September 10, 2001

Mr. Gerry Eisenberg
The American Society of Mechanical Engineers
3 Park Avenue
New York, NY 10016-5990

Dear Mr. Eisenberg:

On June 14, 2001, ASME's draft, Revision 14a, entitled "Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications" was distributed for public review and comment. We are pleased to have an opportunity to comment on Revision 14a. This revision represents the culmination of a significant effort by the nuclear community and will have a major influence on the advancement of risk-informed regulation.

The Commission has continually noted the importance of high quality PRAs for success of risk-informed regulation. We believe that a PRA consensus standard is an integral part in providing the level of confidence that the risk insights derived from the PRA results are both technically sound and technically defensible. Further, at the commencement of this effort by ASME, we had indicated in a correspondence to Ms. Ling in February of 1998 that *"development of a PRA standard can provide a level of confidence to the NRC staff regarding the technical quality of a PRA utilized by a licensee to support a risk informed initiative. Such a standard can, therefore, result in a more focused technical review of the PRA by the NRC staff and thereby make more efficient use of both NRC and industry resources, while still ensuring the safety of the decisions being supported by PRA insights."* We believe that Rev 14a, with some modification, can meet this objective.

The staff has carefully reviewed this latest revision considering the ASME Principles/Objectives for a PRA standard, (Enclosure 3). Based on these, and using the criteria in SECY-00-0162, we have concluded that Revision 14a, modified to address concerns discussed later, would be a standard that

- addresses PRA quality,
- determines where there are weaknesses and strengths in the PRA results and therefore can be useful in the decision-making process,
- provides assistance to the staff in performing a more focused review of licensee PRA submittals, and
- provides assistance in making a more efficient use of NRC resources.

Although there has been substantial progress with Revision 14a, we have concerns that have not been satisfactorily addressed in Revision 14a, most of which were raised during the development of this standard. We believe these concerns can be resolved, so that the NRC can endorse the standard without exception which is our preference. The concerns are described in Enclosure 1 and involve requirements that are not aligned with either the ASME principles and objectives developed for this standard or with NRC guidance (e.g., Regulatory Guide 1.174). We have proposed specific language to resolve these concerns.

In addition to the comments provided in Enclosure 1, we have also enclosed further comments in Enclosure 2. These comments are more "editorial" in nature for ASME consideration and only include suggestions for improved clarity.

We believe that Revision 14a, given satisfactory resolution of the concerns in Enclosure 1, is a standard that will be technically sound and useful in decision-making and improving efficiency and effectiveness, and increasing public confidence. We look forward to the publication of this standard and again commend ASME on this effort. We are prepared to discuss and clarify these comments to support your work to finalize the standard in the upcoming months. If you have any questions, please contact Mary Drouin at (301) 415-6675 or me at (301) 415-5790.

Sincerely,

/RA/

Scott Newberry, Director
Division of Risk Analysis and Applications
Office of Nuclear Regulatory Research

Enclosures: As stated

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G:\NRC letter to ASME on rev. 14a plus attach (9-01)

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Enclosure 1
TECHNICAL CONCERNS

Concerns where the NRC may take exceptions to the present ASME draft, Revision 14a, “Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications”.

Chapter 1 - INTRODUCTION

The following comments relate to requirements on the goal and structure that are not consistent with the ASME Principles and Objectives 1or 4 (i.e.,the requirements are either not well defined or incomplete).

1.1 In paragraph 1.4.2, the second sentence reads “All PRAs using this Standard shall satisfy each of these HLRs, ***but to differing degrees***, as explained in Subsection 1.3." A Standard is either complied with or not, there are no degrees of meeting a standard; delete the bolded word.

1.2 Table 1.3-1:

- In the first row, the term system or train level is used in Category I, SSC for Category II, and component for Category III. Since SSC is an acronym for structure, system or component, and structures are not mentioned in Categories I and III, this is not an appropriate discriminator. Perhaps what is meant is that in Category II, the requirement should be for discrimination at the component level for the significant risk contributors. However, this interpretation implies that for Category III, the model should be capable of discriminating at the component level for all contributors. This however is contradicted in the SRs, see for example, SY-A7.

- In row 2 there is no distinction between Categories II and III. Again, perhaps what is meant is that for Category II, plant-specific data should be used for the most risk-significant contributors. A distinction is needed to explain the distinction in the SRs for this criteria.

Chapter 2 - DEFINITIONS

The following comments relate to definitions that are not consistent with the ASME Principles and Objectives 1, 2 or 4 (i.e.,the requirements are either not well defined, not in concert with current good practices, or incomplete). We believe the proposed changes will minimize the potential for misuse of these terms.

2.1 Availability: Replace with: The availability of an SSC is the probability that it is capable of supporting its function if required to do so. (see unavailability).

2.2 Dependency: Replace with: Dependent events are determined by, influenced by, subordinate to, or correlated to other events or occurrences.

2.3 Event tree: An event tree is not a network. Replace the phrase “A quantifiable logical network” by “A logic diagram”.

2.4 Failure mode: A failure mode is not a mechanism. Replace with: A specific functional manifestation of a failure, i.e., the means by which an observer can determine that a failure has occurred (e.g., fails to start, fails to run, leaks).

2.5 Failure rate: The second part of the phrase beginning with the word expressed is an example of how it might be evaluated, not a requirement. Replace definition with: “expected number of failures per unit time, evaluated, for example, by the ratio of the number of failures in a population of components to the total time observed for that population.”

2.6 Front line system: provide either direct safety function or process function (as opposed to support systems that ensure the front line systems can do their job), e.g., condensate system is sometimes modeled and is a front line system. We suggest changing the definition to: "A system (either safety or non-safety system) that is capable of directly performing one of the accident mitigating functions (e.g., core or containment cooling, coolant makeup, reactivity control, and reactor vessel pressure control) modeled in a PRA."

2.7 Human Error Probability: Add a second sentence: “The HEP is the probability of the human failure event.”

2.8 Human failure event: In the context in which the term human failure event is used in the Standard, this definition is incorrect. Replace with: A basic event that represents a failure or unavailability of a component, system, or function that is caused by human inaction, or an inappropriate human action.

2.9 Human Reliability Analysis: Replace “errors” with “events”.

2.10 Internal Event: This needs to be Internal Initiating Event. If so, the definition only needs to relate back to the Initiating Event definition, and specify that it is an event that occurs internal to the plant.

2.11 Key safety functions: remove the word “bypass” from the phrase “containment bypass integrity”.

2.12 Large Early Release: This definition should be made consistent with the definition of LERF in (revised) Reg Guide 1.174. In particular, the definition should include the idea that the potential for early health effects exists with a large early release.

2.13 Recovery models: Definition is inaccurate, and contains unnecessary words, e,g, the phrase act, process, or instance. Since the term does not actually appear to be used, it can and should be deleted.

2.14 Reliability and unreliability need to be defined since they are used in the standard. These represent different parameters than availability and unavailability.

Reliability – the probability that system or component performs its specified function under given conditions upon demand or for a prescribed time.

Unreliability - the probability that system or component will not perform its specified function under given conditions upon demand or for a prescribed time.

2.15 Risk achievement worth: Remove the phrase “due to testing, maintenance or failure”. It is unnecessary.

2.16 Split fraction: Replace with: A unitless quantity that represents the conditional (on preceding events) probability of choosing one direction rather than the other through a branch point of an event tree. Since “relative frequency” and “degree of belief” are different concepts and this does not add to the definition, delete this second sentence.

2.17 Unavailability: Replace “fraction of time” with “probability”. The last part of the phrase should be deleted: partitioning the contributions to unavailability is not required. Leave it as a general statement.

2.18 Uncertainty analysis: This is too focused on quantification. Replace with “the process of identifying and characterizing the sources of uncertainty in the analysis, and evaluating their impact on the PRA results and developing a quantitative measure to the extent practical.”

Chapter 3 - RISK ASSESSMENT APPLICATION PROCESS

The following comments relate to requirements on the application process that are not consistent with the ASME Principles and Objectives 1or 4 (i.e.,the requirements are either not well defined or incomplete).

3.1 Figure 3.1-1 Application Process Flowchart: If Box A is to represent the definition of what is required of the PRA for the application, the first issue in Box 4 should be the identification of the relevant SRs. It would be more logical if the determination of the capability categories were to follow this. It is necessary to know what the PRA needs to do before determining which category is necessary. The wording throughout the chapter should emphasize this (particularly with respect to the Box 4 discussion). However, for many of the SRs, whether the PRA element is defined as Category I, II, or III doesn't matter, since the PRA can be used in each case. It simply means that the PRA input to the decision will be increasingly more relevant in going from Category I through III. SC-B1 is one example of such an SR. It is only when the SR is written such that Category I would not allow the modeling of the effect of the change whereas Category II would for example, that the Category matters. DA-B1 might be such an example for some applications.

3.2 If a PRA does not meet a SR and it is needed for the application, the standard allows the user to "correct" using "supplementary analyses; however, Rev. 14a does not provide any requirements concerning "supplementary analyses." Use of supplementary analyses in place of meeting one or more SRs means that a portion of the PRA does ***not*** meet the Standard. The Standard needs to make this point very clear.

Chapter 4 - RISK ASSESSMENT TECHNICAL REQUIREMENTS

The following comments relate to technical requirements that are not consistent with the ASME Principles and Objectives 1, 2 or 4 (i.e.,the requirements are either not well defined, not in concert with current good practices, or incomplete).

4.1 In the Section 4.4 tables, some SRs use action verbs such as JUSTIFY, CHECK, SHOW, DEMONSTRATE, CONFIRM, and DETERMINE. In some cases adequate criteria or guidance are provided on how to meet the requirements, in other instances the guidance is vague and in others non-existent. Criteria such as engineering analyses, related technical analyses, sensitivity studies, experiments, or tests, etc. are examples of acceptable guidance or criteria. A few examples of SRs where there is not any guidance or criteria include:

IE-C1: "...JUSTIFY each such credit. Data from the initial year of operation may be excluded; if excluded, JUSTIFY."

SY-A7: "...JUSTIFY the use of limited..modeling."

SY-A8: "...JUSTIFY an alternative assumption."

DA-D4: "CONFIRM that the Bayesian updating does not produce a posterior distribution...."

4.2 In the Section 4.4 tables, the requirement to document the assumptions is inconsistent from element to element. In many of the elements, it is not clear that the assumptions that can impact the results, their bases and impacts are required to be documented. For example, QU-F3 only the assumptions regarding uncertainty are required to be documented and only for Category III. The assumptions that can impact the results, their bases and impact need to be documented and this needs to be consistently stated for each element.

4.3 IE-A6: Use of interview information from other plants for the purpose of identifying initiating events is not valid for Category II. It is recommended that the SR for Category II be the same as for Category III.

4.4 IE-A7/IF-D2: It seems to be inconsistent that IE-A8 and IE-A9 expand across both Categories II and III but IE-A7 does not. All of these seem to be striving for a thorough examination of all IEs which should be a requirement for a Category II PRA. IE-A7 should be changed such that the requirement for Category III also apply for Category II. Also note that IF-D2 addresses the same subject matter for internal flooding events as IE-A7 and IE-A8 does for other internal events (i.e., the treatment of precursors and support system alignments). To be consistent with IE-A7 and IE-A8, the requirements in IF-D2 should not apply for a Category I PRA.

4.5 IE-A10:This SR is the only place where the issue of modeling multi-unit site effects is raised. The range of multi-unit effects can vary depending upon how independent the units are both in terms of shared systems and shared equipment locations. In addition to identifying accident initiators that impact multi-units (e.g., LOSP, a loss of a common cooling water system, or an internal flood initiator), there are other modeling considerations that need to be addressed in the SRs. In the systems and accident sequence analysis, such things as assumptions about how to divide shared systems among units can be an issue in that they can be done incorrectly (e.g., by ignoring the needs of Unit 2 while modeling Unit 1). SRs addressing how to model shared systems seem to be necessary in both of these PRA elements. Also the modeling of cross-ties between separate systems in different units (both electrical power and cooling water systems) should be addressed as an issue not only in the systems analysis but also in the accident sequence analysis. The internal flooding requirements need to indicate that flooding impacts on one unit from sources related to another unit must be included in the PRA. Finally, the success criteria element needs to address situations where calculations are required to show whether a cross-tied or shared system can provide sufficient flow or power for the needs of multi-units.

4.6 IE-C2: The Category II SR should be the same as the Category III SR. This would be consistent with the treatment of component data addressed in DA-D1 and the general criteria identified in Table 1.3-1.

4.7 IE-C2: The way this SR is written seems to imply there is a distinction between what is insufficient data for Categories I and II and what is insufficient data for Category III. If this is so, the distinction should be clearly defined. Otherwise, the requirements for Category II should be the same as for Category III.

4.8 IE-C5: In this requirement the goal should be to use as broad a time period as possible for collecting data. Unrepresentative events should be screened (e.g., the first year of operational data that are no longer possible due to plant changes). At the very least, there should be a new requirement for all three Categories that states "USE as broad a time for data collection that is consistent with the current plant status." Time trend analysis can be limited to the Category III PRA as currently indicated in IE-C5.

4.9 IE-C8: This SR should have a requirement to use the partial system failure data referred to in IE-A7 when quantifying an IE fault tree.

4.10 IE-C9: Some minimal criterion is required in Category I for the recovery action quantification requirements identified in this SR. Plant-specific but conservative estimates may be acceptable. The requirements should be consistent with the requirements in the HRA section of the Standard (specifically those in HR-G which addressed quantification as does IE-C9 and not HR-H1 which deals with the inclusion of recovery actions in the PRA).

4.11 IE-C12: The requirements for Categories I and II are not minimal. At least for Category II, there should be a list of which features should be considered.

4.12 AS-A9/SC-B1/SY-B5/HR-G4: A discrepancy exists between the requirements in these SRs which all address the types of thermal-hydraulic calculations that are required to determine accident progression parameters and system success criteria. We believe that the amount of conservatism and type of calculations (i.e, plant-specific or generic) that can be used in success criteria calculations (addressed in SC-B1 and SY-B5) should be consistent with the calculations used to determine accident progression parameters including timing information (addressed in AS-A9 and HR-G4). Consistent with the general guidance in Table 1.3-1, generic, conservative calculations applicable to the plant are allowable for a Category I PRA (decisions made based on the use of the PRA would be affected by the use of these calculations). Realistic (i.e., best estimate) calculations representative of the plant (could be generic) are acceptable for a Category II PRA (decisions made based on the use of the PRA would likely be unaffected by the use of these calculations). Conservative calculations may be appropriate for a Category II PRA if their use does not impact the dominant contributors. A Category III PRA requires realistic (best estimate), plant-specific calculations (decisions made based on the use of the PRA would not be affected by the use of these calculations). The requirements in these SRs should be changed accordingly using the consistent set of terms suggested above.

4.13 AS-A10: This requirement seems to be the only SR where the differences in the logic structure between categories is addressed. It differentiates between functional level and systemic event trees. However, although it's more difficult to model the operator responses well, a PRA model based on a functional level event tree can be just as detailed as a systemic event tree. It is not clear therefore that the Category I definition is appropriate. The definitions for Categories II and III are acceptable. Perhaps the distinction should be that the functional representations are bounding in the sense that if there are distinctions between timings of operator actions for different systems that can fulfil the function, the most bounding should be used. However, a further distinction is in the choice of systems for which to take credit. For example, in a BWR, the fire water system might not be credited in a Category I whereas it would be in Category III. Somehow, this needs to be reflected in the SRs. It is not reflected in the success criteria section. Also, if functional event trees are used, top logic fault trees for each function need to be developed that account for system interactions and dependencies. There needs to be an SR in this or some other section (e.g., in the peer review chapter) that specifically addresses these high level logic trees.

4.14 SC-B2: "Minimize" is subjective, and not a good criterion for a Standard. Category II and III, the use of expert judgment should be the same and restricted as noted. Leave Category I blank which implies that expert judgement can be used.

4.15 SC-C2: Documentation of the rationale for the use of expert judgement should also be required for a Category I PRA especially since SC-B2 requires that its use be minimized. If the rationale is not documented, it is not possible to know if its use has been minimized.

4.16 SY-A9: This requirement should also be applicable for a Category I PRA. According to SY-A7, a Category I PRA can have detailed system models. Not modeling trains separately would violate the requirements in SY-A7.

4.17 SY-A18: The conditions listed in this requirement for a Category II and III PRA should also apply to a Category I PRA. If you did not do them, then you would not be modeling unavailability "consistent with the actual practices and history of the plant for removing equipment from service."

4.18 SY-B1: Modeling inter-system common cause failures is beyond the state-of-the-art and should be restricted to Category III.

4.19 SY-B9: The exception listed in this SR should be removed. Support system requirements that present circular logic problems should be removed from a fault tree during the fault tree linking process. When constructing the initial fault tree, all support systems should be included since a support system may be required in one use of a fault tree but not in another during the fault tree linking process. Efforts to eliminate support systems prior to the fault tree linking process can result in incorrect models.

4.20 HR-C2: The requirement to add failure modes identified during data analysis should apply to a Category II PRA and possibly all three categories.

4.21 HR-G1/QU-C1: HR-G1 states that a detailed analysis of HEPs is required for all "HFEs included in the model." Detailed analysis is only required for those post-accident HEPs that survive the initial quantification. Per QU-C1, screening HEPs could be used in the initial quantification. These two SRs should be reworded and made consistent. Since the intent of QU-C1 is related to performing a sensitivity study to identify cutsets with multiple HFEs, to avoid confusion with screening suggest deleting the second sentence, and adding on to the first sentence, "by, for example, performing a sensitivity study with HEPs set to values higher than those used as screening values. This avoids premature truncation of these cutsets."

In HR-G1, in Category II include the sentence: "Screening values may be used for HEPs that appear only in non-dominant sequences".

4.22 DA-D1: It should not be a requirement to "ADJUST prior distribution to account for plant-to-plant variability (Categories II and III)", nor to "USE 2-stage Bayesian updating (Category III)". This is too prescriptive. It is sufficient to replace the second sentence in Categories II and III by " Either the prior distribution is chosen as a non-informative prior, or represents the variability in industry data." Delete the third sentence in Category III, leaving Categories II and III the same.

4.23 DA-D3: Undefined modifiers are used in some SRs and should be replaced with numerical guidelines. For example, the use of "contribute measurably to CDF and LERF" is used in the Category I requirement for DA-D3 to identify which basic events need an uncertainty characterization. One possible interpretation for this modifier is all parameter estimates should have a mean value and a representation of their uncertainty intervals since "everything can be measured." A numerical guideline would be beneficial.

4.24 DA-D5: There is a disconnect with the systems analysis (SY-B1) which says nothing about how to model the CCF terms. For Category I, a beta factor model (i.e., a single global CCF term (failing all trains for redundancies greater than 2)) is acceptable, with a more detailed model for Categories II and III. This should be included in the systems analysis section.

4.25 IF-C5: The second criterion, referencing the volume of flood insufficient to cause failure, is not sufficient. The nature of the flood is also important: if it causes a spray, it could still fail equipment even if it is from a low volume source. An additional criterion related to protection for components (e.g., against spray or against immersion) should be included.

4.26 IF-D5: The reference to the requirements of DA-C should be clarified. Some of those SRs are not applicable, and others are uncertain. This section should refer to IE-C instead since that is where the requirements for IE frequency determination are identified. Identify those requirements that are relevant.

4.27 Table 4.4-8f: This table should include the requirement to document the assumptions used in the quantification.

4.28 QU-A4 Category I: The fact that recovery actions are not required for a Category I PRA is not consistent with the requirement in HR-H1. QU-A4 requires that recovery actions be included for all three Categories of PRAs whereas HR-H1 does not. QU-A4 should be changed in the Category I column to be consistent with HR-H1.

4.29 QU-D3 and QU-D5: The distinctions between the categories are unnecessary. For example, in QU-D3, the purpose of the review of significant differences is, at least in part, to confirm that the outliers are unique. In the case of QU-D5, the requirement should be the same for all three ca (Category I), there is no point in evaluating importance measures if the results are not examined, and reviewed to see if they make sense. Therefore, the requirement should be the same for all three categories.

4.30 QU-E3: Suggest the following rewording:

Category II: ESTIMATE the uncertainty interval of the overall CDF results. EVALUATE the uncertainty intervals associated with parameter uncertainties taking into account the "state-of-knowledge" correlation between event probabilities. CHARACTERIZE the uncertainty associated with key model uncertainties.

Category III: EVALUATE the uncertainty interval of the overall CDF results resulting from parameter uncertainties and those model uncertainties explicitly characterized by a probability distribution. EVALUATE the uncertainty intervals taking into account the "state-of-knowledge" correlation between event probabilities. CHARACTERIZE the uncertainty associated with those key model uncertainties not explicitly characterized in the model.

4.31 QU-F3: The requirement to document and ***assess the significance of*** important assumptions and causes of uncertainty should apply to all categories. This is essential for risk-informed applications.

4.32 LE-C2: The use of a permissive (Repair of equipment may be considered if appropriately justified) is not a valid discriminant between categories. Therefore, the Standard, as written, is the same for Categories II and III. If a distinction is to be made it will be necessary to modify Category II to preclude taking into account repair.

4.33 LE-C10: Here Category II appears more restrictive than Category III. Both categories say "TREAT containment bypass in a realistic manner." However, Category II adds "JUSTIFY any credit taken for reducing the class of the release by scrubbing," while Category III has no such requirement. Categories II and III should be the same.

4.34 LE-D1: Failures of containment seals, penetrations, hatches, etc. should also be specified as containment failure modes that need to be addressed for Category II at least, and probably for Category I.

4.35 LE-F2: Category I appropriately calls for a qualitative assessment of key sources of uncertainty. In previous versions of the Standard, Category II called for characterizing the 'quantitative' significance of dominant contributors via sensitivity studies, and Cat III called for 'quantitative' assessment of uncertainty. In the present Revision 14a all mention of 'quantitative' is dropped from Categories II and III. This should be rectified by specifying quantitative characterizations and assessments respectively for these categories.

4.36 LE-G7: Documenting sources of uncertainty should be a requirement for all Capability Categories.

Chapter 5 - PRA CONFIGURATION CONTROL

The following comments relate to requirements on PRA maintenance and update that are not consistent with the ASME Principles and Objectives 4 or 5 (i.e.,the requirements are either incomplete or do not define a sufficient peer review process).

5.1 Section 5.4: Currently, a peer review is not required for any changes to the PRA over time. As a PRA is maintained, it may go through substantial changes over time, such that the original bases (e.g., assumptions) could be significantly different. There needs to be some requirement for a peer review of the changes to the PRA from its maintenance and this requirement should be linked to Chapter 6. This peer review, for example, may be imposed when there is an application.

5.2 Section 5.4: The changes to a PRA due to PRA maintenance are required to meet the requirements in Section 4 of the Standard. Which Category of PRA the changes should meet is not specified. The changes to the PRA should have to match the current categorization; that is, if change affects a certain SR, and in the current PRA this SR meets Category II, then the change affecting this SR should also meet at least Category II.

Chapter 6 - PEER REVIEW

The following comments relate to requirements on PRA peer review that are not consistent with the ASME Principles and Objectives 1,4 or 5 (i.e., the requirements are either not well defined, incomplete or do not define a sufficient peer review process).

6.1 Sections 6.1 and 6.3: Both Sections 6.1 and 6.3 establish that the purpose of the peer review is to determine if the methodology and the implementation of the methodology for each PRA element meet the requirements of Section 4 of the Standard. This statement, while accurate, implies more of an audit than a peer review. We recommend that the objective be expanded to include that the objective is also to determine that the results are supported by the analysis and that the analysis has been performed correctly (i.e., in compliance with the technical requirements of Chapter 4). Section 6.1 states that the peer review does not have to assess all aspects of the PRA against all the requirements in Section 4 and Section 6.3 indicates that it is up to the peer reviewers to determine the scope and depth of the review. Thus, both sections establish that the peer review team is to audit the PRA models rather than to perform an independent verification of every model.

Currently, Section 6.3 does not provide a minimum set of review topics for each of the PRA elements. Instead it provides "specific suggestions" for the peer review team to consider during the review. As such, this section is inconsistent with the purpose of a standard (i.e., to provide a minimum level of acceptability which in this section would help ensure a level of consistency among peer reviews) and leaves open the possibility that the selected scope of the peer review will be inadequate to ascertain the quality of the PRA. The "suggestions for the peer review team to consider" listed for each PRA element thus should be made a minimum set of review topics required for all peer reviews. This minimal set provides flexibility to the peer reviewer in deciding the scope (e.g., how many fault trees and which ones to review), and depth (e.g., the entire structure of the fault tree or selected parts) of the review.

One of the minimum review topics that must be included for each PRA element is the need to review and assess the assumptions and approximations that went into the analysis. This is currently missing from the review list provided for each PRA element (with the exception of the Success Criteria element in Section 6.3.3 which suggests that any assumptions impacting the generic or plant-specific bases for the system success be reviewed). The HLRs and SRs in Chapter 4 recognize that the assumptions made play a crucial role in the results of the PRA, and call for the identification, listing and documentation of assumptions made during the development of the various technical elements. A primary function of the peer review should be to identify those assumptions and models that have a significant impact on the results of the PRA and to pass judgement on the validity and appropriateness of the assumptions. This should be specifically mentioned in Section 6.3 and added to the mandatory review lists for each PRA element. In addition, the peer review report needs to include a discussion of which results are affected by what assumptions.

Finally, even though the peer review only audits portions of the PRA, the models that are reviewed should be compared against all SRs for the applicable element. For example, for each event tree selected for review, it needs to be determined which requirements in Section 4 have been met. Sections 6.1 and 6.3 appear to be contradictory on this fact.

Section 6.1 states that "the peer review need not assess all aspects of the PRA against all Section 4 requirements" while Section 6.3 indicate that the HLRs and the SRs of Section 4 "shall be used by the peer review team to assess the completeness of a PRA element." Both sections need to make it clear that the models selected for review must be reviewed against all of the applicable HLRs and SRs in order to determine the PRA quality.

6.2 Section 6.1.2, last paragraph: This paragraph indicates that ASME finds the peer review process as described in NEI-00-02 to be an acceptable review methodology. It is not clear what is meant by this since there are differences between the Standard and NEI-00-02 and it has not been accepted by all stake holders. These differences include not only those with respect to the technical requirements but also those related to the qualifications of the peer reviewers and the level of review that is performed. Reference to NEI-00-02 should be eliminated in this section.

6.3 Section 6.2.3, last paragraph: As currently written, this paragraph allows one to do the review with any number of people and with less than the required experience as long as you document what you do. In theory, the review could be done with as few as one person who worked on one PRA. This exception is too lenient and this paragraph should be deleted. However, in the preceding paragraph, a review team of five analysts is the preference. The standard could be changed to note and recommend this preference, but allow for a minimum of three individuals with supporting justification.

6.4 Section 6.3: The guidance for reviewing the various PRA elements does not mention review of the uncertainty assessments. The HLRs and SRs in Chapter 4 call for uncertainty assessments, where appropriate, in numerous places and these assessments should be explicitly mentioned in the peer review guidance. Review of sensitivity studies is mentioned in the guidance for the quantification review but should also be mentioned under other sections, at least under the LERF review.

6.5 Section 6.3.5: The review of the HRA should also include a review of the process used to identify the HFEs (both pre- and post- initiating event HFEs), and definitions of the HFEs that are the more important contributors.

6.6 The fifth bullet in Section 6.3.5 states “HEPs for the same human action but with different times required for success.” This should not be meant to imply that available time is the only critical PSF. It would be better to say something like “HEPs for the same function but under the influence of different PSFs.”

6.7 The sixth bullet in Section 6.3.5 needs to be clarified to indicate that multiple HEPs in a sequence need to be reviewed for dependencies, particularly if there is concern that multiple HEPs in cutsets would cause the cutsets to be truncated.

6.8 Section 6.3.6: The list of “typically reviewed data analysis issues” should include review of selected “non-dominant component failure modes” to ensure that non-dominant failure modes are non-dominant for legitimate reasons, and not simply non-dominant because of some error in the data analysis. Some events with high RAWs should be examined since they have the potential for contributing significantly to CDF or LERF if the data analysis was performed incorrectly.

6.9 Section 6.6.1: The Standard needs to assure that the peer review process assess the significance when the technical requirements of the Standard are not met (i.e., what impact the exception or deficiency has on the PRA results). Paragraph (g) of Section 6.6.1 calls for the identification of exceptions and deficiencies with respect to the Supporting Requirements by the peer reviewers, but not for the assessment of the significance of these exceptions and deficiencies. A phrase should be added to paragraph (g) to include such an assessment by the reviewers.

Enclosure 2
EDITORIAL

Comments that are "editorial" in nature for ASME consideration and included as suggestions to improve clarity.

General Comments and Observations

EdG.1 There is an opportunity to expand the stated purpose of the Standard to also be a means to improve existing PRAs. It would be beneficial if PRA upgrades try to eliminate weaknesses identified by the peer review process.

EdG.2 In the current draft of the ANS external event PRA Standard, guidance is provided to help establish the context of the requirements, and therefore, help in interpreting the requirements to ensure appropriate implementation. In Revision 10 of the ASME Standard, similar supplemental guidance was provided in a non-mandatory appendix. It is our recommendation that future revisions of the ASME Standard be enhanced by including this additional guidance information.

One of the Principles and Objectives for the ASME Standard is to "...where appropriate, identify one or more acceptable methods." Except in few places, Rev 14a does not identify acceptable methods. In adding the above guidance, it is recommended that this guidance include identification of one or more acceptable methods.

EdG.3 There are numerous instances of typos, incorrect spelling, font variations and other format errors throughout this draft of Rev 14.

Chapter 1 - INTRODUCTION

Ed1.1 Section 1.2: The last sentence in this Section reads: "In addition, this Standard establishes requirements for a limited LERF analysis sufficient to evaluate the large early release frequency (LERF) for internal events while at power." It would be better to say: "In addition, this Standard establishes requirements for a limited Level 2 analysis sufficient to evaluate the large early release frequency (LERF) for internal events while at power."

Ed1.2 Section 1.3 and Table 1.3-1: In discussing Table 1.3-1, there is no mention what the "CRITERIA" column means or how it applies. These criteria present the general tenets that are used in the Standard to differentiate the capability (by category) of a PRA to support risk-informed decisions.

Ed1.3 Table 1.3-1, Criterion 1: In this criterion, the "resolution" discussed in the table appears to address the level of detail of the PRA model. It is not clear what is meant by "specificity" or if it is addressing the scope or level of detail. We suggest using "scope and level of detail" instead of "resolution and specificity" throughout the criteria. This would be consistent with what is used in Chapter 3

Ed1.4 Table 1.3-1, Criterion 1: This criterion refers to technical issues. There are PRA modeling technical issues (this appears to be the subject of the third criterion) and there are licensing technical issues which an application would address. The context of the criteria for the three categories suggest that the PRA must have the scope and level of detail to address the issue being addressed in the application. We suggest changing the criterion to clearly indicate this fact.

Ed1.5 Table 1.3-1, Criterion 2, Categories II and III: The phrase "to the extent practical" is undefined in the table. Since the degree to which plant-specific data/information is needed is identified in the SRs, we suggest deleting this phrase. Also, since the Category II and III criteria are the same, the boxes should be merged together as is done in the SR tables. (However, see also comment 1.2 in Attachment 1.)

Ed1.6 Table 1.3-1, Criteria 1 and 2: These criteria contain elements that would impact the realism of the results. It is not clear whether Criterion 3 in Table 1.3-1 refer to realism in the PRA methods, success criteria calculations, the model's reflection of the plant, or all three. We suggest adding a clarifying statement to the criterion definition.

Chapter 3 - RISK ASSESSMENT APPLICATION PROCESS

Ed3.1 Chapter 3: There are multiple references to "a part of the PRA." Since the discussion in the Standard is organized around PRA elements and their required HLRs and SRs, for consistency, the discussion on Capability Categories in Chapter 3 should also reference PRA elements and the SRs.

Ed3.2 Section 3.1: The meaning of the second sentence in section 3.1 is not clear. Judging from the context of what follows, probably what is meant is "Rather than specifying a single capability category for the whole of the PRA, the appropriate category of supporting requirements (SRs) are identified individually.

Ed3.3 Figure. 3.1-1 Application Process Flowchart and Section 3.4: The purpose of Box C is not clear. The Standard is a Standard for a PRA of a particular scope (an internal initiating events PRA capable of calculating CDF and giving insights on LERF). By including Capability Category II, the Standard by definition should be addressing a good industry practice PRA, and in Category III, a state-of-the-art PRA. Whether a PRA has the right elements for an application is addressed in boxes A and B. If the Standard has been developed appropriately, there should be no need for Box C. Box C seems to refer to a novel application for which a current industry PRA is inadequate. The real issue seems to be more one of what is needed to expand the state-of-the-art in order to perform the application, which should logically be followed by a change to the Standard.

At the least, to clarify the intent of Box C, there should be, in Section 3.4, criteria for judging the significance of the missing specific requirements that parallels the criteria in Section 3.5 for judging whether failing to meet the standard is significant.

Ed3.4 Figure 3.1-1, Application Process Flowchart: The flowchart is potentially misleading in that it doesn't really match the text well, and does not clearly address how the PRA results would be used. The PRA results would be used even if several SRs were not met. The reason for identifying those SRs that are not met is to understand the limitations which are then addressed by augmenting the PRA results using supplementary analyses, such as sensitivity studies. A flow chart format sends you down one path or the other, and would seem to imply that you only use the PRA if you satisfy all the SRs that have an impact on the application. The process would be clarified by making Box D a DO-loop over all the SRs, and deleting Box 11, and going directly to Box 13, "Use PRA to generate results to support application". Somehow, the message needs to be made very clear that the supplementary analyses that are referred to are additional analyses that a decision-maker would take into account to either support, or compensate for weaknesses in the conclusions of the risk assessment.

Ed3.5 Section 3.4: The example in Section 3.4, concluding as it does that the Standard is acceptable, is not helpful in understanding the intent of this box. It would be much more informative to include an example where the Standard is not adequate for the application.

Chapter 4 - RISK ASSESSMENT TECHNICAL REQUIREMENTS

Ed4.1 Section 4.4 Tables: Some SRs require an activity that we believe should be an option. For example, HR-B1 requires that screening rules be established and that screening be performed. While it is recognized that most people would choose to screen, the standard should not require that screening take place. Rather, screening should be provided as an option. This requirement should begin "If screening is performed,...." IE-B1 is an example of where an option is provided but in a backwards manner (i.e., group IEs, but if you don't group....).

Ed4.2 Section 4.4 Tables: Some SRs have an implied activity that should be clearly enunciated in the requirement. For example, the Category II requirements for HR-D2 imply an iterative process of first using screening values for pre-initiator HEPs and then using values obtained during a detailed analysis for those HEP associated with dominant system contributors. If such an iterative process is truly envisioned, then it should be more clearly stated. Another example is DA-D1 which requires the calculation of "realistic parameter estimates for dominant contributors using Bayesian updates."

Ed4.3 Section 4.4 Tables: Some SRs use different terms within the SR to identify the same concept. For example, it appears that the term "conservative estimates" and "screening values" refer to the same concept. If true, then use the same term. If not, then additional clarification is needed to ensure that someone using the standard clearly understands the distinction that is being drawn.

Ed4.4 Section 4.4.4: This section could be organized better. Specifically, more HLRs could be identified and SRs moved to provide a more logical flow.

Ed4.5 IE-A2: As written, this SR covers things not in the scope of this HLR which is to identify initiating events. For example, the third and fourth sentences should be deleted, as they deal with quantification (IE-C) and grouping (IE-B) respectively. Consider replacing the first paragraph with a single statement that says " IDENTIFY those initiating events that challenge ..... damage. Initiating events fall into the following general categories:"

Ed4.6 IE-A4: References for the methods identified in IE-A4 and IE-B2 should be provided. (For example, it is not clear how many people would know what a heat balance fault tree is.)

Ed4.7 IE-A8: If this requirement is a clarification of IE-A5, it should be moved to IE-A6.

Ed4.8 IE-B1: IE-B1 distinguishes between two types of initiating event groups. It is not clear that this distinction is necessary. A single event tree can be constructed for all initiating events or categories (it could be a functional event tree or a systemic event tree). What is critical is that the affect of each initiator group on the accident response be accounted for in some fashion (e.g., explicitly in different events or by using flags or split fractions). These impacts, if not addressed in separate event tree structures, are addressed in the quantification. Usage of these two different IE category definitions in the Standard should be reviewed for consistency and clarity. It is not clear that "quantification initiating event categories" is used any where else.

Ed4.9 IE-B1: IE-B1 requires a PRA analyst to combine initiating events into groups. This should be a permissible thing to do, not a requirement.

Ed4.10 IE-B3: The Category II requirements for IE-B3 and IF-D3 are inconsistent with respect to this caution about overly conservative results. They should be made consistent. Also, it is not clear that the slight wording differences between Category I and II actually represent a difference in the requirement. We would suggest that the requirements should be the same. The second paragraph in Category III does not add much. "Comparable to or less than" can mean the same as "comparable to or bounded by", which is what is stated in the first paragraph. Suggest deleting the second paragraph.

Ed4.11 IE-C1: The last phrase, "if excluded, JUSTIFY" is not necessary since the previous requirement clearly indicates that data from the first year of plant operation may be excluded. Also, we are uncertain why recovery actions are being credited in the frequency evaluation and not in the event tree structure or quantification. Some examples may be useful (such as failing to open a door upon loss of HVAC or to cross-tie service water systems in multi-unit plants). If they are credited, the probability of "non-recovery actions" that would be used to quantify the frequency of some initiating events, is the recovery action probability. This could be made clearer.

Ed4.12 IE-C4: This requirement has to do with screening IEs, not quantifying them. This SR would more appropriately belong in it's own HLR (or at least in the grouping HLR since IE-D2 lists the documentation requirements for both grouping and screening). Suggest adding a screening HLR to be consistent with HLR-IE-D which indicates that selection, grouping, and screening are the major steps in an IE analysis.

Ed4.13 IE-C12: ISLOCA frequencies are generally calculated using fault trees. Perhaps this should be indicated in IE-C6 and IE-C12.

Ed4.14 AS-A3: The phrase "IDENTIFY the systems needed to mitigate the initiator" should be modified to read "IDENTIFY the systems that can be used to .... initiator."

Ed4.15 SC-B1 and other places: In Category III, the phrase "only if ... do not affect risk significant CDF/LERF sequences" appears. At best this can only be recognized through some sort of iteration. This does not explicitly address the conservatism issue. If so it might be better to say something like "Some conservatism is acceptable" for Category II, and "DO NOT make conservative approximations" for Category III.

Ed4.16 SC-B3: The distinction between the grades Categories II and III lies in the words "scenario specific" used for Category III. The distinction seems too subtle. Analyses appropriate to the event being analyzed is scenario specific.

Ed4.17 SC-B6: The SRs for Categories I and II are more appropriate for QU-E, uncertainty in CDF results.

Ed4.18 SY-A3: Component operability and design limits should also be included in this list in order to help fulfil the requirements of SY-A20.

Ed4.19 SY-A7: The phrase "several failures are combined into supercomponents" is not clear. Perhaps what is meant is, "a single failure of a supercomponent is used to represent the collective impact of failures of several components".

Ed4.20 SY-A12: The reference should be to SY-14 not SY-A15.

Ed4.21 SY-A13: The list could be made comprehensive by adding "failure of a component to perform its required function".

Ed4.22 SY-A15: The caution in Category III about checking that component data does not include pre-accident human error contributions would more appropriately belong in the Data and HRA sections. It should also be applied to Category II if not to all three categories.

Ed4.23 SY-A23: This SR should reference DA-C14.

Ed4.24 SY-B10: This SR is not needed. It appears to be covered in SY-B9. Also note that there are two SRs with the designator SY-B10.

Ed4.25 DA-C2: The requirement should read ".... defined by requirements DA-A 1 through 3 and DA-B1 and 2."

Ed4.26 DA-C10: This requirement could be enhanced by defining a complete test.

Ed4.27 DA-C15: In the second sentence replace the word "component" by "system or function".

Ed4.28 DA-D6, Categories II and III: the second phrase in the first sentence should say "supported by plant-specific screening and mapping of industry wide data, for dominant common-cause events."

Ed4.29 IF-C5: This criterion is misplaced since it requires much of IF-D to have been accomplished. As an alternative, the identification of flooding scenarios with the potential for causing initiating events could be included in IF-C, leaving IF-D for grouping and quantification.

Ed4.30 DA-D3: In Category I delete the reference to sensitivity analysis. A sensitivity analysis is used to check the impact of changes in input to the output. The parameter value is an input.

Ed4.31 IF-D5: It might be helpful to identify which of the criteria in IF-C are applicable.

Ed4.32 QU-E3: It is not necessary in Category II to require the characterization of uncertainty associated with key model uncertainties, since this is the purpose of QU-Ed4.

Ed4.33 Section 4.4.9 LERF Analysis: The use of conservative approaches to non-dominant contributors for Category II is not conditional on whether the insights are distorted. The use of conservative approaches implies that it will not distort insights, therefore, this phrase is not necessary and deletion provide consistency of LE-C9 with LE-B2, C4 and C8.

Ed4.34 LE-A2: The bullet starting with "loss of electric power..." should be indented since it supports the bullet above.

The bullet starting with "operability of containment..." should be indented since it supports the bullet above.

Ed4.35 LE-B1, Category II: It is unnecessary to state "this is the minimum set to be considered".

Ed4.36 LE-C10 Cat I: Change 'TARE' to 'TAKE' in second sentence.

Ed4.37 LE-D3 and LE-D4, Category II): If the evaluation is supposed to be realistic, how can it include conservatisms?

Ed4.38 Tables 4.4-9e, f and g: The title of these tables should read "SUPPORTING REQUIREMENTS FOR LERF QUANTIFICATION..." not "SUPPORTING REQUIREMENTS FOR LEVEL 2 QUANTIFICATION..."

Ed4.39 The Level 2 analysis, even when confined to the estimation of LERF, has the same importance and requires a similar level of effort, as the core damage frequency estimate of the Level 1 analysis. Revision 14 of the Standard treats the entire LERF analysis as a single technical element. This single element contains seven high level requirements (the most of any technical element) and the HLRs are divided into 4 sub-elements (not found in any other technical element). These sub-elements are each comparable to complete Level 1 elements, i.e., Plant Damage State Analysis is analogous to Initiating Event Analysis, Accident Progression Analysis is analogous to Accident Sequence Analysis, and LERF Quantification is obviously similar to the Level 1 Quantification element.

For clarity and consistency with the presentation of the Level 1 elements in the Standard, it would be beneficial to elevate the sub-elements in the LERF Analysis to actual separate technical elements. The LERF Analysis would then consist of three elements: Plant Damage State Analysis, Severe Accident Progression Analysis, and LERF Quantification.

Chapter 5 - PRA CONFIGURATION CONTROL

Ed5.1 Section 5.6: This requirement should only apply to things like categorization of SSCs into high and low risk significance categories, which are representative of the current risk profile. A change that has led to a plant design change and was deemed acceptable at the time it was made, would now have the same status as something designed into the plant in the first place.

Chapter 6 - PEER REVIEW

Ed6.1 Section 6.2.3: ASME Principle/Objective 5.2 states that "...The Standard needs to assure that the peer review process...determines that , when acceptable methods are not specified in the Standard, or when alternative methods are used in lieu of those identified in the Standard, the methods used are adequate to meet the requirements of the Standard." However, the Standard generally does not identify acceptable methods. Section 6.2.3 states that the peer reviewer shall also be knowledgeable of the specific methodology, code, tool, or approach that was used in the PRA Element assigned for review. It should be clarified that this knowledge also cover any methods, etc. not identified as acceptable in the standard though used in the PRA.

Enclosure 3
ASME Principles/Objectives for the ASME PRA Standard[1]

The staff review of Rev 14a considered whether these principles and objectives were met.

In the risk-informed environment in which NRC and industry are currently operating, PRA results are used as one, but not the only input to a decision-making process. Depending on the specific nature of the application, PRA results can play a more or less significant role. The extent to which the PRA results influence the decision will be impacted by the confidence the decision-makers have in those results. Accordingly, development of a Standard that promotes a consistent determination of the strengths and weaknesses of a PRA will directly impact the ability of decision-makers to efficiently establish a level of confidence in the results. The requirements of such a Standard provide a reference point for determining the strengths and weaknesses and also for evaluating alternative PRA approaches. The Standard should also recognize that in some areas methodology and data enhancements will occur over the next several years.

4.1 The PRA Standard needs to provide well-defined criteria against which to judge the strengths and weaknesses of the PRA so that decision-makers can determine the degree of reliance that can be placed on the PRA results of interest.

4.2 The Standard needs to be based on current good practices as reflected in publicly available documents. The need for the documentation to be publicly available follows from the fact that the Standard may be used to support safety decisions.

4.3 To facilitate the use of the Standard for a wide range of applications, categories can be defined to aid in determining the applicability of the PRA for various types of applications.

4.4 The Standard needs to be thorough and complete in defining what is technically required and should, where appropriate, identify one or more acceptable methods.

4.5 The Standard needs to require a peer review process that identifies and assesses where the technical requirements of the Standard are not met. The Standard needs to assure that the peer review process:

- 4.1 determines whether methods identified in the Standard have been used appropriately;
- 4.2 determines that, when acceptable methods are not specified in the Standard, or when alternative methods are used in lieu of those identified in the Standard, the methods used are adequate to meet the requirements of the Standard;
- 4.3 assesses the significance on the results and insights gained from the PRA of not meeting the technical requirements in the Standard;
- 4.4 highlights assumptions that may significantly impact the results and provides an assessment of the reasonableness of the assumptions;
- 4.5 is flexible and accommodates alternate peer review approaches; and
- 4.6 includes a peer review team that is comprised of members who are knowledgeable in the technical elements of a PRA, are familiar with the plant design and operation, and are independent with no conflicts of interest.

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[1]Key objectives and principles developed by Senior Management Group, documented in letter from Gerry Eisenberg (ASME, Nuclear Codes and Standards, Director) to ASME Task Group on Proposed ASME PRA Standard, September 9, 2000.

4.6 The Standard needs to address the maintenance and update of the PRA to incorporate changes that can substantially impact the risk profile, so that the PRA adequately represents the current as-built and as-operated plant.

4.7 The Standard needs to be viewed as a living document. Consequently, it should not impede research but needs to be structured such that when improvements in our state of knowledge occur, the Standard can easily be updated.