appear to be covered under any of the sets or further screening evaluations. Given the importance of this point, it appears another set of HEPs where the value does not change should be added to the 4 sets listed in 5.1.
45	5-3	5.1.1.1	Set 1, Criterion 1 states that the fire does not damage SSE beyond that considered in the internal events PRA with which the HFE applies. This does not appear accurate. First, the wording appears to indicate that the fire should damage only PRA equipment. Second, Criteria 2, 3, and 4 discuss acceptable damage to SSE, which means that some level of damage is OK. It appears based on further reading that Criterion 1 is meant to say "the fire does not significantly damage the SSE being credited for the performance of the HFE, such as the equipment being used or the related indications and instrumentation, other than discussed below in item 2." Please make this correction.

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46	5-3	5.1.1.1	No screening criteria are established for operator "memorized" actions, to which the operators are not referring to a procedure and take actions immediately. Typically some of these include response to ATWS events or tripping of Reactor Coolant Pumps. These memorized actions should not be increased by a factor of 10 due to fire. Some multiplication value may be appropriate (suggest 2). We recommend adding a box take-off for "memorized operator actions" to multiply by a factor of 2
47	5-5	5.1.1.2	Set 2: The rules for applying values to Set 2 include one success path available, does that assume neglecting of spurious failures and only assumes one train is free of fire damage? We recommend revising the statement to state, "one train is free of fire damage."
48	5-6	5.1.1.2	In the last paragraph, the method indicates that long-term actions can be treated differently. However, there is no recommended value to be used in the method.
49	5-9	5.1.3	Another case can be added to the text for using the scoping 0.1 HEP value; When smoke causes an abandonment, and the state of the plant when leaving is safe-and-stable, then the time to prevent core damage is very long, given that systems continue to function. This would be as a result of a back-panel fire, affecting minimal SSE, but causing smoke density to increase to where abandonment is needed. In these cases, we know that long-term control is needed from outside the control room, but the time to perform the actions is difficult to estimate since the smoke, and whether the plant was in manual control with increasing or decreasing level, would impact when operator action is needed. We recommend adding some discussion on smoke abandonment with minimal SSE, using a 0.1 screening value.
50	5-10	5.2.1	Criterion 2 is not really a criterion, but is only a discussion of recovery HFEs. Please describe the criteria for the HFE in using scoping methods.

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51	5-11	5.2.2	The support for quantification scoping discusses the "actual demonstration". The discussion as provided for Operator demonstration is an unrealistic expectation given limited resources and demand for time on the simulator for operator qualifications. It is highly unlikely to get Operations Resources for a "scoping analysis". These should be only considered for detailed HRA analysis and should be limited to a select few HRA that are deemed critical to the results additionally this level of effort is not practical and not required by the standard.
52	5-16	5.2.3	Given the importance of time margins in the determination of scoping HEP determination, some additional guidance is needed to ensure the time estimates used are in fact best estimate. As mentioned above, it is common that the HRA analyst will perform the HFE feasibility using worst case evaluations, including a) worst case crew time, b) worst case plant conditions, c) worst case location for crews at the start of the scenario, and d) conservative estimates for any delays, action times (not performed), etc. For the HRA, the action completion time used here should be based on best estimate (average) times when available. Crew variation should be reviewed and considered in the uncertainty evaluation of the analysis. Additionally, large crew variation should be reviewed once the quantification is complete to ensure the resulting HEP is realistic. We recommend adding a discussion to ensure time estimates are based on best estimate times, and variations are considered in the uncertainty analysis.

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53	5-19	5.2.4	The use of a 60-minute suppression time assumption for the scoping HRA introduces extreme conservatism into the analysis that defeats the goal of approaching realism in the analysis (in comparison to screening). Based on FAQ 50, the average fire is extinguished with 10 minutes, with approximately 87% of fires extinguished within 30 minutes and 98% of fires extinguished in 60 minutes. Fires more important to the Fire PRAs (electrical and transient fires) are extinguished much more quickly. Finally, the control of fires occurs much more quickly for the longer duration fires, as indicated in the preliminary work on the "control of fires" issue identified in NUREG/CR-6850, which will be an update to FAQ 50. On Table 5-2, the factor that results from the 60-minute question is in fact a factor of 10 change in the HEP (see for example, best numbers for A versus E or C versus J, and Table H-1). Given that most fires are out within 10 minutes, and 87% are out within 30 minutes, this factor of 10 would have little justification except for actions within the first 10 minutes. As a result, the 30-minute estimate would still be relatively conservative. We recommend that a value of 30 minutes be used in scoping HRA, given that this encompasses 87% of all fires and more than 90% of electrical and transient fires important to the FPRA. This change in assumed suppression from 60 to 30 minutes (note the exception in the document for T/G Fires, etc.) does not change the assumed stress for actions between 30 and 60 minutes. During this time frame, just as in the internal events PRA HRA, the stress would be considered higher than actions longer than 60 minutes. However, the impact of the fire, including smoke, is not expected to be an effect beyond 30 minutes except in rare cases such as the exceptions listed (where there is no time limit given).

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54	5-23	Figure 5-2	Figure 5-2, Top Box states "Has action been demonstrated to be feasible" if not then assign 1.0. This should be revised to state "Is action feasible". The demonstration of each action is not in of itself feasible, unless a very small number of actions are to be credited in the PSA, which is not typical given the number of internal events MCR actions that are retained in the Fire PRA. It is noted that none of the piloted HRAs were "demonstrated feasible" as the NUREG seems to imply.
55	5-26	5.2.6.2	This section discusses validating that instrument circuits that are in rated fire wrap need to be verified to be unaffected by direct flame impingement or explosive fire. This level of effort is extreme and highly costly, given the testing the fire wrap goes through. This type of requirement will result in no HRA being credited due to the effort required by this NUREG and could result in unrealistically high Fire CDFs. We recommend that the discussion of direct flame and explosive for wrapped circuits be deleted.

NUREG-1921 EPRI/NRC-RES Fire Human Reliability Analysis Guidelines Detailed Comments on Draft Report			
Comment Number	**Page**	**Section**	**Comment**
56	5-32	Tables 5-2, 5-3	The time margins requirements for a number of the HEPs do not make sense: E: This is an action within 60 minutes of the fire, with an action time in less than 30 minutes. The action is in the control room, without smoke and not complex. Presently, the 100% time margin (twice the time is available) is required in the scoping method in order to get any credit for the HEP. In the requirements, there already needs to be a control board operator focused on this action, and the fire could not have affected the train or instruments supporting the train, etc. The action would not be greatly different from a non-fire event, other than the crew distractions to fight the fire. Here, a time margin of zero means that the time available and time to perform are identical, meaning the HEP is a 50/50 probability. Given the timing of the action already includes the simulated conditions, this should also be true here. We recommend for E that 50% TM be used as the point where 1.0 is assigned. F: same as E U: Same as above. H, I, T, V, W: Same as above. Additionally, note that for highly complex actions, the action time already includes consideration of the complexity, including multiple locations, multiple team members, etc. As above, with a time margin of 0, the action should still be a 50/50 probability. Adding additional conservatism (such that any complex HEP with a time margin of less than 200% (3 times the action time) is considered to have a value of 1.0) does not provide a reasonable estimate for scoping purposes, and the time margin values here should be, at a minimum, lowered to 100% (twice the time) to get credit (See B, D, M & N on Table 5-2). Basically, the minimum time margin of 200% in the tables for complex actions double counts the impact of complexity.

NUREG-1921 EPRI/NRC-RES Fire Human Reliability Analysis Guidelines Detailed Comments on Draft Report			
Comment Number	**Page**	**Section**	**Comment**
57	5-30	Figure 5-5	The Control Room Abandonment flow chart does not provide any useful analysis, other than confirming that the procedures match the scenario. For control room abandonment, all primary controls for SSD are transferred to another location. By definition, the action is complex. As such, the branches in Figure 5-5 for non-complex actions will never be used. At best, for complex actions greater than 30 minutes, a value of 0.5 is assigned. Additionally, a time-margin of 200% is required (three times the action time) in order to get the 0.5 HEP credited. Otherwise, the HEP is 1.0. We recommend that Figure 5-5 be reconsidered, based on detailed analysis of control room evacuation scenarios. A simpler flow diagram, but with additional credit for scenarios where sufficient time is present, should be developed. Additionally, see the comment above on smoke evacuation scenarios, where timing is not an issue if SSE damage has not occurred and the SSD functions were operating when the control room was abandoned.
58	5-41	Table 5-5	See the time margin conservatisms discussed above, as applicable to Table 5-5 (minimum TM of 100% or 200% to get credit for the HEP).
59	5-28	Figures 5-3, 5-4, 5-5, etc.	In the figures, the "action time" greater than 30 minutes can easily be confused with the time to perform the action (or manipulation time). In Figure 5-1, this time is called "time available" and is described similarly on page 5-31 and other places. We recommend changing the figures to use available time instead of action time.
60	7-2	7.1	It is not clear from the dependency diagram or discussion on page 7-4 whether the lower or upper branch is taken when "moderate" stress is assumed. From the HRA calculator training, the lower branch is taken for high or moderate stress, and the upper branch is taken for low stress. Please clarify this in the write-up on stress.

NUREG-1921 EPRI/NRC-RES Fire Human Reliability Analysis Guidelines Detailed Comments on Draft Report			
Comment Number	**Page**	**Section**	**Comment**
61	A-1	A.2.1	The requirements listed do not match the fire section of the standard. For example, HRA-A3, A4 are not listed in the appendix.
62	B-1	B	Fire Events Review: It would be much more helpful to take the examples and actually work through the various tables and flowcharts and derive the HRA values. This would greatly increase the usability and understanding of the methods, including the screening/scoping methods.
63	B-2	B.3	Bullet 1 refers to fire-induced spurious equipment operation and inaccurate instrument readings. It appears that only Event 3 had this problem. In general, experience with actual fires shows little or no indication that spurious operations or inaccurate instrument readings occur. We know from testing that this can occur, but this would require a large, unsuppressed fire to damage specific cables (control cables). Additionally, the first sentence seems to indicate that spurious events cause fires (sentence reads; "Actual fires… occur…due to fire induced spurious equipment operations…"). Please correct the wording.
64	B-2	B.3	The staffing bullet does not provide a summary for the conclusions in numerous events, that staffing was not an issue, and the actions performed were not impacted by staffing (fire fighting staffing had more of an impact than Fire Procedure and Control Room Actions). We recommend this lesson learned be summarized in this bullet.

NUREG-1921 EPRI/NRC-RES Fire Human Reliability Analysis Guidelines Detailed Comments on Draft Report			
Comment Number	**Page**	**Section**	**Comment**
65	Appendix C	All – General Comment	A disclaimer sentence in the 1st paragraph of Appendix C states that there is sufficient information to quantify by hand individual HEPs, but this does not appear to be the case. For example: on Page C-47, the sentence "Fire stress (PSF=10) is not implemented in version 4.0 of the EPRI HRA methodology and should be applied externally to the EPRI HRA methodology." There is insufficient information to apply the fire stress PSF=10 external to the EPRI HRA Calculator. This guidance document should describe the methodology.
66	ALL	Appendix C	This section should be better aligned with the latest ANS/ASME PRA Standard, ASME/ANS RA-Sa–2009.
67	C-1	Appendix C	There is a formatting error at the end of the second paragraph, an errant paragraph break after the word "further".
68	C-1	C.1	The reference to References is incorrect: NUREG/CR-6850 is Reference 6 (not 5) in Section C.9 on page C-84; NUREG-1792 is Reference 8 (not 6); SHARP1 HRA framework is Reference 5 (not 4), etc. Please check that all reference callouts throughout the document align with reference sections of the document.
69	C-2, C-5,	Table C-1 Table C-4	SRs should be updated / aligned against ASME/ANS RA-Sa–2009. A fire HRA guidance document should line up with the latest standard, ASME/ANS RA-Sa–2009. The RA-Sb-2005 Addenda is obsolete for Fire HRA.
70	C-9	Table C-4	(HR-SR-H2, H3) are reversed.
71	C-10	C.3	Paragraph 3: A comma is missing in first sentence.

NUREG-1921 EPRI/NRC-RES Fire Human Reliability Analysis Guidelines Detailed Comments on Draft Report			
Comment Number	**Page**	**Section**	**Comment**
72	C-10	C.3	Paragraph 3: We disagree with word "must" in following sentence: "the base case must first be quantified in the EPRI HRA methodology". The base case HEP does not necessarily have to be developed using the EPRI HRA methodology. Other suitable HEP development methodologies are available to the industry. We recommend changing the paragraph such that fire impacts can be applied to base HEPs as long as they were developed correctly, regardless of the methodology employed.
73	C-11	C.3	Please define T_{SW}, T_{delay}, $T_{1/2}$, and T_m prior to stating the criteria as bulleted conditions.
74	C-11	C.4	There is an unlabeled figure on page C-11.
75	C-45	Table C-14	Note 5: This type of Note is not helpful and provides no guidance for a PRA analysis; a suggestion value and basis should be provided. The note states; "Note 5: For PWR CP3 actions there is only 1 data point in the original data set. Thus no distribution can be calculated. Instead overly conservative estimates are presented and are to be used with caution." We recommend that NRC provide a reasonable error factor in table and revise to state to use the provided error factor unless additional information is available, which would change the state of knowledge.

NUREG-1921 EPRI/NRC-RES Fire Human Reliability Analysis Guidelines Detailed Comments on Draft Report			
Comment Number	**Page**	**Section**	**Comment**
76	C-47	C.6.5.2	The "Fire Stress" PSF =10 does not include any clear criteria for applying the factor of 10. Even the example scenarios do not apply the fire stress PSF. The factor may be overly conservative and unnecessary. The methodology should not be limited by the version of technology. Currently as written, the guidance on the "methodology" (i.e. development of the FIRE influence on the base HEPs) is limited by the version of the EPRI HRA Calculator currently referenced in Appendix C. A specific technology or a particular software tool should not limit the methodology.
77	C-84	Section C.9	Reference 2:Assessment is misspelled.
78	D-4	Appendix D	"HRA analysis" is a redundant statement (Human Reliability Analysis analysis… Several occurrences).
79	Appendix E	All	The reference listing is unclear. Most definitions have a source document and reference number listed with it. It is unclear where these references are listed. We recommend either creating one reference section that applies to the entire document or consistently include reference sections in each section of NUREG-1921.
80	E-1	E	The definitions for Cable and Circuit Failure Mode do not match the standard definitions. See NEI 00-01. Failures should include open circuits, short to grounds and hot shorts. Inter and Intra cable shorts are a subset of these. Also, the phrase "and/or shorts between a conductor and an external ground" is redundant.
81	E-3	E	We recommend deleting definitions that are not used, for example, Failure Probability, LERF analysis, Licensee-controlled area, etc.
82	G-3	G.2	3rd Paragraph: "Analysis" should be "analyst."

NUREG-1921 EPRI/NRC-RES Fire Human Reliability Analysis Guidelines Detailed Comments on Draft Report			
Comment Number	**Page**	**Section**	**Comment**
83	H-2	H.2	Paragraph 3 of Section H.2 mentions that the use of time margins provides a safety margin against potentially poor performance. This aspect of use of time margins is the biggest problem in application of time margins to Fire PRA. PRA in general is meant to be realistic, best-estimate analysis, where the types of issues considered in time margins (variability in crew response, plant conditions, etc.) are addressed in the Uncertainty portion of the analysis. As noted above, with a time margin of zero, we estimate a 50/50 (roughly) probability of success for an action. The added general application of 100% time margin (paragraph 5) unduly burdens the scoping HRA, especially since the timings are in general conservative, and already account for the factors considered in the scoping analysis (complexity, smoke, use of SCBAs, etc). We recommend that the importance and stress of time margins in the method be reduced. Alternately, the analysis should focus more on the impact of time on HEPs, similar to the HEP methods such as HCR or ORE. In these methods, the ratio of time available and performance time impacts the HEP differently, depending on a number of factors, including whether the HFE was skill based, rule based or knowledge based. This last point is not addressed in the Fire HRA method, in contrast to previous HRA methods where time was considered in the analysis. Finally, discussions on safety margin in H.2 should be removed. We do not need to impose margins in FPRA.
84	H-10	H.5	Reference 6 is "FAQ 50." We recommend expanding this reference.