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Office of Administration
U.S. Nuclear Regulatory Commission
Washington, DC 20555–0001

Attention: Mr. Michael T. Lesar
U.S. Nuclear Regulatory Commission
Washington, DC 20555–0001

Subject: Pressurized Water Reactor Owners Group
Docket ID NRC-2009-0550
PWROG Comments on Draft NUREG-1921, (PA-RMSC-0484)

Reference: (1) Federal Register Notice of December 11, 2009 Volume 74, Number 237, "NUREG-1921, EPRI/NRC-RES Fire Human Reliability Analysis Guidelines, Draft Report for Comment."

On December 11, 2009, a Federal Register Notice (Reference 1) was issued for public comment on Draft NUREG-1921, "EPRI/NRC-RES Fire Human Reliability Analysis Guidelines." The Pressurized Water Reactors Owners Groups (PWROG) offers the following comments regarding the draft Fire Human Reliability Analysis (HRA) Guidelines. The PWROG comments have been coordinated with the Nuclear Energy Institute (NEI) and the Boiling Water Reactors Owners Group (BWROG).

While the PWROG agrees with the overall intent of Draft NUREG-1921 to clarify issues related to application of existing HRA methods to Fire PRA, we also believe that significant issues remain to be resolved with respect to the alignment of the guidance contained in Draft NUREG-1921 to the applicable supporting requirements of the ASME/ANS probabilistic risk assessment (PRA) standard. The PWROG also believes a final version of NUREG-1921 should not be issued for use until further progress is made in addressing the issues outlined below. The body of this letter provides general comments on Draft NUREG-1921. Specific comments related to the content or technical approaches contained in Draft NUREG-1921 and its Appendices are provided in Attachment 1. Editorial comments on Draft NUREG-1921 and its Appendices are provided in Attachment 2.

SUNSI Review Complete
Template = ADM-013

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

General Comments

1. Overall, the guidance seems to be aimed at meeting Capability Category (CC) III of the ASME/ANS PRA Standard rather than CC II. The alignment of the guidance contained in Draft NUREG-1921 to the gradations contained in the applicable ASME/ANS PRA Standard supporting requirements needs to be specified.

2. The guidelines propose a detailed review of the EOPs to identify Human Failure Events (HFEs) associated with undesired operator actions. In contrast to ARP responses (where the alarm and the response action may be based on parameters without indication in the main control room), EOP actions are typically based on parameter indications in the main control room with redundant indication channels. In addition, the symptom-based EOPs are designed to provide additional confirmation after significant decision points to allow the operating crew to correct any misdiagnosis that may have occurred. Experience gained in Fire PRAs to date indicate that detailed analysis of the EOPs for the purpose of identifying potential undesired operator responses in response to a single instrument failure (as required to meet CC II of Supporting Requirements HRA-A3 and HRA-B4) produces minimal insights. Therefore, it is recommended that the guidance utilize the existing experience to restrict this EOP review to those EOP actions that have been found to potentially produce undesired operator responses, if any have indeed been identified.

3. It is the PWROG's opinion that the differentiation between the requirements for the various quantification methods is not logical and does not seem to represent an increasing level of detail and effort such as would be expected. For example, the guidance specifies use of extensive demonstrations to support identification of operator action timing and to establish feasibility for both the scoping and detailed quantification methods. In discussions with the writing team, the purpose of the demonstrations is to minimize uncertainty in the timing estimates for human error probability (HEP) quantification. While the use of feasibility demonstrations may be appropriate for some complex actions such as those related to control room abandonment, the use of operator walkthroughs or talkthroughs as allowed in the ASME/ANS PRA Standard should be sufficient for the scoping methodology. This is especially true since the scoping methodology includes other features to address uncertainty in the operator action timing. As written, the guidance provides no reduction in the level of effort required to implement the scoping method commensurate with the penalty in final HEPs applied by the method. While this may be the preference of the writing team, it does not recognize the reality of Fire PRA in that progressively detailed methods are applied to other aspects of the modeling commensurate with the risk-significance of the fire area and/or scenario.

4. Inclusion of guidance for conduct of operator walkthroughs and talkthroughs could be useful in establishing the minimum expectations for these processes. This would help ensure consistency in performing these steps of the HRA, minimize the uncertainty in timing estimates obtained through these processes, and limit the need for complex feasibility demonstrations to a few highly important operator actions.

5. The EPRI/NRC Fire HRA Guidelines are written with the assumption that the unpredictability of a fire event will increase operator stress levels above those experienced for non-fire events (e.g., pages 4-15 and following). However, the pilot plant operator interviews indicated that the stress level for many fire HEPs would be the same as for similar actions in non-fire events. The guidance should allow for assignment of stress levels to be based on operator interview input and plant operating experience, not an assumption that a fire event would always result in a higher stress level than non-fire events for which the same HEP applies.

6. Although it is the only HRA method specified for quantification of errors of commission in response to spurious instrument indications, there is little guidance in Appendix D related to quantification of these types of Human Failure Events (HFEs) using the ATHEANA methodology. Provision of an example similar to those used in Appendix C for the EPRI HRA method would be helpful.

7. The guidance, as written, may not be able to be implemented by a PRA analyst with internal events HRA experience without having formal training or additional background/discussions added to the NUREG.

The PWROG appreciates your consideration of these comments. ***All correspondence related to the PWROG comments on Draft NUREG-1921 should be addressed to:***

Mr. W. Anthony Nowinowski, Program Manager
PWR Owners Group, Program Management Office
Westinghouse Electric Company
Mail Stop ECE 5-16
P.O. Box 355
Pittsburgh, Pennsylvania 15230-0355

If you have any questions, please do not hesitate to contact me at (704) 382-8619, Ms. Ashley Mossa at (860) 731-6124, or Mr. W. Anthony Nowinowski, Program Manager of the PWR Owners Group, Program Management Office at (412) 374-6855.

Sincerely yours,

B. Gimmel for M. Arey

Melvin L. Arey, Chairman
PWR Owners Group

MLA:BSG:las

Attachments: PWROG Comments on Draft NUREG-1921

cc: PWROG Risk Management Subcommittee
PWROG PMO
USNRC Document Control Desk
J. Rowley, USNRC
B. Baron, Westinghouse
P. Hijeck, Westinghouse
D. McCoy, Westinghouse
A. Mossa, Westinghouse
D. Olinski, Westinghouse
V. Anderson, NEI
B. Bradley, NEI
F. Emerson, GE
K. Canavan, EPRI
S. Lewis, EPRI
J. Julius, Scientech

Pressurized Water Reactor Owners Group (PWROG) Content/Technical Comments on Draft NUREG-1921

Comment Number	Section	Comment	Proposed Resolution
1	Pages 3-1 and 3-10	Pages 3-1 and 3-10 make references to procedures being standardized based on the vendor. For WEC PWRs, the PWROG maintains the generic ERGs; however, plants/utilities can and do often opt to differ from the ERGs. Also, the content of fold out pages is not vendor specific, but plant/utility specific.	Revise the references to EOPs to acknowledge that although they are based on vendor guidance, there can be plant-specific differences in step sequencing, level of detail, and the manner in which cues are specified.
2	Section 3.5	Section 3.5 spends a lot of time discussing undesired actions in the EOPs. In contrast to ARP responses (where an alarm and the response action may be based on parameters without indication in the main control room), EOP actions are typically based on parameter indications in the main control room with redundant indication channels. In addition, the symptom-based EOPs are designed to provide additional confirmation after significant decision points to allow the operating crew to correct any misdiagnosis that may have occurred. Experience gained in Fire PRAs to date indicate that detailed analysis of the EOPs for the purpose of identifying potential undesired operator responses in response to a single instrument failure (as required to meet CC II of Supporting Requirements HRA-A3 and HRA-B4) produces minimal insights.	Collect available industry experience from reviews of the EOPs to identify potential undesired operator responses and limit the scope of the required review to those actions that have been identified as problematic, if any. This approach would be similar to the use of the generic lists of Multiple Spurious Actions to focus the scope of the circuit analysis.

Comment Number	Section	Comment	Proposed Resolution
3	Section 3.5, Paragraph 1	The intent of the sentence "If an operator responds to a spurious indication and the action is judged to not impact the CCDP or CLERP, then it does not need to be considered further, except as a dependency on other actions." In order to consider an action in the dependency analysis, a basic event will have to be developed for the HFE. Addition of the event to the model, even with a value of 1.0, to ensure that it appears in cutsets for consideration of dependency would seem to require that it be considered further.	Clarify the meaning of the phrase "...it does not need to be considered further."
4	Page 3-12, Table 3-1	The examples of operator actions in the EOPs resulting in undesired operator response (Table 3-1) seem to be actions that would be screened for CC II based on redundancy. This is an example of an area where the guidance seems to be directed at CC III since multiple indication channels would be required to fail to result in an undesired operator response.	The examples should be revised to show cases which would need to be considered to meet CC II given the previous guidance on redundancy and other considerations.
5	Section 3.5.2, Step 3	The bulleted items at the top of page 3-14 are the same as those under Section 3.4 Step 3. It would seem that the considerations for Errors of Commission should be different.	Differentiate the guidance for Errors of Commission. For example, the first item might be revised to say "The specific high level tasks leading to the undesired end state."

Comment Number	Section	Comment	Proposed Resolution
6	Section 4.3.2	Section 4.3.2 states that "Thus, to demonstrate the feasibility of HFEs modeled in the fire PRA, the actions should be walked through and timed under as realistic circumstances as possible". This guidance seems to go far beyond the applicable supporting requirements of the ASME/ANS PRA Standard. In general, the Fire HRA SRs in the ASME/ANS standard refer back to the corresponding requirements for internal events PRA in Part 2. With regard to establishing the time required to perform a modeled action in HEP quantification, SRs HRA-C1 refers back to the requirements in SR HR-G5. For CC II, HR-G5 only requires action time measurements for significant HFEs. Even then, the time measurements can be based on "walkthroughs or talkthroughs of the procedures or simulator observations." The process described in Section 4.3.2 seems to be requiring the equivalent of a "simulator observation" in the form of a complex demonstration for all Fire HFEs regardless of the significance. This is another example of the guidance being directed toward meeting CC III.	Clarify the alignment of the guidance with the applicable supporting requirements of the ASME/ANS PRA Standard. The guidance should allow establishment of timing for operator response on walkthroughs or talkthroughs as allowed by the ASME/ANS standard. If there is a concern about minimal requirements for walkthroughs or talkthroughs in the context of a fire HFE, additional guidance for performance of these types of activities should be provided.

Comment Number	Section	Comment	Proposed Resolution
7	Page 4-15, top paragraph	This paragraph discusses the concept of a higher stress level for fire. The EPRI/NRC Fire HRA Guidelines are written with the assumption that the unpredictability of a fire event will always increase operator stress levels above those experienced for non-fire events. However, the pilot plant operator interviews indicated that the stress level for many fire HEPs would be the same as for similar actions in non-fire events. The same comment applies to the discussion of Fire Stress on pages C-46 and C-47.	Consider whether higher stress levels than those encountered in a non-fire initiating event are really applicable, especially for control room actions. If it is determined that higher stress levels are applicable to some fire scenarios, the types of scenarios requiring application of higher stress levels should be identified and this should be supported in the applicable software tools (e.g., the HRA Calculator).
8	Section 5.1, General	In general, it seems the authors are trying to define screening methods in such a way that screening is essentially useless. Users are forced into gathering such detailed information that by the time they can support the screening analysis, they already have sufficient information to perform a more detailed HRA. Certainly, screening values should not be used in the final HRA, but they do have a place in the initial stages. This methodology almost bypasses a true screening by requiring far more detailed information than is normally associated with a traditional screening analysis. If the intent is to force users to utilize more detailed and specific HEP's, why expend so much effort defining such an elaborate "screening" methodology?	Consider revision of the guidance to apply a progression in effort and level of detail required as the analysis progresses through application of the screening, scoping, and detailed quantification methods.

Comment Number	Section	Comment	Proposed Resolution
9	Section 5.1.1.1	In general, the Screening analysis seems to require more detailed information (e.g., Set 1 criterion 2) than would be expected for a quick screening assessment.	Detailed circuit analysis should not need to be applied for screening purposes. Instead, it would seem appropriate at the screening stage to assume that if applicable cables are in the area affected by the fire, there will be spurious behavior of instrumentation and the only question to be determined is whether the instrumentation is relevant to the HFE.
10	Table 5-1	Set 3 "HEP Value to Apply" column says: "Use both HEPs in sensitivity analysis" It is unclear why sensitivity analysis would be required on screening values? Does this mean it is considered acceptable to use screening values in the final quantification?	Clarify the intent of this statement.
11	Section 5.1.3, General	Section 5.1.3 is confusing. The statement is made that "This approach is not recommended by this guideline unless a detailed analysis and timeline is done...." It appears that the main point is that use of a single screening value is not recommended and that use of the scoping or detailed analysis methods are preferred to account for the impact of the applicable PSFs. However, this section of the guidance is addressing screening HRA quantification. Performing a detailed analysis for a screening assessment is self-contradictory and defeats the purpose of having a screening method.	If this can be conveyed in fewer words, it may be less confusing. If the true intent of this section is to say that the screening method is not appropriate for control room abandonment, this should be clearly stated and justified based on the requirements of the ASME/ANS PRA Standard. If the intent is to recommend that a different value than 0.1 be used in the screening assessment, an appropriate value should be specified which does not required detailed analysis.

Comment Number	Section	Comment	Proposed Resolution
12	Section 5.2.2	Section 5.2.2 outlines an extensive demonstration process that may be difficult to achieve. Granted, an action must be feasible if it is to be included in the Fire PRA. However, this level of detail in feasibility assessments is more suited to detailed analyses than to scoping methods, goes beyond the typical requirements for actions included in the Internal Events PRA, and seems to go far beyond what is required in the standard. For example, in Figure 5-3, Scoping HRA for MCR Actions, the assigned scoping HEP is largely based on the time margin. Page 5-16 has the time margin equation. Given that time margins in excess of 100% are generally required to obtain HEPs less than 0.1, the requirement for performance of complex demonstrations seems excessive.	Consider revision of the guidance to apply a progression in effort to establish timing estimates and feasibility as the analysis progresses through application of the screening, scoping, and detailed quantification methods. The scoping method should allow use of detailed operator walkthroughs or talkthroughs supplemented with available fire drill information instead of the extensive demonstration process outlined here.

Comment Number	Section	Comment	Proposed Resolution
13	Page 5-13, "Available Indications and Main Control Room Response"	There is much discussion of feasibility assessments and making sure they reflect actual fire conditions as accurately as possible. This section states that "…the actual effects of the fire conditions should be simulated, to the extent possible, in the plant training simulator and the operators should diagnose the need for the relevant actions based on the expected pattern of indications (including cues expected to be affected by the fire)." Regarding the effects of the fire conditions, how do you decide which to include in a given demonstration? Simply including all possible spurious failures for the fire is completely unrealistic and would result in a uselessly overconservative assessment. Spurious failures are assigned probabilities (values from NUREG/CR-6850, which are themselves extremely conservative) of occurrence in the detailed circuit analysis, but how should it be decided which spurious actuations are included in a feasibility assessment? They could be assessed individually, but the significance of most spurious actuations and when they are addressed will vary depending on occurrence of other fire-induced failures, spurious or otherwise, so individual assessments of each would not necessarily be representative of an actual fire.	Clarify the expected treatment of spurious indications in feasibility assessments and demonstrations.

Comment Number	Section	Comment	Proposed Resolution
14	Page 5-15, "Other Aspects Important to the Demonstration"	The second bullet point reads, "If the conditions that could be generated by the fire have the potential to vary significantly, this should be accounted for when deciding how to model the scenario(s) for purposes of the demonstration." (The application of this statement to spurious actuations is part of the concern here, but that is certainly not the limit of the concerns.) This represents a good thought; however, the statement itself is another 6850-type catch-all generality. It is unclear how a demonstration should apply this statement? How do you decide which of the potentially variable conditions are to be included in a given demonstration? Obviously it is not possible to account for all possible combinations of all variable conditions in individual demonstrations.	If this guideline is to be at all useful it needs to be more specific; otherwise it's just an exercise in good intentions and the industry will be left with the same issues in Fire HRA that we are currently facing in Fire PRA due to the lack of specificity and realism in NUREG/CR-6850. It is suggested that the correct answer is NOT to simply assume all possible failures simultaneously. PRA only works as a tool when it is best-estimate; conservative assumptions in a PRA make it unreliable and inaccurate. The aggregate effects of conservative assumptions in a PRA model quickly overshadow real risk and the results become meaningless.
15	Page 5-19, Last paragraph	The following statement is made: "For modeling of actions during these events, the analyst should always assume the cue occurs before the fire has been suppressed, regardless of when the cues occur relative to the start of the fire."	Consider revising the statement to indicate conditions where the assumption that cues occur before the fire has been suppressed may not be appropriate. For example, cues related to alignment of ECCS recirculation will not typically occur until several hours after the reactor trips.
16	Page 5-24, first bullet under 5.2.6.1	The formula on line 3 does not match the formula in NUREG/CR-6850 Section 11.5.2.11.	Revise the formula to be consistent with NUREG/CR-6850.

Comment Number	Section	Comment	Proposed Resolution
17	Page 5-42, Paragraph 2	The meaning of the following statements is unclear: "At present time the method selected for detailed quantification will be based on considerations such as plant-specific scenario information, fire context/impact, and general suitability (for non-fire conditions). NUREG/CR-1842 [8] provides general insights on the strengths and weaknesses of HRA methods for non-fire conditions." It appears that the intent is that the same considerations should be used for selecting a method as would be done for non-fire scenarios in NUREG/CR-1842. Therefore, it is not clear how the scenario information and fire context/impact should influence the method selection.	Revise the wording to clarify the intent. It would be preferable that the authors provide useful guidance for selection of an appropriate detailed quantification method. That is, the specific considerations which would lead to preferential selection of the EPRI HRA or ATHEANA method should be identified.
18	Section 6	It would be useful to include in Section 6 examples of types of recoveries that can be credited in the Fire PRA.	The discussion could be expanded to address issues such as conditions under which LOOP recoveries can be credited in the Fire PRA.
19	Section 8.2	It is unclear why the application of error factors to values assigned using the screening and scoping methods is required. There should be no distribution because the value was not derived from a carefully detailed analysis for which uncertainty can be reasonably defined; instead it was selected from a table using the answers to some pretty general questions.	Consider whether it is more appropriate to address uncertainty in the screening and scoping HEPs using sensitivity analysis rather than propagation of parametric uncertainty.

Comment Number	Section	Comment	Proposed Resolution
20	Section A.2.2	The recommended alignment of the screening, scoping, and detailed assessment methods against the gradations of SR HR-G3 should be discussed in Appendix A. Likewise, the relationship of the demonstration requirements in the guidance to the gradations of SR HR-G5 should be discussed.	Provide specific discussion of the alignment of the recommended guidance to the capability category gradations of the applicable ASME/ANS PRA Standard supporting requirements.
21	Page B-2	In the final bullet, it is stated that "The use of SCBAs can be key in maintaining the plants in a safe shutdown condition. These tools should be available to the plant operators for electrical fires." Yet in all suggested quantification approaches detailed in this guideline, limited credit is provided for operator actions involving use of SCBAs.	Clarify why limited credit is provided for operator actions requiring use of SCBAs when they are observed to be "key" to maintaining plants in a safe shutdown condition.
22	Page C-19, Paragraph 2 under bulleted list	The use of the "Key Assumptions" designation in this document and the HRA Calculator should be reconsidered since the standard has been revised to drop the designation of "Key".	Consider changing the guidance to reflect the current use of "assumptions" in the ASME/ANS PRA Standard.
23	Section C.6.2.6	It would be beneficial to have some discussion in the document concerning factors affecting the decision about which crew members are required for a specific action. This is especially true for cases where one operator and supplemental personnel perform actions from the fire procedures while a different operator and the shift manager may do actions from the EOPs.	Expand guidance on application of crew makeup in the EPRI HRA Calculator.

Comment Number	Section	Comment	Proposed Resolution
24	Page C-24, Table C-6	Under "Guidance Specific for Fire HRA" the following statement is made: "The displayed branch value of 0.0 or negligible should alert the analyst that HFE being modeled is outside the scope of this decision tree and needs to be redefined." It is not clear why this guidance is appropriate and what type of redefinition of the HFE is intended in response.	Clarify why this guidance is appropriate and whether this statement is generally applicable to all branch values or specific to p_ca branch g. Also, the highlight box in the screen shot needs to be aligned with the warning statement.
25	Table C-8	Under "Formal Communications" guidance on treatment of additional communications issues during a fire event needs to be provided.	Consider providing guidance on treatment of the following communications issues in the "Guidance Specific for Fire HRA" column: - Dependence on runners to transfer instructions from the control room to the field, and - Unavailability of normal communication methods.
26	Table C-9	The "Guidance Specific for Fire HRA" column for the "Specific Training" and "General Training" decision nodes state that "Fire specific training is to be verified by training staff and or operators." This seems to imply that no credit can be given for training and JPMs on EOP and AOP actions under normal accident conditions to fire events.	Provide additional guidance for application of JPMs for EOP/AOP actions to quantification of fire actions using the same actions. For example, if the fire event requires the same action steps, and the fire scenario does not cause damage to equipment or indications required for success, the training for non-fire events should be applicable.
27	Page C-46	Execution Stress is not consistently discussed in the draft Guide. The paragraph above Section C.6.5.2 on Page C-46 states that "...if any one of the PSFs shown above is considered negative the stress (determined in execution stress) should be at least moderate." The third paragraph on Page C-47 states that "... a high stress level should be used, if any of the execution PSFs are negative."	Ensure that the guidance is consistent with respect to application of execution stress. Consider allowance for the stress level to be determined during operator talkthroughs consistent with the process used for internal events HEPs.

Comment Number	Section	Comment	Proposed Resolution
28	Appendix E	The appendix includes Fire PRA terms not used in the document and does not address some HRA-specific terms which should be addressed like "undesired operator response," "talkthroughs," and "walkthroughs."	Remove definitions from the appendix that are not used in the document and add necessary Fire HRA-specific terms which are used in the document.

Pressurized Water Reactor Owners Group (PWROG) Editorial Comments on Draft NUREG-1921*

*Note in "Proposed Resolution" Section, the suggested text to add is indicated in bold and red.

Comment Number	Section	Comment	Proposed Resolution
29	Section 2.4, Item 1, Fourth bullet	This seems like it should be two separate bullets. Crew awareness of the potential for unusual plant behavior seems related to spurious actuations or indications. Staffing seems to be a separate issue based on fire brigade makeup.	Separate into two separate items.
30	Section 3.1, Paragraph 2	Recommend that the final sentence be re-worded.	Revise the final sentence to say: "As the initial risk model is developed, the FPRA analysts will need to determine which operator actions can or can not be credited."
31	Page 3-3, Paragraph 2	Recommend that item 2 in this paragraph be reworded.	Revise item 2 in this paragraph to say: "(2) those that are proceduralized in the EOPs but are not modeled as basic events or ~~are~~ developed into detailed HEPs…"
32	Page 3-3, Step 2	In line 8, "maybe" should be "may be".	Revise wording as indicated. This was also noted in other sections and should be corrected on a global basis.
33	Page 3-5, Paragraph 2, Fourth Bullet	Revise sentence.	Change wording as follows: "Operators fail to locally operate a residual heat removal pump when ~~motor~~ the control circuit is failed by the fire."
34	Section 3.3.3, Paragraph 1	The paragraph contains a line break that is not needed.	Delete extra line space between lines 10 and 11.
35	Section 3.4, Step 1	Revise paragraph.	Change wording as follows: "…To identify the operator actions in this approach, the fire PRA analyst will need to create **a** timeline for the fire sequence of events in sufficient level of detail such that the HRA analyst can map the expected operator action as directed in the fire procedures to the specific fire sequence. This **may**~~many~~ also require operator interviews to confirm the expected plant response for each fire scenario."

t	Section	Comment	Proposed Resolution	Commen Number
	Page 3-8, Table item ACP-OPSISO-1FDG1	Revise wording in the "Related Basic Event Identifier in PRA" column.	Change "Related Basic Event Identifier in PRA" to: "EAC-OPS-FO-DG1 – Operators fail to **operate**~~operator~~ Diesel Generator 1 (DG 1)"	36
	Page 3-8, Table item FZ50-OPS-SUPRESS	Revise wording in "Fire Response Basic Event Description" column.	Change Fire Response Basic Event Description to "Operators fail to **activate**~~active~~ suppression system for AA-55 from control room"	37
	Section 3.5, Paragraph 3	It is not clear what the parenthetical statement in line 7 "(during? to? cooldown and depressurization)" is intended to convey.	Clarify the wording.	38
	Section 4.2	There needs to be an introductory paragraph to this section that discusses the intent of the list of steps and explains that each listed step is explained in further detail in the following sections.	Add an introductory paragraph.	39
	Page 4-3, Bulleted list just prior to Section 4.2.3	Revise wording in the third bullet.	The third bullet should say "Increase in cognitive response **time** due to misleading or unclear indications"	40
	Section 4.2.3	Does "section" in the last sentence refer to the supporting requirements under HLR HR-H or Section 4 of the EPRI guideline?	Revise wording to clarify the intent.	41
	Section 4.3, Paragraph 1	Revise paragraph wording.	Revise as follows: "… In many cases, the same guidance for internal event **HFEs**~~events~~ can also be applied to fire and is reproduced here for clarification. The implementation of these PSFs is discussed within the appropriate section for quantification. (Scoping is addressed in section**s** 5.2 and ~~the section~~ C-7 for the EPRI approach)"	42

Comment Number	Section	Comment	Proposed Resolution
43	Page 4-6, Paragraph 3 after bulleted list	The following statement seems incomplete: "NUREG-1852 [6] notes that, in addition to the SSCs needed to directly perform the desired function, instrumentation and cues needed to provide diagnostic indications (either EOOs or EOCs) relevant to the desired operator manual actions."	Revise wording to clarify the intent.
44	Page 4-7, Paragraph 1	The following statement is unclear: "For example, if the operator follows procedure in response to a spurious high-temperature alarm and shuts down an otherwise operable pump because of the spurious indication."	Revise wording to clarify the intent.
45	Page 4-9, Paragraph under "Demonstrating Feasibility and the Use of Time Margins"	The reference to "Section 6" in line 3 should be changed to "Section 5".	Update the section reference as indicated.
46	Section 4.3.3, Paragraph 4	The last sentence of the paragraph is poorly worded.	Recommend re-wording the last sentence to say "These cases could be considered, provided that **the** following **provisions of**~~requirements~~ Supporting Requirement HR-H2 of the ASME Standard…"
47	Page 4-13, Top bullet	Incorrect word usage.	Change "diagnosis" to "diagnose".
48	Page 4-13, Second bullet	The phrase "in many instances some of the operators will be assigned to the fire bridge and unable to assist" should be in parentheses and should be reworded.	Change second bullet to read: "There are enough crew members available (in many instances some of the operators will be assigned to the fire **brigade** and unable to assist)."
49	Page 4-13, Second bullet	The phrase "The location of the fire will not prevent the operators from performing the tasks." Should be a separate bulleted item.	Add new bullet.
50	Section 4.3.4, Paragraph 1	The first sentence is poorly worded.	Revise first sentence to say "As stated in NUREG-1792, [4] the **complexity** PSF ~~complexity~~ attempts to measure…."

Comment Number	Section	Comment	Proposed Resolution
51	Page 4-14, top paragraph	The paragraph contains a line break that is not needed.	Delete extra line space between lines 8 and 9.
52	Section 5.1.1, Paragraph 1	Revise wording in line 11.	In line 11, change "…during identification and definition…" to "…during **the** identification and definition…."
53	Page 5-7, Top 2 paragraphs	Sections 5.1.1.6 and 5.1.16 do not exist.	Change references to sections "5.1.1.6" and "5.1.16" to "5.1.3".
54	Section 5.1.2	The font does not appear to be consistent with other sections.	Font usage should be consistent throughout the document.
55	Page 5-9, Paragraph 1	In line 7, "in to" should be "into".	Correct wording as indicated. This was also noted in other sections and should be corrected on a global basis.
56	Page 5-10, Paragraph 1	In item 4 at the top of the page, the phrase "…as described in ANS Fire PRA standard…" should be revised.	Revise line 4 to say: "…as described in **the** ANS Fire PRA standard…."
57	Page 5-13, "Equipment Functionality and Accessibility"	The first line should be revised.	The first line should say "Access to the relevant systems…"
58	Section 5.2.4, Paragraph 2	The third sentence should be revised.	Revise the third sentence to say "Similarly, questions are asked in all of the flowcharts regarding smoke levels for areas in which operators will be performing actions ~~in~~ or through which ~~areas~~ they will have to pass on the way to perform actions."
59	Page 5-19, Last paragraph	In line 5, "arching" should be "arcing".	Correct wording as indicated. This was also noted in other sections and should be corrected on a global basis.
60	Page 5-21, "Accessibility" paragraph	The third sentence is incomplete.	The third sentence should say "Analysts must determine whether the action needs to be performed in the vicinity of the fire or if the presence of the fire and actions associated with suppressing it could prevent operators from being able to reach the action **location**."
61	Page 5-24, second bullet under 5.2.6.1	NUREG/CR-6850 Section 11.5.2.11 uses "…optical density of the smoke is less than **0.3** m-1."	Revise the criteria to be consistent with NUREG/CR-6850.

Comment Number	Section	Comment	Proposed Resolution
62	Page 5-38, Paragraph 3	The final sentence is poorly worded.	Change wording as follows: "If, however, the HRA analyst feels that due to other circumstance**s** ~~that might cause~~ the operator ~~to~~ **might** ignore this warning and ~~might, therefore,~~ commit the error anyway (e.g., time pressure, real or inferred, keeping the operator from verifying the "suspect" instrument), the analyst may still model the action as if an EOC or EOO has occurred."
63	Page 5-40, final paragraph	The third sentence is poorly worded.	Change wording as follows: "Assuming the area and travel path are accessible, the analyst must work through a series of question**s** similar to those asked for ~~in~~ MCR actions."
64	Page 6-2, Paragraph 2	The first sentence is poorly worded.	The wording should be revised to say: "The scoping approach does not address complex recoveries associated with MCR evacuation, dealing with **multiple** spurious actuations, **multiple** spurious instrument cues, or **removal and restoration of** power on buses and circuits."
65	Page 6-5, final paragraph	The reference to "Section 8" should be changed to "Section 7".	Correct reference as indicated.
66	Page 7-1, Paragraph 2	The wording should be clarified.	The first sentence should say "This section is concerned with identification of dependencies among HFE**s** at the cutset level that have ~~been~~ up until this point been quantified as independent HFEs." The third sentence should say "The relationships among multiple PSFs within a single HFE are addressed **as part of the** scoping or detailed HRA quantification."
67	Page 7-4, Paragraph 2	The reference to "Table 8-1" in line 2 should be "Table 7-1".	Correct reference as indicated.
68	Page 8-8, Paragraph 1 of quote under 8.2.3.1	In the last line, "t o" should be "to".	Correct wording as indicated.

Comment Number	Section	Comment	Proposed Resolution
69	Page A-5, Table A-2	In "Discussion 1" for HRA-C1, the meaning of "@2#" in line 2 is unclear.	Correct the text.
70	Page B-20, Table B-3 heading	There is no note "8" corresponding to the reference in the heading. Somewhere in the appendix and/or the wording of the assessments in this table, it should be noted that procedures for responding to fires and operator training have changed significantly since this event.	Clarify the intent of the note reference or remove it. Add clarification that this historical event is not reflective of current plant procedures and operations.
71	Page C-11, Paragraph 1	In line 2, "anyone" should be "any one".	Correct wording as indicated.
72	Page C-14, Paragraph 1 under C.6.1	In line 5, "instrumentations" should be "instrument".	Correct wording as indicated.
73	Page C-15 and following	All HRA Calculator screen shots do not match the current version.	Update screen shots to match the version of the EPRI HRA Calculator applicable at the time the guidance is finalized.
74	Section C.6.2.4	This section should be revised to reflect the placement of the Scenario Description and Key Assumptions on different screens in HRA Calculator version 4.1.1.	Revise document to match the current EPRI HRA Calculator version.
75	Page C-19, under bulleted list.	Incorrect word usage: "Instrumentations impacts…."	The sentence should say "**Instrument** impacts are also identified in the scenario description along with known equipment failed by the fire."
76	Page C-43, Paragraph 2	In line 5, the phrase "…HCR/ORE is…" is incomplete.	Correct wording to say: "…HCR/ORE **correlation** is…" or "…HCR/ORE **sigma modeling** is…."
77	Page C-51, Table C-15	The table number should appear at the top of page C-52 rather than the bottom of page C-51.	Correct page break.
78	Page C-52, Table C-15	The second paragraph for "Execution PSFs" contains an incomplete statement: "If two are more executions PSFs are negative."	Revise the paragraph to read "If two are more executions PSFs are negative**, the fire scenario has** ~~.~~ ~~For fire scenarios which~~ impeded communications**,** or smoke is present such that it will impact the operator performance**,** the stress should be fire stress."

Comment Number	Section	Comment	Proposed Resolution
79	Page C-55, Section C.7	In the last line, "SHAPR/SHAPR1" should be "SHARP/SHARP1".	Correct the text as indicated.
80	Page C-57, Section C.7.2	The formatting of the designations "TSW", "TM, and "T1/2" is inconsistent.	Correct the formatting to "T_{sw}", "T_m", and "$T_{1/2}$" and apply it consistently within the document.
81	Page C-59, Paragraph 6	The wording in line 1 seems incomplete.	Revise line 1 to say: "The variation in crew response is characterized within the HCR/ORE **correlation** by the use of sigma." This same issue appears in additional locations (e.g., page C-67 paragraph 1) and should be reviewed globally.
82	Page C-63, paragraph before Section C.7.3	This paragraph is an incomplete sentence.	Revise the paragraph to say "Because of the expected large crew to crew variation associated with when the operators abandon the control room, the upper bound for sigma will always **be used** in the HCR/ORE correlation."
83	Page C-64, final paragraph	Incorrect punctuation and missing word in line 5.	In line 3, there are two period marks between the second and third sentences. In line 5, "…multiple attachments be used…" should be "…multiple attachments **are** used…."
84	Page C-69, final paragraph	The wording of the last line, "Unclearly or ambiguously labeled, part…" is unclear.	Change wording to: "**Valves that are unclearly** or ambiguously labeled **or are** part…."
85	Page C-70, Paragraph 3	Incorrect word usage.	In line 3, "…potential snow-covered…" should be "…**potentially** snow-covered…."
86	Page C-70, Paragraph 4	Incorrect word usage.	In line 1, "…the crews ideal travel path…" should be "…the **crew's** ideal travel path…."
87	Section C.7.10, Paragraph 1	Line 1 is poorly worded.	Revise line 1 to say: "Crew to crew variability **is** modeled ~~in~~**in** the HCR/ORE **correlation** by using…."
88	Page C-75, Paragraph 1 under C.8	Incorrect word usage.	In line 5, "…the value is failed…" should be "…the **valve** is failed…."

Comment Number	Section	Comment	Proposed Resolution
89	Page C-78 under "Operator Interview Insights"	The specified position for valves 8804A and B appears incorrect. There are also several grammatical errors.	Revise as follows: "The operators stated that it would be obvious~~ly~~ that 8804A or B failed to **open**~~close~~ when attempted from the control room. In the control room in addition to the position switches the valve position **is**~~are~~ also monitored on monitor light boxes. The cabling for the monitor light boxes **is**~~are~~ separate from the valve cabling."
90	Page C-80	In the final line on the page, "However complete of step ES 1.3…" is an incomplete statement.	Revise the wording to say: "However**, completion** of **the required steps in** ES 1.3…."
91	Page D-3, final sentence	Missing word.	Revise as indicated: "This section provides some discussion of how to specifically apply **the** ATHEANA HRA method when using this document."
92	Page D-4, Paragraph 1	Incorrect formatting in the second line.	The footnote reference should be superscripted.
93	Page D-4, Second set of bullets	Missing word in the following statement in line 3 of the second bullet, "…slightly deviate relevant procedural…"	Correct wording to: "…slightly deviate **from** relevant procedural…."
94	Page D-5, Line 2	Incorrect grammar in the following phrase: "…which they may be…"	Correct wording to: "…which **there** may be…."
95	Page D-5, Paragraph under bullets	Incomplete statement in line 4, "…HFE (and sub-event HFEs) and associated can…."	Correct wording to: "…HFE (and sub-event HFEs) and associated **influencing factors** can…."