

COMMENTS ON DRAFT FIRE PROBABILISTIC RISK ASSESSMENT METHODOLOGY STANDARD, BOARD OF STANDARDS/AMERICAN NUCLEAR SOCIETY 58.23

The NRC staff has reviewed the subject standard using criteria from Regulatory Guide 1.200 For Trial Use, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," dated February, 2004. These comments provide the perspectives of users from within NRC, who have needs across various nuclear power plant applications. Our comments are directed towards clarifying and strengthening requirements, and towards improvements to facilitate implementation of the standard. Overall, NRC's view of this standard is positive, as reflected in the cover letter of this enclosure. This enclosure contains general comments on this standard and a table of comments on the individual requirements.

GENERAL COMMENTS

1. Experience with the performance of FPRA (Fire PRA) is not as extensive as that for internal events PRA. Therefore, it would be helpful to include in Section 1.5.1, in addition to the listing of elements, a brief description of each element. The discussion in Section 1.5.1 should also include a description of how the elements are interrelated, perhaps using a flow diagram similar to that in Figure 1 of the Preface to Volume 2 of NUREG/CR-6850 as a basis. The figure from the NUREG/CR may need to be modified since the NUREG/CR assumes that a FPRA is developed based on a completed internal events PRA. Our understanding is that the intent of the Standard developers is to not have to rely upon a completed internal events PRA (developed according to the American Society of Mechanical Engineers (ASME) PRA Standard). In particular, the NUREG/CR figure should be modified to indicate that there will be feedback between "Task 5: Fire-Induced Risk Model" and "Task 2: Fire PRA Component Selection" if the FPRA is being developed as a stand-alone analysis.
2. As discussed above, it is our understanding that a completed internal events probabilistic risk assessment (PRA) done in accordance with the ASME PRA Standard is not necessary as a starting point to successfully perform a FPRA according to this Standard. This approach complicates both the development and the use of the Standard. For example, Section 4.5, Equipment Selection and Location, is contingent on Section 4.8, FPRA Accident Sequence Model, because equipment selection is targeted toward equipment whose failure can cause an initiating event or relied upon to mitigate the initiating event. Selection of equipment to include in the FPRA relies heavily on the availability of an internal events PRA or a plant response model developed along the lines of an internal events PRA model (see General Comment 3). Both ES-A1 and ES-B1 refer directly to using an internal events PRA model to identify relevant initiating events and mitigating equipment respectively. As discussed in General Comment 3, the technical adequacy of this Level 1 internal events PRA (or plant response model) should be based on the ASME standard.

Furthermore, not relying on an internal events PRA as a starting point is insufficiently emphasized in this draft as evidenced by the initial confusion among the NRC reviewers who assumed that the starting point was a completed internal events PRA. If this is really the intent, the fire Standard should clearly state the Standard does not assume

Enclosure

that a completed internal events PRA was used as a starting point. NRC's specific comments include proposals for additional text throughout the Standard to ensure that users of the FPRAs Standard are aware of the additional analysis demands placed on the analysts and the reviewers of FPRAs that have not been developed from internal events PRA. It is possible that other additions to the draft standard may be required that have not been identified by the NRC comments.

3. The Standard in its current form does not facilitate the integration with the ASME PRA Standard (ASME RA-S-2002, ASME RA-Sa-2003, and ASME RA-Sb-2005), which is one of the goals of both American Nuclear Society and ASME. For example, while the Human Reliability Analysis element of a PRA is specifically addressed, the structure of the requirements does not parallel that of the ASME Standard. However, the major problem is with the requirements for the evaluation of the conditional core damage probability (CCDP) and conditional large early release probability (CLERP). In performing a FPRAs, these probabilities are evaluated using what is essentially a PRA model evaluated for the plant damage state created by each fire scenario. This PRA model should be constructed to the requirements of the ASME Standard. While this is the intent of the FPRAs Standard, as is evidenced by the fact that the ASME requirements are indeed referenced in the Accident Sequence Model (ASM) and FPRAs Quantification (FQ) sections of the Standard, the way this is accomplished is not clearly defined.

Part of the problem is in the language used. For example, in the ASME PRA Standard, the term accident sequence is essentially synonymous with an event tree sequence, whether it be a functional or systemic, or a large event tree sequence. Using a parallel interpretation, a FPRAs accident sequence should be the result of combining a fire initiating event with a specific fire scenario resulting from that initiating event, and with a path through a plant response model (see below) to produce a fire induced accident sequence that when quantified provides a fire induced core damage frequency (CDF) and large early release frequency (LERF). The FPRAs ASM using the definition and interpretation discussed above, is to a large extent addressed in Section 4.15, Fire Risk Quantification, since this is where the integration of the fire scenarios and the CCDP and CLERP is addressed.

What Section 4.8, FPRAs ASM should address is the construction of the model that enables the response of the plant to a specific plant damage state caused by a fire to be quantified, such that a CCDP or CLERP can be evaluated. To avoid confusion with the definition in the ASME Standard, it would help to replace the term FPRAs ASM in Section 4.8 by a new term such as plant response model. As stated above, a crucial requirement is that this plant response model shall be constructed in accordance with the requirements of the ASME Standard. This could even be stated as a high level requirement. It should be noted that not all the requirements for the internal events PRA model are needed. For example, there is no need to evaluate initiating event frequencies; in the FPRAs model they arise from the frequency of the plant damage state associated with each fire scenario, and to derive the CCDP, the initiating event frequencies in the plant response model are set to one. Similarly, the set of initiating events is not the complete set in the internal events PRA (e.g., there is no need to address loss-of-coolant accidents or steam generator test rigs for example.)

The following suggestions are intended to provide greater clarity with respect to invoking the requirements of the ASME Standard. This can be achieved by addressing the development of the logic model in Section 4.8, and addressing the compilation of the various elements of the FPRA, namely, fire ignition frequencies, fire damage state probabilities and CCDP and CLERP, in Section 4.15, FQ. For example, the supporting requirements for DA (ASME) and the estimation of human error probabilities (HEPs) (HLR-G in ASME) could be addressed in Section 4.15, FQ.

Section 4.8: With this motivation the suggestion is in Section 4.8, FPRA plant response model, to define the objectives of the FPRA plant response model element as:

- To depict the logical relationships between given a fire.
- To provide the basis for the quantification of the CCDP and CLERP for each fire scenario that survives screening.

The discussion should include a comment to the effect that typically the starting point would be the internal event PRA model. The second paragraph in the introduction can be deleted, as it more properly belongs in Section 4.15, QU, Fire Risk Quantification, which is where the elements of the quantification (i.e., fire scenario frequency and CCDP or CLERP) are combined.

Define the HLR-ASM-A as: The FPRA plant response model shall be constructed to depict the logical relationships etc. (as in the objective statement), and shall be capable of providing the CCDP and CLERP for all the fire scenarios identified in accordance with the requirements of Sections 4.9.

The supporting requirements of HLP-PRM-A should include:

A1: The plant response model logic structure should be developed in accordance with the requirements of IE, AS, SC, SY, HR of ASME as appropriate (clarification pertaining to the fact that not all initiating events will be required, that there is no need to estimate the initiating event frequencies, the important requirements of the HR are those pertaining to identification of the human factors engineering (HFEs), etc., could be provided in a note or commentary. One of the issues is that while the logic model can be constructed at this stage, not all the probabilities associated with the events can be determined, This is particularly true for the HFEs, because they will be fire scenario dependent.

A2: Identify initiating events caused by fires.

As currently written, the requirements to supplement the failure modes to include spurious actuations are included in the requirements for HLR-ASM-B. Comments on HLR-ASM-B are included in the specific comments.

Section 4.15: In FQ-A1, include a clarification as follows: For each fire scenario selected into a plant damage state ~~corresponding to the FPRA accident sequence model~~, i.e., **initiating event and equipment failed** including consideration of insights

from the circuit failure (CF) analysis (see the CF requirements), **to provide the boundary conditions for the evaluation of the CCDP using the appropriate ASM.**
(Bold to show changes only)

Expand the FQ section to include a SR: “Use the plant response model developed per Section 4.8 to evaluate the CCDP and CLERP for each fire scenario,” another that addresses parameter estimation in accordance with the ASME DA requirements and another to address the HEPs. (Referencing Section 4.13).

In FQ-A2 replace CDF and LERF by CCDP and CLERP.

FQ-A3 should be more explicit about what gets multiplied together. The calculation performed is to multiply the frequency of the initiating event by the conditional probability of the fire scenario (if that is what is referred to as the conditional damage probability factor) and by the CCDP or CLERP. The circuit failure likelihoods should either be in the probability of the plant damage state or in the CCDP, and don't need to be called out specifically. If it is felt to be necessary to make it clear, then another SR could be added that addresses circuit failure likelihoods.

4. The staff has not reviewed the non-mandatory Appendices A and B. Therefore, the staff has no position on these appendices at this time.

The following table provides specific comments on the various sections of the Standard.

Table: NRC Staff Comments on Specific Requirements in the Fire PRA Methodology Standard

Index No.	Issue	Position	Resolution
Section 1			
Section 1.3.3	The acronym "SSC" is not defined the same as in ASME 2005 or the Acronyms list of Section 2.1.	Clarification	. . . to which must be added a number of Systems , Structures, Systems , and Components (SSCs) and human actions ...
Section 1.3.5	Typo	Clarification	. . . and applications fore evaluating . . .
Table 1-1	Typo	Clarification	Capability Category ii II Capability Category iii III
Section 2			
Section 2.1	Hyphenate defense-in-depth for consistency with other sections (see page 15).	Clarification	DID - Defense-In-Depth
Section 2.1	Expand acronym "FRRS"	Clarification	Add "NUREG/CR-6850 (EPRI 1011989) to definition
Section 2.1	SSC acronym should have defined by pluralized elements.	Clarification	SSC - Structures, Systems, and Components
Section 2.2	In the definition of Electrical Overcurrent Protective Device, generally passive items do not change state during operation to ensure proper function. See definition of active fire barriers which implies the term, active, requires an action to take place to ensure proper function. Therefore, in this context, both fuses and breakers would be considered active.	Clarification	An active or passive device designed . . .

Index No.	Issue	Position	Resolution
Section 2.2	Definition of fire suppression feature, should include manual hose stations as an example, otherwise they may be confused and considered a fire suppression system.	Qualification	For example, the manual fire brigade, and portable fire extinguishers, and manual hose stations are considered fire suppression features.
Section 2.2	Definition of Risk, capitalize first word in sentence.	Clarification	Risk: p Probability and . . .
Section 2.2	“Definition of Terms” needs to be supplemented with definitions of the following terms mentioned in the Standard: Ignition Frequency, Combustion Loading, Secondary Combustibles, Damage Criteria, and Damage Threshold.	Clarification	Include terms in the “Definition of Terms” list.
Section 2.2	Definition of Walkdown. Suggested additional text to emphasize the importance of walkdowns in FPRAs.	Clarification	Add the text: Because of the high spatial dependence of fire damage, walkdowns are a useful way to gather information during all phases of a FRPRA.

Index No.	Issue	Position	Resolution
Section 2.2	Internal fire is not an external event. Adjust definitions for external event and internal event.	Clarification	<p>External event: An initiating event originating outside a nuclear power plant that causes safety system failures, operator errors, or both, that in turn may lead to core damage or large early release. Events such as earthquakes, tornadoes, fires, and floods from sources outside the plant and fires from sources inside or outside the plant are considered external events (see also internal event). By convention, loss of offsite power not caused by another external event is considered by convention to be an “internal event” (ANS-58.21-2003).</p> <p>Internal event: An event originating within a nuclear power plant that, in combination with safety system failures and/or operator errors can affect the operability of plant systems and may lead to core damage or large early release. By convention, loss of offsite power is considered to be an internal event, and internal fire is considered to be an external event (ASME 2005).</p>
Section 3			
Section 3.2	The explanation for “plant activities” should emphasize that the specific examples quoted are in addition to those that would be addressed in developing the plant response model	Clarification	...to a fire event, as well as those activities related to the maintenance and operation of the SSCs required for safe shutdown.

Index No.	Issue	Position	Resolution
Section 3.3.1	Section incorrectly referenced	Clarification	This standard adopts this aspect of the overall process description as provided in Section 3.2 3.1 of ASME 2005. . .
Section 4			
Section 4.1		No objection	
Section 4.2		No objection	
Section 4.3	Reference to Table 1-1 is incorrect. The correct reference is to Table 1.4-1 of ASME 2005.	Clarification	...The interpretation of a Supporting Requirement whose action spans multiple categories is stated in Table 1.4-1 of ASME 2005...

Index No.	Issue	Position	Resolution
Section 4.4 Plant Partitioning			
PP-A1	The distinction between categories is based on the potential scope of the analysis. CC I and II are assumed to apply to applications that may require analysis of a limited number of fire areas rather than the whole plant, whereas a CC III application is assumed to address the complete plant. This is an inappropriate distinction, since even for a fire PRA done to CC III, the application may only address a limited number of fire areas. A CCI or CCII PRA should have the potential to address the complete plant.	Qualification	Use the CC III words for all categories.
PP-A3	The intent of this SR, and the distinction between the Categories is not clear. A fire in a sister plant area might cause an unavailability of shared equipment, but if it does not lead to an initiating event at the plant of interest, would the fire be included in the fire PRA? Furthermore, the discussion states that for CC I and II only equipment relied upon for safe-shutdown should be addressed. This is inconsistent with SR ES-B1.	Qualification	Clarification required.

Index No.	Issue	Position	Resolution
PP-B2	<p>CC II and III suggest consistency with regulatory guidance is useful. Partitioning should be based on barriers or physical features, not regulatory guidance which is different for each plant and each plant may claim since they are licensed they are automatically consistent with regulatory guidance and therefore CC III. Use words from GL 86-10, which defines fire area.</p> <p>Furthermore, if the condition in the SR for CC II/III is met, there is no distinction between the categories. In this case, are SRs PP-B3 and PP-B4 bypassed?</p>	Qualification	<p>... been defined consistent with existing regulatory guidance as bounded to withstand the hazards associated with the area.</p> <p>Clarify the SR for CC II/III. Should there be no requirement for CC II/II because it is expected that this condition is not met?</p>
PP-B2, Discussion 1	Similar justification as above for removal of discussion of regulatory requirement compliance discussion.	Qualification	<p>... so long as those areas comply with existing regulatory requirement are bounded to withstand the hazards associated with the area.</p>
PP-B3, Discussion 1	Similar justification as above for PP-B2 for removal of discussion about regulatory requirement compliance.	Qualification	<p>... fire areas that should be bounded by rated fire barrier elements consistent with existing regulatory requirements to withstand the hazards associated with the area.</p>
PP-B6	CC I should not credit active fire barriers, this would be consistent with PP-B3 and PP-B4. Add new CC I to not allow credit for unanalyzed active barrier elements.	Qualification	DO NOT CREDIT active fire barrier elements as a partitioning feature.

Index No.	Issue	Position	Resolution
PP-B8	All CC should be enhanced to require periodic, complete barrier inspection by licensees. As written, there may be holes in barriers that will not be identified by the walkdown, yet the barrier may be fully credited.	Qualification	. . . partitioning elements. Also verify that the licensee has a procedure that maintains and periodically inspects the credited partitioning elements.
Table 4.4-3 for PP-C	Two tables are labeled 4.4-3. The PP-C table should be 4.4-4.	Clarification	4.4-3 4
Section 4.5 Equipment Selection and Location			
Notes on ES-A1 and ES-B1	This section does not make specific mention or give consideration to items such as microprocessors, digital instrumentation, and fiberglass cables, for which information about fire and combustion products (smoke) induced malfunction is quite sparse. These items may exist in some operating plants, and are planned for ALWRs as well as other advanced designs.	Clarification	Include a Discussion 3 that states that consideration should be given to items such as microprocessors, digital instrumentation, and fiberglass cables.
ES-A1	The discussion in Discussion 2 on equipment is insufficient	Clarification	Discussion 2:....FPRA accident sequence model. This includes instrumentation and interlocks (with their associated cabling) that control the equipment.

Index No.	Issue	Position	Resolution
ES-A2	This section refers to identifying equipment associated with internal events PRA initiators effectively assuming that a completed internal events PRA is available.	Clarification	<p>Add an asterisk to “Internal Events PRA initiator” with the associated note.</p> <p>*Note: If an internal events PRA is not available, an evaluation of initiating events that shall be considered should be done in accordance with ASME Section 4.5.1 Initiating Event Analysis (IE).</p>

Index No.	Issue	Position	Resolution
ES-B1	<p>The SR for both CC II and CC III include the statement, “as well as ... Internal Events PRA equipment”. Therefore it is implied that the internal events PRA is the starting point for equipment identification. This is stated in NUREG/CR-6850, Chapter 2.</p> <p>If the fire PRA standard is to be applied when an internal events PRA is not available, a note should be added indicating that an analysis comparable to the accident sequence model development in the ASME standard should be performed for all fire induced initiating events identified in ES-A1.</p> <p>For CC I, the requirement is to only take credit for the equipment on the fire safe shutdown/Appendix R list.</p> <p>By contrast for CC II the requirement is to include “risk significant internal events PRA equipment.” What is risk significant for fire scenarios may be different from what is significant for internal events. The fire PRA should include those SSCs that are taken credit for in the internal events PRA for event mitigation, whether they be risk significant or not. There should be no distinction between CC II and CC III.</p>	Qualification	<p>See general comment #2.</p> <p>For CC II: Identify Fire Safe Shutdown/Appendix R equipment as well as the risk significant internal events PRA equipment other internal events PRA equipment that is credited for preventing core damage, as modified ...</p> <p>For CC II: Identify Fire Safe Shutdown/Appendix R equipment as well as all other internal events PRA equipment that is credited for preventing core damage, as modified.</p> <p>* Note: If an internal events PRA is not available, each initiating event that could be caused by fire that is identified in ES-A1 should be fully developed with an internal events model according to the ASME standard. The FPRA development should then be continued using these models.</p>

Index No.	Issue	Position	Resolution
ES-B2	<p>This SR is difficult to interpret for a number of reasons. The terms function and adversely affect are not defined. The SR is intended to support the task objective “ to select the plant equipment that will be included/credited in the FPRA accident sequence model.”</p> <p>To meet this objective, it is difficult to see how to specify the number of spurious actuations that should be taken into account. It is clear how this can be done in the case of a series system of potential spurious actuations. However, the HLR is phrased as “adversely affect credited functions,” which includes affecting a single train of a multi-train system. If each train is affected by a potential spurious actuation, wouldn't it be necessary to include a spurious actuation for each train? The portion of this SR dealing with the number of spurious actuations is difficult to interpret in this case.</p> <p>Should this SLR focus on identifying those SSCs whose spurious actuation could negatively impact one of the credited functions? It is not clear why the phrase “for a given fire” is relevant here. Won't this be the result of the analysis to follow? In order to determine whether this requirement has been met, it would be necessary to identify each fire scenario and its impact.</p>	Qualification	<p>Define functions to be the key safety functions as defined in ASME 2005.</p> <p>Define adversely affect in terms of failures of equipment that support the function.</p> <p>Change the first bullet to read “Fire induced failures of equipment including (bolder statement for each of the CCs) of equipment for a given fire spurious actuation.”</p> <p>In addition, if this is the intent, include a screening step that excludes for CC I consideration of two or more spurious actuations in series, and for CC II, consideration of three or more spurious actuations in series.</p> <p>Delete “for a given fire”.</p>

Index No.	Issue	Position	Resolution
ES-B3	This requirement looks more like a result of an analysis than a search for the SSCs and their failure modes that should be included in the model.	Qualification	Delete requirement.
ES-C1	See comment on ES-B1	Qualification	See resolution in ES-B1
ES-C2	See comment on ES-B2	Qualification	See resolution in ES-B2
ES-C2	The discussion of the exception regarding compensation for an invalid instrumentation output is incomplete	Clarification	<p>Cat I,II, and III</p> <p>EXCEPTION: It is expected that....unaffected by the initiator or the fire and the affected instrumentation is explicitly identified to be disregarded by the operators in the procedure being used in response to the fire, the failed or....</p> <p>In addition for Cat III</p> <p>.....in the FPRA). In addition, the collective effects of invalid instrument outputs must be evaluated to ascertain that they do not cause a significant distraction for operators to execute the mitigation strategy/achieve and maintain safe shutdown.</p>

Index No.	Issue	Position	Resolution
ES-C3, Discussion	As defined in Section 2.2, equipment excludes electrical cable. The problem of identifying cable routing information in FPRAs is well-known. However, it is peculiar that the Standard would endorse the notion “. . . that practicality may limit the completeness of <u>equipment location</u> information.” Note that ES-A3 and ES-B5 are similar SRs, but do not contain the discussion below ES-C3.	Qualification	Delete the discussion.
ES-D1	The last bullet refers to “. . . equipment considered but screened out of the FPRA.” It appears that the only explicit reference to screening process within the entire ES element is contained within ES-C2.	Clarification	Either indicate which SRs provide input to the last bullet, or delete the last bullet.

Index No.	Issue	Position	Resolution
Section 4.6			
CS-A1	Failure is fire-induced. Ensure consistency throughout standard	Clarification	IDENTIFY cables whose fire-induced failure
HLR-CS-A CS-A1	Cables do not mal-operate; they fail	Clarification	remove mal-operation
CS-A1, CS-A2	CS-A2 identifies cables whose failure would adversely affect instrumentation; however, CS-A1 already identifies cables whose failure would adversely affect equipment. This is redundant as equipment includes instrumentation in its definition in section 2.2	Clarification	Resolve inconsistency between definition of equipment in section 2.2 and its use. This inconsistency may exist elsewhere in the standard.
CS-A3	CC I appears to state a contradiction since it says to identify any one cable, and includes inter-cable hot shorts. One cable cannot experience an inter-cable short.	Clarification	Address this apparent contradiction.
CS-A3	CC II and CC III. Is it the intent of the additional condition, that those instances where hot shorts on up to two cables (CC II) or more than two cables (CC III) are necessary to create the adverse effect on a single piece of equipment? Or is it the intent that the model should include up to two hot short related spurious actuations per modeled FS? If the latter, this is the wrong place for this requirement.	Clarification	Clarify the intent in the light of the comments on Section 4.5 above.

Index No.	Issue	Position	Resolution
CS-A4	The discussion permits CC I, II and III to use exclusionary cable routing. This should not be allowed for CC III, since the quality of the FPRA will be limited if this analysis assumption is used.	Qualification	. . . The routing of cables on an exclusionary basis is acceptable for Capability Categories I and II.
CS-A4	Discussion 1: The FPRA should strive for completeness in its cable routing information. fire area/compartments/scenarios being analyzed.	Clarification	Discussion 1: The FPRA should strive for completeness in its cable routing information. . . . fire area/compartments/scenarios location being analyzed.
CS-A4	The second bullet under Discussion 1 appears to state a requirement	Qualification	If this is the intent, it should be elevated to SR status.
Section 4.7 Qualitative Screening			
QLS-A1	DEFINE qualitative screening criteria that provide reasonable assurance that fire areas/compartments that are screened out are insignificant contributors to fire risk consistent, at a minimum, with SRs QLS-A2 and QLS-A3. (See note 1)	Qualification	This element should be removed to prevent confusion and misuse. This element is an unnecessary and extraneous element because QLS-A2, and QLS-A3 say that you can not qualitatively screen out any area that contains equipment that is credited in FPRA analysis or even could cause a TS shut down. Doesn't seem to be any room for any additional qualitative criteria.
Section 4.8 FPRA Accident Sequence Model			
Section 4.8	See General Comment #3	Qualification	See general Comment #3.
ASM-B2	There should be a reference to the grouping requirements of ASME-RA-Sb-2005.	Clarification	(a) consistent with other Internal Events PRA initiator groupings the requirements for internal events initiating event grouping (Table 4.5.1-2(b) of ASME RA-Sb-2005)

Index No.	Issue	Position	Resolution
ASM-B5, B6, and B7	These do not support the HR, which is concerned with the construction of the logic model, not its quantification. These should be dealt with under technical elements SY, DA, etc., that parallel those in the ASME Standard.	Clarification	See proposal under General Comment #3.
Section 4.9 Fire Scenario Selection and Analysis			
General Comment	The fire scenarios define the fire damage states that will be used to quantify the fire risk. As such, there should be a HLR to characterize the plant damage caused by the fire scenario in terms of the initiating event assumed and the equipment failed.	Qualification	Introduce a new HLE, and supporting SRs.
Text on Page 55	The objectives of the Fire Scenario Selection and Analysis (FSS) element are: • To select a set of fire scenarios for each unscreened fire area/compartments upon which fire risk estimates will be based,	Clarification	The objectives of the Fire Scenario Selection and Analysis (FSS) element are: • To select a set of fire scenarios for each unscreened fire area/compartments/ location upon which fire risk estimates will be based,
FSS-A1 and FSS-A2	There is no need to make a distinction between capability categories - the analysis should be performed at the level of partitioning done in accordance with Section 4.4	Clarification	Use the CCII/III words across all three categories with the addition of, as determined by the partitioning performed in accordance with Section 4.4

Index No.	Issue	Position	Resolution
FSS-A4	Identification of damage criteria for target failure is performed in FSS-B3 (which is mislabeled and should be FSS-B4), later in the standard, when other information necessary for determining damage is identified.	Qualification	Delete FSS-A4.
FSS-A5	In CCII and III, make language consistent with CCI	Clarification	Change “one or more fire scenarios” to “at least one fire scenario”
FSS-A5	Scenario should not be plural on first line of CC I.	Clarification	Select at least one fire scenarios of each . . .
FSS-A5, Discussion 1	The discussion incorrectly implies that an overall Capability Category is assigned to a FPRA. Also, use of the term “risk importance” is not in keeping with RG 1.200.	Qualification	. . . quantified at a level of detailed commensurate with both the risk importance significance of the scenario and the overall Capability Category of the FPRA.
FSS-A5, Discussion 2	Using the phrase “dominant fire risk contributors” is not in keeping with RG 1.200.	Clarification	. . . that are identified as the dominant significant fire risk contributors. . .
FSS-A6	Discussion: One aspect of confirmation by walkdown is the verification of information obtained from engineering drawings or other plant documentation. However, the objectives of walkdowns also include the confirmation of configuration specific factors that influence fire growth and damage behaviors to ensure that these factors have been properly accounted for in the fire growth and damage analyses (i.e., in the fire modeling efforts).	Clarification	Add the following Discussion 2. Because of the high spatial dependence of fire damage, walkdowns are a useful way to gather information during all phases of a FRPRA and should have been used extensively, although formal documentation is not always required. Inclusion of walkdowns as a specific element here is intended to ensure that walkdowns performed at this step have been systematic and formally documented.

Index No.	Issue	Position	Resolution
FSS-A7	A new CC II and III should be added that includes the procedural requirements for control room abandonment.	Qualification	CCII/III DEFINE the condition that are assumed to cause procedures require control room abandonment.
FSS-B1	In CC I, add “selected” as third word similar to CC II and III. The missing word implies a different meaning which is probably not intended.	Clarification	For each selected fire scenario.
FSS-B1	Third variation under discussion needs clarification	Clarification	A third variation is to determine the (1) minimum fire intensity capable of causing fire spread and/or damage to at least one member of the target set.....exceed this minimum threshold (the severity factor approach) and (2) to characterize the damaging fires encompassing low likelihood, but potentially risk contributing fire events using a two-point fire intensity model to represent fires larger than the minimum damaging fire.
FSS-B2	In CC II and III, clarify the fire growth profile.	Clarification	. . . fire growth profile to a maximum heat release rate and then decay, not requiring active suppression in every case (i.e., a time-dependent. . .
FSS-B2	Add Discussion 2, to describe types of fires that always need active suppression.	Qualification	Discussion 2: Active suppression will generally be needed in cable tray fires and other fire scenario’s with extensive combustibles (such as, transformer, lube oil fires or hydrogen fire where the fuel source is not isolated).
FSS-B3	There are two FSS-B3s. Renumber accordingly.	Clarification	FSS-B3 3 4, and so forth.

Index No.	Issue	Position	Resolution
Old FSS-B3, new FSS-B4	Add a discussion to CC I as created in the above comment, to warn analysts of targets that can not appropriately apply the general class of damage thresholds	Qualification	Discussion: Some target sets, specifically cable types, may be subject to low damage thresholds, lower than the general cable damage threshold for that cable type. When known, the lower thresholds must be used. (Kerite FR is a thermoset cable type that should be considered no better than thermoplastic cables.)
FSS-B6/B7 (old B6 new B7)	This requirement is written such that no credit can be given when detailed analysis is performed.	Qualification	Is the state of the art (CCIII) adequate to evaluate the protection provided by raceway wraps from either mechanical damage or direct flame impingement? If so, then for CCIII: If raceway wraps are credited: ESTABLISH a technical basis for their fire endurance rating and ANALYZE the protection provided by the wrap from either mechanical damage or direct flame impingement from a high-hazard source
FSS-C1, Discussion	Using the phrase “risk importance” is not in keeping with RG 1.200.	Clarification	For example, the relative risk importance significance of a fire scenario. . .
FSS-C1, Discussion	Extraneous indefinite article was used.	Clarification	. . . more sophisticated tools such as a compartment fire models.
FSS-C1, Discussion	Same issue identified in FSS-A5, Discussion 1 concerning the overall Capability Category of a FPRA.	Qualification	Delete the sentence “The capability category that the FPRA is aiming to achieve would also influence the selection of the modeling tools and approaches.”

Index No.	Issue	Position	Resolution
FSS-C2, Discussion	Using the phrase “risk importance” is not in keeping with RG 1.200.	Clarification	. . . a fire compartment’s risk importance significance . . .
FSS-C5	This requirement is not a technical, performance-oriented requirement.	Qualification	Delete this SR.
FSS-C10	It is important to identify the key parameters for all capability categories. It is also important to identify the sources of uncertainty for all capability categories. How the uncertainties are addressed may differ. See for example QU-E3 and QU-E4 of ASME (2005).	Clarification	<p>Include a new SR, FSS-C9 (there is currently no FSS-C9) across all categories: IDENTIFY key input parameters, where key parameters are those that have the most impact on the result.</p> <p>Include a new SR to address uncertainty in the parameter estimates, using DA-D3 of ASME (2005) as an example.</p>
FSS-C11	<p>The wording of the CC II and III SRs implies that plant-specific data should be assessed, but not actually used in the FPRA. The wording does not meet the intent expressed in the discussion.</p> <p>The terms reliability/availability <u>factors</u> are not in common usage.</p> <p>CC III reads INCLUDE a plant-specific assessment of system availability and USE generic estimates of reliability. Is this intentional or should both read reliability? The motivation behind this distinction is not clear.</p>	Qualification	<p>Compare with SR DA-D1 of the ASME Standard which addresses the issue of distinguishing between categories with respect to plant specific vs generic data.</p> <p>Is what is meant reliability and availability estimates? It would be better to use the terms failure probability and unavailability and discuss them separately. Generic estimates for failure probabilities are likely to be more appropriate than unavailabilities, since the latter are more likely to be affected by plant practices. However, if using generic estimates for availability, ensure that plant practice is to maintain the operability of credited detection and suppression systems.</p>

Index No.	Issue	Position	Resolution
FSS-C11	Assessing the effectiveness is a different function than assessing reliability or unavailability.	Qualification	Separate the effectiveness assessment as its own SR.
FSS-C12	Explain “- -” This notation is not explained. If it means that there is no requirement for CC I, then state this plainly.	Clarification	CCI There is no requirement
FSS-C13, Discussion	Using the term “importance” is not in keeping with RG 1.200.	Clarification	. . . will be commensurate with both the risk importance significance of the fire areas In the case of a detailed analysis of an importance a significant fire scenario
FSS-C13	CONDUCT WALKDOWNS to verify that the factors influencing the timing	Clarification	Add the following Discussion 2. Because of the high spatial dependence of fire damage, walkdowns are a useful way to gather information during all phases of a FRPRA and should have been used extensively, although formal documentation is not always required. Inclusion of walkdowns as a specific element here is intended to ensure that walkdowns performed at this step have been systematic and formally documented.
FSS-D1	The vulnerability of exposed structural steel to the effects of a fire should be a concern for areas housing high-hazard sources even for CC I and II. The SR as written limits this consideration to the turbine building. If there is a rationale for this, clarify in a Discussion note.	Qualification	Combine the SR across all three Capability Categories, and use the current wording for CC III, or provide a discussion on why this is not a concern for CC I and II.

Index No.	Issue	Position	Resolution
FSS-D1	The discussion in this SR mentioning lube-oil fires is incomplete	Clarification	Discussion 2: the prototypical ...an ensuing lube-oil fire. For the lube-oil fire, the effects of pooling, the flaming oil traversing multiple levels, and spraying from continued lube oil pump operation, at a minimum, are to be considered. However, the.....
FSS-D1	There is no Discussion "1" only Discussion "2". Renumber the discussion.	Clarification	Discussion 2-1: . . .
FSS-E1	Those requirements for fire modeling of single fire compartments are not clearly specified.	Clarification	Need to refer specifically to those relevant SRs for fire modeling of single compartment fires.
HLR FSS-F	There is no requirement to document the key sources of uncertainty	Qualification	Add a new SR under this HLR to address the documentation of the key sources of uncertainty, across all capability categories.
FSS-F8	Using the phrase "risk importance" is not in keeping with RG 1.200.	Clarification	. . . fire scenarios identified as potentially risk important significant ; . . .
FSS-F9	Current documentation requirements do not require documentation of walkdown	Qualification	Add SR which states, DOCUMENT walkdown. Also add the following discussion: Because of the high spatial dependence of fire damage, walkdowns are a useful way to gather information during all phases of a FPRA, and should be used extensively. Inclusion of walkdowns as a specific element here is intended to ensure that walkdowns performed at this step have been systematic and formally documented.

Index No.	Issue	Position	Resolution
Section 4.10 Ignition Frequency			
IF-A1	The specification of the historical period is incomplete.	Clarification	Use current nuclear power industry event history JUSTIFY excluded data that is not considered to be either relevant or applicable (e.g., due to changes in industry practices).
IF-A2	The discussion appears to contain a requirement in the first sentence.	Qualification	Include a new SR to read: CALCULATE fire frequencies on a reactor-year basis. INCLUDE in the fire frequency analysis the plant availability, such that frequencies are weighted by the fraction of time the plant is at power. (This is modified from IE-C3 of ASME (2005), which also includes a note explaining the term reactor-year.)
IF-A2 and IF-A6	Updating data should be performed using Bayesian methods.	Qualification	Add a new SR IF-A? Across all three categories: (Taken from IF-C2 of ASME 2005) When combining evidence from generic and plant-specific data, USE a Bayesian update process or equivalent statistical process. JUSTIFY the selection of any informative prior distribution used on the basis of industry experience.
IF-A4	The phrase “self-consistent methodology” is not defined in Section 2, nor explained elsewhere.	Qualification	Provide attributes or criteria to enable a user to ascertain if a given methodology for apportioning high-level fire frequencies is “self-consistent.”

Index No.	Issue	Position	Resolution
IF-A5	This SR seems to be redundant with SR IF-A3 which specifies that an ignition frequency greater than zero should typically be assigned.	Clarification	Could this SR be deleted and a discussion on the need to assign a non-zero frequency due to transients moved to the discussion of IF-A3? Are the presence of transient combustibles the primary basis for assigning a non-zero frequency in IF-A3?
IF-B4	Add new SR for IF, to ensure that the methodology for updating IF is documented.	Qualification	New SR, document the updating methodology, weighting methods, and assumptions used in this analysis that facilitates FPRA applications, upgrades and peer reviews.
Section 4.11 Quantitative Screening			
QNS-A1	<p>This requirement requires the screening criteria to meet the quantitative goals set in SR-QNS-B3. Why not specify the criteria here?</p> <p>In addition, since the FPRA may be used for a number of applications, there should be a requirement that the screening criteria be structured so that fire areas are retained when equipment (that is taken credit for in the CCDP calculation) that is taken out of service leads to a significant change in CDF.</p>	Qualification	Include the criteria from QNS-B3 here, but note comment below.

Index No.	Issue	Position	Resolution
QNS-B3	<p>The CCI requirement to “VERIFY that the Quantitative Screening Process does not screen the highest risk fire areas” is not very useful, and could allow the sum of the quantitatively screened areas to be a significant risk contributor.</p> <p>There are several options to address this.</p>	Qualification	<p>Option 1: Add discussion to CC I: Discussion: The highest risk fire areas are any areas that have a fire risk within an order of magnitude of the highest risk fire area. For example, if the highest risk area has a CDF of 1E-5/year, any area with a CDF of 1E-5 to 1E-6/year, is considered a “highest risk fire area.”</p> <p>Option 2: Make Capability Category II also apply to Capability Category I; Verify that the Quantitative Screening Process does not screen the highest risk fire areas: C The sum of the CDF contributors for all screened fire compartments is less than 10% of the estimated total CDF for internal events, <u>and</u> C The sum of the LERF contributors for all screened fire compartments is less than 10% of the estimated internal events LERF.</p> <p>Option 3: Require that the sum of the quantitatively screened contribution be included in the FPRA risk results: Verify that the Quantitative Screening Process does not screen the highest risk fire areas., <u>and</u> The sum of all screened fire compartments is included in the FPRA results and identified as a source of uncertainty.</p>

Index No.	Issue	Position	Resolution
Section 4.12 Circuit Failures			
CF-A1, 2, 4, 5, 6	These SRs do not support the HR, which is to identify cable and circuit failure modes. These SRs are all stated as REVIEW and/or CONFIRM.	Clarification	Resolve inconsistency.
CF-A3	This SR is inconsistent with ES-B3, which identifies two (CC I and CC II) or three (CC III) spurious actuations.	Clarification	Resolve inconsistency.
CF-B1	This SR is written as REVIEW and CONFIRM the assigned conditional failure probabilities for fire-induced failure probabilities. There should be a reference to the SR which requires the estimation of the failure probabilities.	Qualification	Provide a cross-reference to the SR(s) that address quantification of the failure probabilities, OR write this requirement to address that issue directly.
Section 4.13 Human Reliability Analysis			
HLR-HRA-A	<p>This HR addresses identifying human actions relevant to the credited functions and including them in the PRA model. This is a combination of HLR-HR-E of ASME Standard, which is the identification of operator responses, and HLR-HR-F, which is the definition of HFEs. The SRs only support the second of these since they relate only to HFEs.</p> <p>HFEs are not only included in the accident sequence models (see comment on section 4.8) but also in the fault tree models.</p>	Qualification	<p>Requirements are needed to address the identification of responses, in parallel to HLR-HR-E of the ASME standard.</p> <p>The FPRA shall identify . . . and shall include the corresponding human failure events failures of these actions in the FPRA accident sequence model as appropriate.</p>

Index No.	Issue	Position	Resolution
HRA-B2 and B3	These can be deleted, since they are addressed in HRA-B1 which requires the HEPs be calculated consistent with the requirements of HR-G of ASME 2005.	Clarification	Delete HRA-B2 and HRA-B3.
Section 4.14 Seismic Fire			
SF-A4	CC I: There is no requirement other than to review the plant response procedures.	Clarification	Add a requirement to assess the significance of the results of the review.

Index No.	Issue	Position	Resolution
Section 4.15 Fire Risk Quantification			
FQ-A1	The plant damage state is not well defined.	Qualification	For each fire scenario selected . . . Into a plant damage state corresponding to the FPRA accident sequence model, i.e., initiating event and equipment failed including consideration of insights from the Circuit Failure analysis (see the CF requirements), to provide the boundary conditions for the evaluation of the conditional core damage probability using the appropriate accident sequence model.
FQ-A3	The plant damage state is not a quantification factor.	Qualification	For each fire scenario . . . circuit failure likelihoods (per the CF requirements), and the conditional core damage probability corresponding to the plant damage state (per SR FQ-A1).
FQ-A3	The evaluation of uncertainty in this SR duplicates HLR UNC-B.	Qualification	. . . and the plant damage state (per SR FQ-A1). <u>and</u> INCLUDE uncertainty evaluations consistent with: <ul style="list-style-type: none"> • the other technical elements in the Standard and their requirements; and • the Internal Events PRA QU and LE requirements (ASME 2005).

Index No.	Issue	Position	Resolution
FQ-A3	There is no requirement to establish an appropriate accident sequence truncation frequency.	Qualification	Provide a requirement to establish an appropriate accident sequence truncation frequency.
HLR FQ-B	There is no requirement to review the results of the FPRA quantification, as is done by SRs QU-D1, QU-D3, and QU-D4 in the Internal Events PRA Standard (ASME 2005).	Qualification	Provide requirements to review the results of the FPRA quantification.
Section 5 FPRA Configuration Control — No objection			
Section 6 FPRA Peer Review			
Section 6.2.1	The requirement is for documented evidence of familiarity with EPRI TR1011989/NUREG/CR-6850.	Clarification	Absent a certificate of attendance at the workshops, what would constitute documented evidence?
Section 6.3.1	Insufficient direction has been established for plant partitioning	Qualification	Perform a selective review of the plant partitioning analysis by walkdown is recommended.
Section 6.4	A section on the peer review of expert judgment is not provided.	Qualification	<p>6.4 Expert Judgment</p> <p>This standard adopts in whole the provisions for peer review of expert judgment as set forth in Section 6.4 of ASME 2005, as modified by the following:</p> <p>C Whenever ASME makes reference to the ASME standard, it should be interpreted as a reference to the equivalent section of the FPRA standard.</p>

Index No.	Issue	Position	Resolution
Section 6.5	A section corresponding to the section on peer review of the PRA Configuration Control in the ASME Standard is not provided.	Qualification	<p>6.5 FPRA Configuration Control</p> <p>This standard adopts in whole the provisions for peer review of the FPRA Configuration Control as set forth in Section 6.5 of ASME 2005, as modified by the following:</p> <ul style="list-style-type: none"> C Whenever ASME makes reference to “PRA”, “FPRA” is substituted. C Whenever ASME makes reference to the ASME standard, it should be interpreted as a reference to the equivalent section of the FPRA standard.

Index No.	Issue	Position	Resolution
Section 6.6	A section corresponding to the section on documentation of the peer review in the ASME Standard is not provided.	Qualification	<p>6.6 Documentation</p> <p>This standard adopts in whole the provisions for documentation of the peer review of the FPRA as set forth in Section 6.6 of ASME 2005, as modified by the following:</p> <p>C Whenever ASME makes reference to “PRA”, “FPRA” is substituted.</p> <p>C Whenever ASME makes reference to the ASME standard, it should be interpreted as a reference to the FPRA standard.</p> <p>C Address the clarification in RG 1.200, Table a-1, index No. 6.6.1.</p>
Appendix A	As identified in the General Comments, the staff has not reviewed this non-mandatory Appendix and has no position on it at this time.		
Appendix B	As indicated in the General Comments, the staff has not reviewed this non-mandatory Appendix and has no position on it at this time.		