June 8, 2005

MEMORANDUM TO: David C. Lew, Chief
Probabilistic Risk Analysis Branch
Division of Risk Analysis and Applications
Office of Nuclear Regulatory Research

FROM: Michael D. Tschiltz, Chief ***/RA/ Mark Rubin for***
Probabilistic Safety Assessment Branch
Division of Systems Safety and Analysis
Office of Nuclear Reactor Regulation

SUBJECT: RESULTS OF THE REGULATORY GUIDE (RG) 1.200 IMPLEMENTATION PILOT PROGRAM

RG 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," was issued for trial use in February 2004. In 2004, the staff, with industry support and coordination by the Nuclear Energy Institute (NEI) initiated a RG 1.200 implementation pilot program with the following objectives:

1. To determine whether RG 1.200 and Standard Review Plan (SRP) 19.1 provide adequate guidance to demonstrate the technical adequacy of a probabilistic risk assessment (PRA);

2. To identify specific changes to improve the clarity of RG 1.200 and SRP 19.1;

3. To identify specific technical issues requiring additional guidance;

4. To determine whether the requirements of the American Society of Mechanical Engineers (ASME) PRA Standard, as endorsed in RG 1.200 with clarifications and qualifications, provide a sufficient basis for assessing technical adequacy;

5. To determine whether the ASME PRA Standard can be interpreted in an unambiguous manner;

CONTACTS: Donald G. Harrison, NRR/DSSA
415-3587

Martin A. Stutzke, NRR/DSSA
415-4105

Gareth W. Parry, NRR/DSSA
415-1464

6. To assess the effectiveness of the industry's self-assessment process as a means to identify weaknesses in PRAs (primarily for those elements not addressed by the peer review); and

7. To assess the effectiveness of peer review as a means to identify weaknesses in PRAs.

The attached report provides the results of the pilot program.

A team of U.S. Nuclear Regulatory Commission (NRC) staff and contractors reviewed the PRA model documentation, industry peer review results, and utility self-assessment report for each of five nuclear power plants to ascertain the efficacy of the ASME Standard, RG 1.200, and the self-assessment process. The five plants involved and the dates when their site reviews were conducted are provided below:

- Columbia Generating Station, 6/7/2004 to 6/11/2004
- Limerick Generating Station, 7/12/2004 to 7/16/2004
- South Texas Project Electric Generating Station, 11/15/2004 to 11/19/2004
- San Onofre Nuclear Generating Station, 1/31/2005 to 2/4/2005
- Surry Power Station, 2/28/2005 to 3/4/2005

Based on the pilot program results, the Probabilistic Safety Assessment Branch (SPSB) concludes that RG 1.200 provides adequate guidance to demonstrate the technical adequacy of PRAs. Further, the pilot program's results suggest that:

- Industry self-assessment is capable of demonstrating the technical adequacy of PRAs, and

- Peer review is an effective and efficient approach to identifying weaknesses in PRAs.

SPSB notes that licensees are responsible for demonstrating the technical adequacy of the PRA results used to support risk-informed license amendment requests (LARs). The integrity and objectivity of any self-assessments and peer reviews referenced to support this demonstration must be ensured.

The pilot program did not identify any specific changes needed to RG 1.200. The next revision to SRP 19.1 should include a reviewer's cross-reference table and guidance on determining when a site audit is warranted during the review of submitted LARs.

The pilot program identified some PRA technical elements requiring additional methodological guidance:

- Identification of key sources of uncertainty and key assumptions,

- Use of fault trees to identify the frequency of support system initiating events,

- Incorporation of phenomenological conditions caused by accidents (e.g., high-energy line breaks) into PRA models, and

- Incorporation of multi-unit interactions into PRA models.

This guidance could either be developed by the staff or by industry, with subsequent staff review and endorsement.

SPSB suggests that further dialog among the staff, NEI, and licensees concerning the following topics would be beneficial:

1. The supporting requirements that were consistently assessed by the staff across most pilot applications as being either not met or not applicable should be adequately considered during the self-assessment process.

2. Licensees should record the bases for determining each supporting requirement capability category in the self-assessment documentation.

3. Licensees should ensure that their PRAs are consistent with the definitions provided in Section 2 of the ASME PRA Standard, as clarified and qualified by RG 1.200.

4. Industry must take the actions necessary to ensure the integrity and objectivity of the self-assessment process.

Attachment: As stated

- Incorporation of phenomenological conditions caused by accidents (e.g., high-energy line breaks) into PRA models, and

- Incorporation of multi-unit interactions into PRA models.

This guidance could either be developed by the staff or by industry, with subsequent staff review and endorsement.

SPSB suggests that further dialog among the staff, NEI, and licensees concerning the following topics would be beneficial:

1. The supporting requirements that were consistently assessed by the staff across most pilot applications as being either not met or not applicable should be adequately considered during the self-assessment process.

2. Licensees should record the bases for determining each supporting requirement capability category in the self-assessment documentation.

3. Licensees should ensure that their PRAs are consistent with the definitions provided in Section 2 of the ASME PRA Standard, as clarified and qualified by RG 1.200.

4. Industry must take the actions necessary to ensure the integrity and objectivity of the self-assessment process.

Attachment: As stated

DISTRIBUTION: SPSB R/F ADrozd MStutzke MRubin
GParry MDrouin

ADAMS Accession No.: ML

C:\MyFiles\Copies\RG 1-200 Final Report.wpd NRR-096

OFFIC	NRR/DSSA/SPSB	NRR/DSSA	NRR/DSSA/SPSB	NRR/DSSA/SPSB	NRR/DSSA/SPSB
NAME	DHarrison	GParry	MStutzke	MRubin	MTschiltz /RA/ M Rubin for
DATE	06/ 08 /05	06/ 08 /05	06/ 08 /05	06/ 08 /05	06/ 08 /05

OFFICIAL RECORD COPY

RG 1.200 IMPLEMENTATION PILOT PROGRAM

1.0 Introduction

RG 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," and the SRP Chapter 19.1, "Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," are being developed to provide one acceptable approach for determining that the quality of the PRA, *in toto* or of those parts that are used to support a risk-informed application, is sufficient to provide confidence in the results such that the PRA can be used in regulatory decisionmaking for light-water reactors. Specific benefits of RG 1.200 include:

1. Increased confidence that the base PRA used to support an application is technically adequate.

2. Improved consistency and focus of any reviews performed of the base PRA.

3. Reduced need for in-depth staff reviews of the base PRA.

RG 1.200, with Appendices A and B, was issued for trial use in February 2004:

- Appendix A provides the staff's position on the American Society of Mechanical Engineers (ASME) Standard RA-S-2002, "Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications," including the RA-Sa-2003 Addenda (hereafter referred to as the "ASME PRA Standard"). The ASME PRA Standard addresses Level 1 (core-damage frequency (CDF)) and limited scope Level 2 (large early release frequency (LERF)) PRAs for full-power internal events (excluding internal fires).

- Appendix B provides the staff's position on the NEI guidance document NEI 00-02, Revision A3, "Probabilistic Risk Assessment Peer Review Process Guidance." NEI 00-02 provides a process for conducting a peer review, including acceptance criteria, of a Level 1, full-power, internal events (excluding internal fires) PRA. The document is supplemented by the NEI subtier criteria (to be included in a revised version of NEI 00-02), which are the criteria for assigning a grade to each PRA subelement. NEI has compared the NEI subtier criteria for a Grade 3 PRA to the requirements in the ASME PRA Standard for a Capability Category II PRA, and determined that some of the ASME PRA Standard requirements are not addressed by the NEI subtier criteria. Thus, NEI has provided guidance to its members (that will be included in NEI 00-02) to perform a self-assessment of their PRAs against the criteria in the ASME PRA Standard that were not addressed during the NEI peer review of their PRAs. Appendix B of RG 1.200 also provides the staff's position on the self-assessment process.

As additional industry PRA standards are developed, RG 1.200 and SRP 19.1 will be updated to provide the staff's position on them.

In 2004, the staff, with industry support and NEI coordination, initiated a RG 1.200

ATTACHMENT

implementation pilot program (hereafter termed the "pilot program"). Section 2.0 describes the objectives of the pilot program, while Section 3.0 describes the approach used to conduct it. Section 4.0 provides general observations made as a result of the pilot program. Section 5.0 presents the staff's conclusions, including a discussion of how well the pilot program's objectives, as stated in Section 2.0, were met.

2.0 Objectives of the Pilot Program

The following objectives were established for the RG 1.200 implementation pilot program:

1. To determine whether RG 1.200 and SRP 19.1 provide adequate guidance to demonstrate the technical adequacy of a PRA;

2. To identify specific changes to improve the clarity of RG 1.200 and SRP 19.1;

3. To identify specific technical issues requiring additional guidance;

4. To determine whether the requirements of the ASME PRA Standard, as endorsed in RG 1.200 with clarifications and qualifications, provide a sufficient basis for assessing technical adequacy;

5. To determine whether the ASME PRA Standard can be interpreted in an unambiguous manner;

6. To assess the effectiveness of the industry's self-assessment process as a means to identify weaknesses in PRAs (primarily for those elements not addressed by the peer review); and

7. To assess the effectiveness of peer review as a means to identify weaknesses in PRAs.

3.0 Approach to Conducting the RG 1.200 Implementation Pilot Program

The pilot program consisted of a review of five PRAs as identified below:

- Columbia Generating Station, 6/7/2004 to 6/11/2004
- Limerick Generating Station, 7/12/2004 to 7/16/2004
- South Texas Project Electric Generating Station, 11/15/2004 to 11/19/2004
- San Onofre Nuclear Generating Station, 1/31/2005 to 2/4/2005
- Surry Power Station, 2/28/2005 to 3/4/2005

Each of these PRAs supports an actual plant-specific risk-informed license amendment request (LAR). In order to reach a regulatory decision to grant the LAR, the staff must determine (and document in a safety evaluation) that the PRA results are supported by the underlying analysis. This determination is made by reviewing those parts of the PRA, as identified by the licensee and refined by the staff, that are called upon to provide the supporting PRA results. For some LARs, all parts of the PRA are relevant; for other LARs, a limited set may suffice. However, to achieve the goals of the pilot program, the entire full-power, internal events (excluding internal fires) Level I and limited scope Level 2 (LERF determination) PRAs were reviewed:

- Initiating Events (ASME PRA Standard Section 4.5.1)
- Accident Sequence Analysis (ASME PRA Standard Section 4.5.2)
- Success Criteria (ASME PRA Standard Section 4.5.3)
- Systems Analysis (ASME PRA Standard Section 4.5.4)
- Human Reliability Analysis (ASME PRA Standard Section 4.5.5)
- Data Analysis (ASME PRA Standard Section 4.5.6)
- Internal Flooding (ASME PRA Standard Section 4.5.7)
- Quantification (ASME PRA Standard Section 4.5.8)
- LERF Analysis (ASME PRA Standard Section 4.5.9)

In addition, PRA Configuration Control (ASME PRA Standard Section 5), which addresses the process for update and maintenance of the licensee's PRA, and Peer Review (ASME PRA Standard Section 6) were reviewed. It should be noted that Office of Nuclear Reactor Regulation (NRR) reviewers assigned to each LAR will review other risk contributions (e.g., external events, shutdown and low power operations) in a separate effort since the current version of RG 1.200 does not currently address these risk contributors.

The review was performed by a team consisting of NRC staff and support contractors having experience in the development and review of PRAs. The team included the specific NRR reviewers assigned to each LAR, NRC staff that participated in the development of the ASME PRA Standard, and developers of risk-informed regulatory guidance (including RG 1.200). Each team member was assigned specific PRA technical areas to review. In general, at least two members reviewed each technical area.

The PRA reviews were conducted during a one-week site visit. Several weeks prior to each site visit, licensees sent some of their PRA documentation and self-assessment results to the NEI offices in Washington, D.C. for the review team to examine. This arrangement precluded the need for each licensee for formally docket their PRAs, yet provided the staff with the opportunity to become acquainted with the information before the start of the one-week site visit. The reviews consisted of the following steps:

1. The review team examined documentation provided by the licensee, as supplemented by interactions between the staff and the licensee as needed to clarify or navigate the documentation.

2. Based on its review and without consulting the results of the PRA peer review or licensee self-assessment, the review team assigned a capability category for each supporting requirement in the ASME PRA Standard, considering the clarifications and qualifications provided in RG 1.200. If the review team considered that a supporting level requirement was not met or not applicable, the reason why was documented.

3. Once the review of each technical element was completed, the results of the review by the NRC team were compared with those of the licensee's self-assessment (for San Onofre, a comparison was made directly with the results of the licensee's peer review against the ASME PRA Standard). The results of this comparison were used to identify those supporting level requirements for which there appeared to be differences in interpretation between the staff and the licensee. The reason for such differences were ascertained where possible. In addition, where supporting requirements were not met, the reasons given by the staff were compared to those given by the licensee, either as a

result of the self-assessment or from the peer review facts and observations (F&Os).

4. After all five site visits were finished, the staff summarized its observations (Section 4 below) and assessed the pilot program's performance against the stated objectives (Section 5 below).

4.0 Observations

4.1 Agreement Between Staff Assessments and Licensees' Self-Assessments

In general, the staff's assessment of the supporting requirement capability categories agreed with the licensee's self-assessment. Causes of differences between the staff's assessment and the self-assessment were, for the most part, identifiable. Some of the causes for differences include:

- Differences in interpretation of how to infer that the intent of the requirement was met;

- The lack of PRA documentation that explicitly indicated that a requirement was met, resulting in the need to infer that the requirement was met; and

- The one-week staff's review as compared to the licensee's lengthier peer review and self-assessment, which may have led the staff to conclude in certain instances that a requirement was not met when a more detailed review might have changed this conclusion.

In addition, there were some supporting requirements that were consistently assessed by the staff across most pilot applications as being either not met or not applicable. Table 1 provides a summary assessment of those specific supporting requirements for which there were inconsistent assessments or were not met by the majority of the pilot plants. SPSB suggests that further dialog among the staff, NEI, and licensees would be beneficial to help ensure that these supporting requirements are adequately considered during the self-assessment process.

TABLE 1. ASSESSMENT OF SPECIFIC SUPPORTING REQUIREMENTS (SRs) - INCONSISTENT ASSESSMENTS OR NOT MET			
SR	**Description**	**Observations**	**Recommendation/Comment**
IE-A10	All Capability Categories: INCLUDE those multi-unit site initiators such as dual unit LOOP events or total loss of service water that may impact the model at multi-unit sites with shared systems.	Not all multi-unit site initiators are addressed (at least one missing initiator identified for each multi-unit site). For three of the sites, the staff was not able to determine whether, or how, multi-unit initiating events were addressed, even though the peer review/self-assessment determined the requirement was met.	Development of guidance on treatment of multi-unit initiating events would be beneficial.
AS-A9	Capability Category I: **USE generic thermal hydraulic analyses (e.g., as performed by a plant vendor for a class of similar plants)** to determine the accident progression parameters (e.g., timing, temperature, pressure, steam) that could potentially affect the operability of the mitigating systems. Capability Category II: **USE realistic, applicable (i.e., from similar plants) thermal hydraulic analyses** to determine the accident progression parameters (e.g., timing, temperature, pressure, steam) that could potentially affect the operability of the mitigating systems. Capability Category III: **USE realistic, plant-specific thermal hydraulic analyses** to determine the accident progression parameters (e.g., timing, temperature, pressure, steam) that could potentially affect the operability of the mitigating systems.	Most PRAs use a mixture of generic and plant-specific approaches which causes differences in scoring	An assessment needs to be made on a case-by-case basis whether the method used produces significant uncertainty on the assessment of operability of mitigating systems
AS-B3	All Capability Categories: For each accident sequence, IDENTIFY the phenomenological conditions created by the accident progression. Phenomenological impacts include generation of harsh environments affecting temperature, pressure, debris, water levels, humidity, etc. that could impact the success of the system or function under consideration [(e.g., loss of pump net positive suction head (NPSH), clogging of flow paths]. INCLUDE the impact of the accident progression phenomena.	For each plant, some issues that might have an impact were identified by the staff. It is difficult to confirm that this evaluation has been performed since the reason for not including phenomenological effects is not typically documented.	Some guidance on what types of impacts should be addressed would be useful, including guidance on screening of phenomenological issues.

TABLE 1. ASSESSMENT OF SPECIFIC SUPPORTING REQUIREMENTS (SRs) - INCONSISTENT ASSESSMENTS OR NOT MET			
SR	**Description**	**Observations**	**Recommendation/Comment**
AS-C4	All Capability Categories: DOCUMENT the following: (a) the success criteria established for each initiating event category including the bases for the criteria (i.e., the system capacities required to mitigate the accident and the necessary components required to achieve these capacities) (b) the models used (including all sequences) for each initiating event category (c) a description of the accident progression for each sequence or group of similar sequences (i.e., descriptions of the sequence timing, applicable procedural guidance, expected environmental or phenomenological impacts, dependencies between systems and operator actions, end states, and other pertinent information required to fully establish the sequence of events) (d) any assumptions that were made in developing the accident sequences, and the bases for the assumptions and their impact on the final results (e) existing analyses or plant-specific calculations performed to arrive at success criteria and expected sequence phenomena including necessary timing considerations (f) sufficient system operation information to support the modeled dependencies (g) calculations or other bases used to justify equipment operability beyond its "normal" design parameters and for which credit has been taken (h) how all requirements for accident sequence analysis have been satisfied when sequences are modeled using a single top event linked fault tree	Some aspects of documentation were missing for nearly every plant	Documentation in general is a concern. Consider changes to Section 4 of RG 1.200 to clarify expectations.
SC-A4	All Capability Categories: SPECIFY success criteria for each of the mitigating functions for each initiating event group. IDENTIFY systems capable of meeting the specified mitigating function success criteria. IDENTIFY mitigating systems that are shared between units, and the manner in which the sharing is performed should both units experience a common initiating event (e.g., LOOP).	This SR relates to IE-A10 for shared systems, and therefore, when shared systems were not addressed, this requirement cannot be met.	See comment on IE-A10

TABLE 1. ASSESSMENT OF SPECIFIC SUPPORTING REQUIREMENTS (SRs) - INCONSISTENT ASSESSMENTS OR NOT MET			
SR	**Description**	**Observations**	**Recommendation/Comment**
SC-B5	All Capability Categories: CHECK the reasonableness and acceptability of the results of the thermal/hydraulic, structural, or other supporting engineering bases used to support the success criteria. Examples of methods to achieve this include: (a) comparison with results of the same analyses performed for similar plants, accounting for differences in unique plant features (b) comparison with results of similar analyses performed with other plant-specific codes (c) check by other means appropriate to the particular analysis	This is a CHECK step, as opposed to a DO step, and as such is typically not documented as being done. It is also the sort of SR for which it is difficult to infer that it has been met.	The analysis documentation should address this.
SC-C1	Capability Category I: **DOCUMENT bases, references, and assumptions for success criteria. IDENTIFY which of the key assumptions are conservative or optimistic, and IDENTIFY their general impacts on the results.** Capability Categories II & III: **DOCUMENT each of the success criteria and the supporting engineering bases, references, and key assumptions for success criteria and the supporting engineering calculations performed in support of the PRA.** **(a) IDENTIFY conservative, optimistic, or simplifying assumptions or conditions.** **(b) PROVIDE specific justification, based on results of evaluation or quantification, as appropriate to the application Category, for use of conservative, optimistic, or simplifying assumptions or conditions.** **(c) PROVIDE the basis for the success criteria development process and the supporting engineering calculations.**	Limited documentation discussing significant conservative or optimistic assumptions and impacts on results	This provides input to the determination of key assumptions and uncertainties. See comments on QU-E2 and QU-E4.
SC-C2	All Capability Categories: DOCUMENT uses of and rationale for expert judgement.	Relates to SC-B2, though the scores between these SRs are inconsistent (SC-B2 most score 2/3, but SC-C2 most are N/A). Most state that expert judgment is not used, though clearly judgment is used throughout PRA development and modeling. The peer reviews use too narrow an interpretation when scoring SC-C2 to only be for expert elicitation.	This relates to the determination of key assumptions and uncertainties Addendum B has new documentation requirements, in which this requirement is embedded as an example of the documentation typically included. RG 1,200 should clarify that expert judgement does not necessarily mean expert elicitation.

TABLE 1. ASSESSMENT OF SPECIFIC SUPPORTING REQUIREMENTS (SRs) - INCONSISTENT ASSESSMENTS OR NOT MET			
SR	**Description**	**Observations**	**Recommendation/Comment**
SC-C3	All Capability Categories: DOCUMENT the rationale used in the application of success criteria for situations in the PRA for which there is more than one technical approach, none of which is universally accepted as correct, and the approach represents a key source of uncertainty.	Most do not perform alternate calculations to determine the sensitivity of the approach	This should provide input to determination of key assumptions and uncertainties. See comments on QU-E2 and QU-E4
SY-A8	All Capability Categories: IDENTIFY the boundaries of the components required for system operation. MATCH the definitions used to establish the component failure data. For example, a control circuit for a pump does not need to be included in the system model if the pump failure data used in quantifying the system model include control circuit failures. MODEL separately portions of a component boundary that are shared by another component or affect another component, in order to account for the dependent failure mechanism.	Many licensees had issues identified in identifying component boundaries (see also DA-A1)	The definition of component boundaries can be inferred from the fault trees. However, the data used may be from sources with boundaries that are different. This is an important analytical interface that should be given careful attention.
SY-A10	All Capability Categories: If super components or modules are used to simplify system fault trees, PERFORM the modularization process in a manner that avoids grouping events with different recovery potential, events that are required by other systems, or events that have probabilities that are dependent on the scenario. Examples of such events include (a) hardware failures that are not recoverable versus actuation signals, which are recoverable (b) HE events that can have different probabilities dependent on the context of different accident sequences (c) events that are mutually exclusive of other events not in the module (d) events that occur in other fault trees (especially common-cause events) (e) SSCs used by other systems	Most PRAs do not use supercomponents so that the SR should be classified as N/A, whereas many characterized as MET. Others mistook undeveloped events as being supercomponents As a general comment, in other places when an SR should have been N/A, the peer review/self- assessment characterized it as being MET, which can cause confusion. These are typically minor issue that will not impact results	Need to make clear that if an SR is N/A (or the Capability Category has no requirement for being met), then it should be documented as not being applicable instead of being MET
SY-B9	All Capability Categories: INCLUDE explicit treatment of containment vent effects (BWRs) and containment failure effects on system operation in the consideration of possible hazards.	Most consider this a BWR-only issue and do not address it for PWRs	May miss potential impacts at PWRs due to narrow interpretation. However, AS-B3 would also address this, and to some extent, this SR is redundant.

TABLE 1. ASSESSMENT OF SPECIFIC SUPPORTING REQUIREMENTS (SRs) - INCONSISTENT ASSESSMENTS OR NOT MET

SR	Description	Observations	Recommendation/Comment
SY-B15	All Capability Categories: IDENTIFY SSCs that may be required to operate in conditions beyond their environmental qualifications. INCLUDE dependent failures of multiple SSCs that result from operation in these adverse conditions. Examples of degraded environments include (a) LOCA inside containment with failure of containment heat removal (b) safety relief valve operability (small LOCA, drywell spray, severe accident) (for BWRs) (c) steam line breaks outside containment (d) debris that could plug screens/filters (both internal and external to the plant) (e) heating of the water supply (e.g., BWR suppression pool, PWR containment sump) that could affect pump operability (f) loss of NPSH for pumps (g) steam binding of pumps	Most do not credit operation beyond EQ (though many scored at MET instead of N/A)	See comment on SY-A10
HR-A3	All Capability Categories: IDENTIFY those work practices that could introduce a mechanism which simultaneously affects equipment in either different trains of a redundant system or diverse systems [e.g., use of common calibration equipment by the same crew on the same shift, a maintenance or test activity that requires realignment of an entire system (e.g., SLCS)].	Generally, the search for work practices that lead to pre-initiators that affect multiple trains is done in a cursory manner, if at all.	These are typically more important than the independent pre-initiator events.
HR-B2	All Capability Categories: DO NOT screen activities that could simultaneously have an impact on multiple trains of a redundant system or diverse systems.	This is related to HR-A3. Therefore, when HR-A3 is not met, HR-B2 can also not be met.	
HR-C2	Capability Category I: For each unscreened activity, INCLUDE those modes of unavailability that, following completion of each unscreened activity, result from failure to restore (a) equipment to the desired standby or operational status (b) initiation signal or set point for equipment start-up or realignment (c) automatic realignment or power Capability Categories II & III: For each unscreened activity, INCLUDE those modes of unavailability that, following completion of each unscreened activity, result from failure to restore (a) equipment to the desired standby or operational status (b) initiation signal or set point for equipment start-up or realignment	Staff found no evidence of a review of plant specific or generic data to identify new modes of unavailability.	It is difficult to imagine that new modes of unavailability would be identified, although examples of events could be found. Recommend a clarification in RG 1.200 that the bolded item in category II and III should apply to III only.

TABLE 1. ASSESSMENT OF SPECIFIC SUPPORTING REQUIREMENTS (SRs) - INCONSISTENT ASSESSMENTS OR NOT MET			
SR	**Description**	**Observations**	**Recommendation/Comment**
	(c) automatic realignment or power **ADD failure modes identified during the collection of plant-specific or applicable generic operating experience that leave equipment unavailable for response in accident sequences.**		
HR-D3	Capability Category I: No requirement for evaluating the quality of written procedures, administrative controls, or human-machine interfaces. Capability Categories II & III: For each detailed human error probability assessment, INCLUDE in the evaluation process the following plant-specific relevant information: (a) the quality of written procedures (for performing tasks) and administrative controls (for independent review) (b) the quality of the human-machine interface, including both the equipment configuration, and instrumentation and control layout	In the PRAs reviewed there was no evidence of review of written procedures or quality of human machine interface	ASEP does not have the capability to assess these factors, but THERP has the capability of assessing factors such as the layout of the procedures and the panels. Therefore, use of ASEP cannot be claimed to achieve Capability Category II.
HR-D7	All Capability Categories: CHECK the reasonableness of the HEPs in light of the plant's history, procedures, operational practices, and experience. Operating experience may be used to support quantification of impact that test, maintenance, and calibration activities have on overall system unavailability	No evidence of a reasonableness review of HEPs	Since pre-initiators typically do not play a major role in the risk profile of a plant, this is probably not very significant. However, it would be prudent to conduct such a review if the relative importance of HEPs could be significant to an application.
HR-G6	All Capability Categories: CHECK the consistency of the post-initiator HEP quantifications. REVIEW the HFEs and their final HEPs relative to each other to check their reasonableness given the scenario context, plant history, procedures, operational practices, and experience.	This is similar to HR-D7, though more important from a risk perspective, since post-initiator HFEs are typically more critical to determining the risk profile of the plant.	This is an important sanity check that should be performed. A review of results used for an application may trigger a review of the base PRA
HR-G8	All Capability Categories: DEFINE and JUSTIFY (accounting for the dependencies identified in supporting requirement HR-G7) the minimum probability to be used for the joint probability of multiple human errors occurring in a given cutset.	Only one licensee defined the minimum HEP.	This requirement is somewhat redundant to those addressing the treatment of dependancy. Based on this, the SR has been removed in Addendum B

TABLE 1. ASSESSMENT OF SPECIFIC SUPPORTING REQUIREMENTS (SRs) - INCONSISTENT ASSESSMENTS OR NOT MET			
SR	**Description**	**Observations**	**Recommendation/Comment**
HR-I1	Capability Categories I & II: INCLUDE human recovery actions that can restore the functions, systems, or components **on an as needed basis to eliminate unnecessarily conservative contributions to accident sequences.** Capability Category III: INCLUDE human recovery actions that can restore the functions, systems, or components.	Documentation is generally poor.	See comment on AS-C4.
Data (General)	Data Analysis	The collection and analysis of plant specific data, if any, was difficult for the staff to review in the pilot reviews, because of the quality and/or the nature of the documentation required such a review (e.g., detailed raw data records and their analysis.)	Unless the plant specific values are significantly different from the generic values, this is not likely to be a concern, and could be dealt with via sensitivity studies.
DA-A1	All Capability Categories: IDENTIFY from the systems analysis the basic events for which probabilities are required. ESTABLISH definitions of SSC boundaries, failure modes, and mission success criteria consistent with corresponding basic event definitions in Systems Analysis (SY-A4, SY-A7, and SY-A8) for failure rates and common cause failure parameters, and ESTABLISH boundaries of unavailability events consistent with corresponding definitions in Systems Analysis (SY-A19). Basic events typically include (a) independent or common cause failure of a component or system to start or change state on demand (b) independent or common cause failure of a component or system to continue operating or provide a required function for a defined time period (c) equipment unavailable to perform its required function due to being out of service for maintenance (d) equipment unavailable to perform its required function due to being in test mode (e) failure to recover a function or system (e.g., failure to recover offsite-power) (f) failure to repair a component, system, or function in a defined time period	It was apparent that little attention was paid to definition of component boundaries.	This can lead to significant errors in choice of parameter values, and/or inconsistencies (e.g., between independent and common cause failure probabilities.) This may be a flag for an audit of this particular aspect if probabilities of SSC failures in application-specific analysis are significantly lower than expected. NOTE: In addendum B this SR has been split into DA-A1 - identification of basic events for which probabilities are needed, and DA-A1a - definition of SSC boundaries and failure modes

TABLE 1. ASSESSMENT OF SPECIFIC SUPPORTING REQUIREMENTS (SRs) - INCONSISTENT ASSESSMENTS OR NOT MET			
SR	**Description**	**Observations**	**Recommendation/Comment**
DA-B2	Capability Categories I & II: DO NOT INCLUDE outliers in the definition of a group (e.g., do not group valves that are never tested and unlikely to be operated with those that are tested or otherwise manipulated frequently) Capability Category III: DO NOT INCLUDE outliers in the definition of a group (e.g., do not group values that are never tested and unlikely to be operated with those that are tested or otherwise manipulated frequently). **When warranted by sufficient data, USE appropriate hypothesis tests to ensure that data from grouped components are from compatible populations.**	Not addressed by most licensees.	This could be an issue for some applications, including 50.69, but in that particular case, it should be addressed by the integrated decision-making panel (IDP).
DA-C8	Capability Category I: When required, **ESTIMATE** the time that components were configured in their standby status. Capability Categories II & III: When required, **USE plant-specific operational records to determine** the time that components were configured in their standby status.	Another example of where peer reviewers seemed to say met even though it was NA.	This should not be a problem since if it were needed for an application to use standby failure rates, it would be addressed there.
DA-C10	Capability Category I: When using surveillance test data, REVIEW the test procedure to determine whether a test should be credited for each possible failure mode. COUNT only completed tests or unplanned operational demands as success for component operations. Capability Category II: When using surveillance test data, REVIEW the test procedure to determine whether a test should be credited for each possible failure mode. COUNT only completed tests or unplanned operational demands as success for component operation. **If the component failure mode is decomposed into sub-elements (or causes) that are fully tested, then USE tests that exercise specific sub-elements in their evaluation. Thus, one sub-element sometimes has many more successes than another.** Capability Category III: When using surveillance test data, REVIEW the test procedure to determine whether a test should be credited for each possible failure mode. COUNT only completed tests or unplanned operational demands as success for component operation. **DECOMPOSE the component failure mode into sub-elements (or causes) that are fully tested, and USE tests that exercise specific sub-elements in their evaluation. Thus, one sub-element**	Two licensees appeared to perform to Capability Category II, though in one case the scope was limited, which is why the peer review said it was not met	

TABLE 1. ASSESSMENT OF SPECIFIC SUPPORTING REQUIREMENTS (SRs) - INCONSISTENT ASSESSMENTS OR NOT MET			
SR	**Description**	**Observations**	**Recommendation/Comment**
	sometimes has many more successes than another.		
DA-C12	Capability Category I: EVALUATE the duration of the actual time that the equipment was unavailable for each contributing activity. Since maintenance outages are a function of the plant status, INCLUDE only outages occurring during plant at power. Special attention should be paid to the case of a multi-plant site with shared systems, when the Technical Specifications (TS) requirements can be different depending on the status of both plants. Accurate modeling generally leads to a particular allocation of outage data among basic events to take this mode dependence into account. In the case that reliable estimates of the start and finish times of periods of unavailability are not available, **provide conservative estimates**. Capability Categories II & III: EVALUATE the duration of the actual time that the equipment was unavailable for each contributing activity. Since maintenance outages are a function of the plant status, INCLUDE only outages occurring during plant at power. Special attention should be paid to the case of a multi-plant site with shared systems, when the Specifications (TS) requirements can be different depending on the status of both plants. Accurate modeling generally leads to a particular allocation of outage data among basic events to take this mode dependence into account. In the case that reliable estimates or the start and finish times are not available, **INTERVIEW the plant maintenance and operations staff to generate estimates of ranges in the unavailable time per maintenance act for components, trains, or systems for which the unavailabilities are significant basic events.**	Very little evidence of detailed unavailability evaluation, and none of interviewing maintenance and operations staff. Unavailability assessment did not appear to be performed, or documented, well at any of the plants.	Maintenance unavailability is a significant contributor to overall unavailability for some SSCs, and should be addressed.

TABLE 1. ASSESSMENT OF SPECIFIC SUPPORTING REQUIREMENTS (SRs) - INCONSISTENT ASSESSMENTS OR NOT MET			
SR	**Description**	**Observations**	**Recommendation/Comment**
DA-D5	Capability Category I: USE **the Beta-factor approach (i.e., the screening approach in NUREG/CR-5485) or an equivalent for the estimation of CCF parameters.** Capability Category II: USE **one of the following models for estimating CCF parameters for significant CCF basic events:** **(a) Alpha Factor Model** **(b) Basic Parameter Model** **(c) Multiple Greek Letter Model** **(d) Binomial Failure Rate Model** **JUSTIFY the use of alternative methods (i.e., provide evidence of peer review or verification of the method which demonstrates its acceptability).** Capability Category III: USE **one of the following models for estimating CCD parameters:** **(a) Alpha Factor Model** **(b) Basic Parameter Model** **(c) Multiple Greek Letter Model** **(d) Binomial Failure Rate Model** **JUSTIFY the use of alternative methods (i.e., provide evidence of peer review or verification of the method which demonstrates its acceptability).**	Those who were judged by the licensees to have CC III did not use the method for all CCF, but focused on the significant ones, therefore they should have been CC II.	
DA-D7	Capability Category I: If modifications to plant design or operating practice lead to a condition where past data are no longer representative of current performance, LIMIT the use of old data: *(a)* If the modification involves new equipment or a practice where generic parameter estimates are available, USE the generic parameter estimates updated with plant-specific data as it becomes available **for unique design or operational features,** or; *(b)* If the modification is unique to the extent that generic parameter estimates are not available and only limited experience is available following the change, then ANALYZE the impact of the change and assess the hypothetical effect on the historical data to determine to what extent the data can be used. Capability Category II: If modifications to plant design or operating practice lead to a condition where past data are no longer representative of current performance, LIMIT the use of old data:	None of the licensees used extensive data sets, therefore this was not really an issue	

TABLE 1. ASSESSMENT OF SPECIFIC SUPPORTING REQUIREMENTS (SRs) - INCONSISTENT ASSESSMENTS OR NOT MET			
SR	**Description**	**Observations**	**Recommendation/Comment**
	(a) If the modification involves new equipment or a practice where generic parameter estimates are available, USE the generic parameter estimates updated with plant-specific data as it becomes available **for significant basic events**, or; *(b)* If the modification is unique to the extent that generic parameter estimates are not available and only limited experience is available following the change, then ANALYZE the impact of the change and assess the hypothetical effect on the historical data to determine to what extent the data can be used. Capability Category III: If modifications to plant design or operating practice lead to a condition where past data are no longer representative of current performance, LIMIT the use of old data: *(a)* If the modification involves new equipment or a practice where generic parameter estimates are available, USE the generic parameter estimates updated with plant-specific data as it becomes available, or; *(b)* If the modification is unique to the extent that generic parameter estimates are not available and only limited experience is available following the change, then ANALYZE the impact of the change and assess the hypothetical effect on the historical data to determine to what extent the data can be used.		
DA-D8	This is a new SR proposed in RG 1.200 and reads for all categories: For each SSC for which repair is to be modeled, ESTIMATE, based on the data collected in DC-C14, the probability of failure to repair the SSC in time to prevent core damage as a function of the accident sequence in which the SSC failure appears.	Since this was a new requirement not in Addendum A, none of the licensees addressed it.	This SR closes the link between data collection and an event in the PRA model. Since it is not included in Addendum B, the recommendation is that it be retained in RG 1.200.

TABLE 1. ASSESSMENT OF SPECIFIC SUPPORTING REQUIREMENTS (SRs) - INCONSISTENT ASSESSMENTS OR NOT MET			
SR	**Description**	**Observations**	**Recommendation/Comment**
QU-A2	Capability Category I: ESTIMATE the point estimate CDF from internal events. PROVIDE estimates of the individual sequences in a manner consistent with the estimation of total CDF to identify significant sequences and confirm the sequence logic is appropriately reflected. The estimates may be accomplished by using either fault tree linking or event trees with conditional split fractions. Capability Category II: ESTIMATE the mean CDF from internal events, ensuring that the "state-of-knowledge" correlation between event probabilities is taken into account. PROVIDE estimates of the individual sequences in a manner consistent with the estimation of total CDF to identify significant sequences and confirm the sequence logic is appropriately reflected. The estimates may be accomplished by using either fault tree linking or event trees with conditional split fractions. Capability Category III: CALCULATE the mean CDF from internal events by propagating the uncertainty distributions, ensuring that the "state-of-knowledge" correlation between event probabilities is taken into account. PROVIDE estimates of the individual sequences in a manner consistent with the estimation of total CDF to identify significant sequences and confirm the sequence logic is appropriately reflected. The estimates may be accomplished by using either fault tree linking or event trees with conditional split fractions.	The staff had some problems interpreting differences in Capability categories. Full propagation of uncertainty, including correlation, was only performed by one licensee.	Even if the state-of-knowledge correlation is shown not to be significant at the CDF/LERF level, it may be significant for a specific application. Addendum B has changed and clarified the requirement.
QU-B9	All Capability Categories: If modules, subtrees, or split fractions are used to facilitate the quantification, USE a process that allows (a) identification of shared events (b) correct formation of modules that are truly independent (c) results interpretation based on individual events within modules (e.g., risk significance)	Not clear why the peer reviewers said this was met, when it was not applicable	This SR is closely related to SY-A10 and should be given a consistent characterization of capability category.
QU-D2	All Capability Categories: IDENTIFY the modeling assumptions that drive the results. QUESTION modeling assumptions, asking if conditions outside those modeled could occur and, if so, could success criteria or other assumptions change. QUESTION modeled human actions for consistency with plant procedures and the range of conditions that would be obtained in the associated PRA sequence.	Predominantly not met	This SR is deleted in Addendum B as being redundant with QU-E3

TABLE 1. ASSESSMENT OF SPECIFIC SUPPORTING REQUIREMENTS (SRs) - INCONSISTENT ASSESSMENTS OR NOT MET			
SR	**Description**	**Observations**	**Recommendation/Comment**
QU-D4	All Capability Categories: REVIEW a sampling of non-significant accident cutsets or sequences to determine they are reasonable and have physical meaning.	Only one licensee addressed this, but it was not documented explicitly	This is intended as an additional logic check. In all probability this would not be a significant omission for many applications
QU-E1	All Capability Categories: CHARACTERIZE parameter uncertainty consistent with DA-D3.		Since as it was originally written this requirement was redundant with DA-D3, it has been rewritten in Addendum B to “IDENTIFY key sources of model uncertainty”.
QU-E2	All Capability Categories: IDENTIFY key sources of model uncertainty, and the assumptions made or models adopted in response to those uncertainties.	This was not addressed by any of the pilots	The identification of key sources of uncertainty is particularly important on an application specific basis. Work is underway by Electric Power Research Institute (EPRI) and the staff to provide more guidance on the identification of key sources of uncertainty (see Section 4.7). NOTE: This has been modified in Addendum B to read “IDENTIFY key assumptions ... “.

TABLE 1. ASSESSMENT OF SPECIFIC SUPPORTING REQUIREMENTS (SRs) - INCONSISTENT ASSESSMENTS OR NOT MET			
SR	**Description**	**Observations**	**Recommendation/Comment**
QU-E4	Capability Category I: **PROVIDE an assessment of the impact of the key model uncertainties on the results of the PRA.** Capability Category II: **EVALUATE the sensitivity of the results to uncertain model boundary conditions and other key assumptions using sensitivity analyses. EXAMINE key assumptions and parameters both individually and in logical combinations. For example, a sensitivity analysis of logical combinations may evaluate the combined effects of modeling assumptions, HEP, CCF probabilities, and safety function success criteria.** Capability Category III: **EVALUATE the sensitivity of the results to uncertain model boundary conditions and other key assumptions using sensitivity analyses. EXAMINE key assumptions and parameters both individually and in logical combinations. For example, sensitivity analyses of logical combinations may evaluate the combined effects of modeling assumptions, HEPs, CCF probabilities, and safety function success criteria unless such sources of uncertainties have been adequately treated in the quantitative uncertainty analysis.**	Only one licensee met this requirement and that at category I	The assessment of the impact of key sources of uncertainty on results is particularly important on an application specific basis. Work is underway by EPRI and the staff to provide more guidance on the identification and analysis of key sources of uncertainty (see section 4.7). NOTE: This has been modified in Addendum B to remove the last paragraph in CC II and C III
LE-C2	Capability Category I: INCLUDE **conservative** treatment of feasible operator actions following the onset of core damage. **An acceptable conservative treatment of operator actions is provided in the event trees of NUREG/CR-6595 [Note (1)].** Capability Categories II & III: INCLUDE **realistic** treatment of feasible operator actions following the onset of core damage. **Repair of equipment may be considered if justified through** an adequate recovery analysis (e.g., one that considers equipment availability, repair procedure availability, adequate time available, environmental conditions appropriate to allow repair).	Many did not meet this SR and/or did not explicitly treat post-core melt operator actions, such as from the SAMGs	

TABLE 1. ASSESSMENT OF SPECIFIC SUPPORTING REQUIREMENTS (SRs) - INCONSISTENT ASSESSMENTS OR NOT MET			
SR	**Description**	**Observations**	**Recommendation/Comment**
LE-C8	Capability Category I: TREAT containment environmental impacts on continued operation of equipment and operator actions in a **conservative** manner. **An acceptable alternative is the approach in NUREG/CR-6595 January 1999 [Note (1)].** Capability Category II: TREAT containment environmental impacts on continued operation of equipment and operator actions in a **realistic** manner for risk significant accident progression sequences resulting in a large early release. Conservative or a combination of conservative and realistic treatment is used for non-significant accident progression sequences. Capability Category III: TREAT containment environmental impacts on continued operation of equipment and operator actions in a realistic manner.	Not all containment environmental impacts on continued operation of equipment were documented as being considered. Consequently it was difficult in some cases to determine to what extent they were considered.	Environmental conditions may significantly impact equipment availability. Some guidance on what types of impacts should be addressed would be useful, including guidance on screening of phenomenological issues. This is related to the comment on AS-B3.
LE-C9	Capability Category I: TREAT containment failure impacts on continued operation of equipment and operator actions in a **conservative** manner. **An acceptable alternative is the approach in NUREG/CR-6595 January 1999 [Note (1)].** Capability Category II: TREAT containment failure impacts on continued operation of equipment and operator actions in a **realistic** manner for risk significant accident progression sequences resulting in a large early release. Conservative or a combination of conservative and realistic treatment is used for non-significant accident progression sequences. Capability Category III: TREAT containment failure impacts on continued operation of equipment and operator actions in a **realistic** manner.	Not all containment failure impacts on continued operation equipment were documented as being considered (e.g., loss of NPSH).	Environmental conditions resulting from containment failure may significantly impact equipment availability. Some guidance on what types of impacts should be addressed would be useful, including guidance on screening of phenomenological issues. This is related to the comment on AS-B3.

TABLE 1. ASSESSMENT OF SPECIFIC SUPPORTING REQUIREMENTS (SRs) - INCONSISTENT ASSESSMENTS OR NOT MET

SR	Description	Observations	Recommendation/Comment
LE-F2	Capability Category I: **PROVIDE a qualitative assessment of the key sources of uncertainty.** **Examples:** **(a) Identify bounding assumptions.** **(b) Identify conservative treatment of phenomena.** Capability Category II: PROVIDE uncertainty analysis which identifies the key sources of uncertainty and includes sensitivity studies for the **significant** contributors to LERF. Capability Category III: **PROVIDE uncertainty analysis which identifies the key sources of uncertainty and includes sensitivity studies.**	Most did not meet this SR since key sources of uncertainty are typically not discussed for LERF either quantitatively or qualitatively	Important aspect is to identify and address key sources of uncertainty, but this does not seem to be a focus of most licensees in LERF NOTE: The NUREG on uncertainty and the EPRI guidance on identifying sources of uncertainty will provide significant guidance in this area.
LE-G5	All Capability Categories: DOCUMENT the model integration process. INCLUDE the results of the quantification including uncertainty and sensitivity analyses, as appropriate for the level of detail of the analysis. Documentation typically includes (a) a general description of the quantification (b) key assumptions that affect the results (c) the total plant LERF and contributions from the different plant damage states and accident classes (d) equipment or human actions that are significant basic events (e) the results of all sensitivity studies, (as applicable)	Most did not meet this SR as they do not document the model integration process, in particular the analysis of uncertainties or sensitivity analyses and identification of key assumptions	This SR is related to the quantification process and is thus linked to LE-F2 comment NOTE: The NUREG on uncertainty and the EPRI guidance on identifying sources of uncertainty will provide significant guidance in this area.
LE-G7	All Capability Categories: DOCUMENT sources of uncertainty consistent with QU-F3.	None met this SR as none discussed key sources of uncertainty in LERF	An important aspect of the analysis is to identify and address key sources of uncertainty, but this does not seem to have been a focus of most licensees in LERF NOTE: The NUREG on uncertainty and the EPRI guidance on identifying sources of uncertainty will provide significant guidance in this area.

TABLE 1. ASSESSMENT OF SPECIFIC SUPPORTING REQUIREMENTS (SRs) - INCONSISTENT ASSESSMENTS OR NOT MET			
SR	**Description**	**Observations**	**Recommendation/Comment**
LE-G8	All Capability Categories: IDENTIFY limitations that would impact applications.	Most did not meet this SR since they did not identify limitations in their LERF assessments	This is related to the requirement LE-F2. An important aspect of the analysis is to understand the limitations of the analysis, since they contribute to uncertainty in the results. This is most significant when the LERF evaluations are used to support applications.

In addition to the technical supporting requirements identified in ASME PRA Standard Section 4, the staff also reviewed the PRA information against Sections 5 and 6 of the ASME PRA Standard. ASME PRA Standard Section 5, PRA Configuration Control, addresses among other topics, PRA maintenance and upgrades. ASME PRA Standard Section 6, Peer Review, addresses when and how PRA peer reviews should be conducted. The general findings in these areas, common to the majority of the pilots, are identified in Table 2.

TABLE 2. ASSESSMENT OF ASME PRA STANDARD SECTIONS 5 & 6 REQUIREMENTS

Requirement	Observation	Assessment
General	Most licensees did not perform a self-assessment against the requirements of Sections 5 and 6. NEI 00-02 contains an element specific to PRA maintenance and upgrade (MU).	PRA maintenance, updates, and upgrades are fundamental to achieving the purposes of RG 1.200. No changes are needed to either RG 1.200, SRP 19.1, the ASME PRA Standard, or NEI 00-02. Licensees need to evaluate their PRA processes against ASME PRA Standard Sections 5 and 6.
General - 6	Many requirements of this section of the ASME PRA Standard were not part of the NEI 00-02 process, or were purposefully not included to ensure anonymity. This primarily relates to the peer review selection process, training, specific areas reviewed by each member, extent of review, and differing opinion process (covering sections 6.1.2, 6.2.2, 6.2.3, and 6.3.1 - 6.3.9)	Future reviews need to meet these requirements and the self- assessment needs to assess the peer review against these requirements, and augment areas in which the peer review may not have been complete.
5.2(c) / 5.5	Requires a process that ensures that the cumulative impact of pending changes is considered when applying the PRA, but most licensees did not have a process to address this area.	Licensees need to ensure they establish and implement this process.

TABLE 2. ASSESSMENT OF ASME PRA STANDARD SECTIONS 5 & 6 REQUIREMENTS		
Requirement	**Observation**	**Assessment**
5.2(d) / 5.6	Requires a process that evaluates the impact of changes on previously implemented risk-informed decisions that have used the PRA, but most licensees did not have a process to address this area.	Licensees need to ensure they establish and implement this process.
5.2(e) / 5.7	This requirement is limited to only the computer codes used to support PRA quantification (e.g., CAFTA, NUPRA, etc.).	The ASME PRA Standard should include in configuration control the actual PRA model (event trees and fault tree computer models), not just the computer codes.
5.2(f) / 5.8	This subsection contains a large number of elements associated with documenting the configuration control process that most licensees do not meet fully.	Licensee documentation of their processes needs to be enhanced.
6.2.2 & 6.6.1d	There was at least one licensee that had peer reviewers that either provided support to the licensee prior to or after the peer review and also identified peer reviewers that were of the same organization that supported the licensee.	Though the licensee indicated that no individual reviewed his/her own work, there is clearly the potential for at least an organizational conflict of interest that should be avoided.
6.3.1 - 6.3.9 & 6.6.1e	The NEI 00-02 peer review process did not require the documentation of the depth and scope of review of the peer review for each of the technical elements and thus it cannot be completely assessed as being fully performed.	Future reviews need to meet these requirements and the self- assessment needs to assess the peer review against these requirements, and augment areas in which the peer review may not have been complete.

4.2 Bases Behind Self-Assessment Determinations

The review team found it difficult to identify the bases for the peer review/self-assessment determinations for a number of supporting requirements, especially for those supporting requirements determined to be met. SPSB suggests that further dialog among the staff, NEI, and licensees would be beneficial to help ensure that licensees record the bases for determining each supporting requirement capability category in the self-assessment documentation. For many supporting requirements, this record could be as simple as cross-referencing the specific section/passage of the licensee's documentation that provides the basis for having met the supporting requirement. This documentation would also act as a check for the licensee to ensure that all supporting requirements are documented in a fashion that would support maintenance of the information and ease of review.

4.3 New Review Findings Identified by the Staff

The staff identified only a few findings that had not been previously identified during the licensees' self-assessments. This result indicates that the peer review/self-assessment process is generally effective in identifying the technical issues (findings) that need resolution to improve the technical adequacy of licensee PRAs.

4.4 Interrelationships Among Supporting Requirements

There are a number of supporting requirements in nearly every technical area that cross-references to other technical areas (e.g., LE-E3 refers to the entire QU technical area to ensure that LERF quantification is performed correctly). Though appropriate, this structure makes reviews of specific technical areas difficult. SPSB suggests that a reviewer's cross-reference table be developed and incorporated into the next revision of SRP 19.1.

4.5 Staff Guidance on When to Perform an Audit

During conduct of the pilot program, the staff recognized that there is no guidance for the staff to apply to help determine when the staff should perform a site audit of a licensee's PRA in conjunction with various licensing activities (e.g., risk-informed license amendment requests). SPSB suggests that guidance on determining when a site audit is warranted be developed and incorporated into the next revision of SRP 19.1.

4.6 RG 1.200 Definition of "Significant"

One of the identified items of the pilot program was to gain insight into the utility of the RG 1.200 proposed definitions of the terms "significant basic event" and "significant accident sequence." These definitions were crafted subsequent to the completion of the PRAs reviewed during the pilot program, and also subsequent to the original peer reviews of these PRAs. Consequently, there was no consistency in the way these concepts were defined, if indeed they were even used.

If quantitative measures of significance were used, they differed from those proposed in RG 1.200. In addressing this as part of the review, the staff gained an increased appreciation of how the terms are used in the ASME PRA Standard. This improved understanding will be of benefit in reassessing the need for such quantitative definitions and in assessing any changes provided in Addendum B of the ASME PRA Standard.

4.7 Identification of Key Uncertainties and Assumptions

One of the identified items of the pilot program was to gain insight into the utility of the RG 1.200 proposed definitions of the terms “key source of uncertainty” and “key assumptions.” These definitions were crafted subsequent to the completion of the PRAs reviewed during the pilot program and also subsequent to the original peer reviews of these PRAs. Consequently, there was no consistency in the approaches that licensees used to (1) identify key sources of uncertainty and key assumptions, and (2) assess their impacts on the PRA results.

In the majority of the PRAs reviewed during the pilot program, there was no identification of significant uncertainties or assumptions in the base PRA. One licensee created a process for identifying key sources of uncertainty using a literal interpretation of the definition added by the RG 1.200 clarification of ASME PRA Standard Section 2.2. However, this approach led to the identification of PRA modeling aspects that would not typically be characterized as key sources of uncertainty and did not identify aspects that would be expected to be identified as key sources of uncertainty.

5.0 Conclusions

Throughout this process, the NRC staff gained an increased appreciation for the level of information and effort required by the ASME PRA Standard. The staff involved in the pilot program also gained a deeper understanding of specific supporting requirements. In general, the objectives of the pilot program were achieved, as further discussed below.

5.1 Objective 1: Does RG 1.200 provide adequate guidance to demonstrate the technical adequacy of PRA?

On the basis of its participation in the pilot program, SPSB concludes that RG 1.200 provides adequate guidance to demonstrate the technical adequacy of PRAs.

5.2 Objective 2: What specific changes to RG 1.200 are needed to improve its clarity?

The project team did not identify any significant changes to RG 1.200 or SRP 19.1. However, since documentation was an area of concern for all the PRAs reviewed, it is suggested that additional guidance be provided in Section 4 of RG 1.200 that addresses, for example, the cross-referencing of the supporting requirements to sections of the PRA archival (sometimes referred to as Tier 2) documentation. This would serve the dual purpose of making sure that the PRA owner has a complete picture of the PRA and also would provide a reference for the resolution of any requests for additional information that might arise during staff review of a risk-informed submittal.

5.3 Objective 3: Are there specific technical issues requiring additional guidance?

The ASME PRA Standard is a document that specifies what should be done, but not how to do it. While, for the most part, the methods used for the Level I PRA technical elements are well established, there are some analyses where there appears to be significant lack of uniformity or understanding of what is expected, and for which there would be benefit in providing additional technical guidance. This has been provided, for example, for data parameter estimation in NUREG/CR-6823, "Handbook of Parameter Estimation for Probabilistic Risk Assessment," and for HRA in NUREG-1792, "Good Practices for Human Reliability Analysis." The pilot program identified four areas where additional guidance should be developed, as discussed in the following paragraphs.

5.3.1 Identification of key sources of uncertainty and key assumptions

As stated in RG 1.174, the impact of uncertainties and assumptions must be assessed when comparing the results of a PRA to quantitative acceptance guidelines. To do so, those assumptions and uncertainties that could impact the decision must be identified. However, as noted above, in Section 4, the identification of key sources of uncertainties and key assumptions was not adequately addressed in any of the pilot plants. While the particular assumptions and uncertainties that are significant in risk-informed decisionmaking will vary from application to application, it is important that the PRA documentation be such that they can be identified. This is an area that has already been recognized as needing additional guidance. EPRI has produced a draft document entitled "Guideline for the Treatment of Uncertainty in Risk-Informed Applications - Technical Basis Document" and is preparing an application document. The Office of Research is also preparing a NUREG on the treatment of uncertainty, and in particular, model uncertainty in decisionmaking, which will reference the EPRI document as appropriate.

5.3.2 Use of fault trees to estimate the frequency of support system initiating events

The supporting level requirements in the ASME PRA Standard that address this topic are IE-C6, IE-C7, IE-C8 and IE-C9. While the supporting requirements pertaining to systems analysis contained in the ASME PRA Standard could be used by a knowledgeable PRA engineer to construct an initiator fault tree, they provide little guidance to ensure consistency and adequacy of the resulting trees.

Therefore, SPSB suggests that guidance on developing fault trees to estimate the frequency of initiating events be developed. The guidance should discuss relevant probability theory, describe how initiator fault trees may be integrated into PRA logic models, provide or identify suitable data sources for quantifying fault tree basic events, describe how common-cause failures should be considered, describe how to incorporate human reliability considerations, describe how to incorporate repair actions and timing considerations, and describe how typical PRA quantification tools should be used when estimating initiator frequencies. Fully worked examples should also be provided.

This guidance could either be developed by the staff or by industry, with subsequent staff review and endorsement.

5.3.3 Phenomenological Conditions Caused by Accident Sequence

The supporting level requirements in the ASME PRA Standard that address this topic are AS-B3, LE-C8, and LE-C9. SPSB recommends that guidance on addressing phenomenological conditions be developed. It is observed that supporting requirement AS-B3 provides some examples of phenomenological conditions; however, this list is not complete and an approach is needed to ensure that all relevant conditions are identified and addressed, including containment failure impacts. The role of screening analysis should be explored (Some issues that could be addressed include: Is screening analysis a viable approach? If so, how should screening be done and documented? What are the screening criteria?). For phenomenological conditions that cannot be screened from further consideration, a discussion on how to represent them in the PRA model should be developed.

This guidance could either be developed by the staff or by industry, with subsequent staff review and endorsement.

5.3.4 Treatment of Multi-Unit Interactions

The supporting level requirements in the ASME PRA Standard that address this topic are IE-A10, SC-A4, and SY-A11. SPSB suggests that guidance on addressing multi-unit interactions be developed. This guidance should discuss not only how to represent multi-unit initiating events (e.g., grid-related loss-of-offsite events) in the PRA model but also how to credit shared systems during recovery analysis, which requires consideration of the impact of multi-unit initiators, the operating modes of the units (at-power, low power, shutdown), and Technical Specifications.

This guidance could either be developed by the staff or by industry, with subsequent staff review and endorsement.

5.4 Objective 4: Do the requirements of the ASME PRA Standard provide a sufficient basis for assessing technical adequacy?

SPSB concludes that the requirements of the ASME PRA Standard, when augmented with the clarifications and qualifications contained in RG 1.200, provide a sufficient basis for assessing PRA technical adequacy, even given the issues identified above, because the pilot program did not identify any major omissions to these requirements.

5.5 Objective 5: Can the ASME PRA Standard be interpreted in an unambiguous manner?

SPSB concludes that the ASME PRA Standard can, for the most part, be interpreted in an unambiguous manner. The staff reviewers were aware that ambiguities that arise because of the use of multiple actions verbs in a single supporting requirement. Table 1 identifies a few supporting requirements where some additional clarity could be remove ambiguity. The staff understands that most of these clarifications have been addressed in Addendum B, which will be issued in the near future.

SPSB observes that users of the Standard should be adequately trained on the Standard. Further, it is suggested that licensees ensure that their PRAs are consistent with the definitions provided in Section 2 of the ASME PRA Standard, as clarified and qualified by RG 1.200.

5.6 Objective 6: Is the industry's self-assessment process effective in demonstrating technical adequacy?

The results of the pilot program suggest that industry self-assessment is capable of demonstrating the technical adequacy of PRAs. However, SPSB suggests that further dialog among the staff, NEI, and licensees is essential to re-emphasize that industry must take the actions necessary to ensure the integrity and objectivity of the self-assessment process.

SPSB observes that self-assessment is more than a bookkeeping exercise involving the mapping of past peer review results into the format of the ASME PRA Standard. Rather, it should provide a licensee with an in-depth understanding of the base PRA's capabilities and limitations (see, for example, Table 2). The staff expects that licensees will:

- Objectively and critically review their PRAs as specified in Sections 5 and 6 of the ASME PRA Standard, and

- Make demonstrable progress towards resolving peer review and self-assessment findings (as opposed to deferring them indefinitely because their resolution is not necessary to support individual risk-informed licensing actions).

5.7 Objective 7: Is the use of peer review an effective and efficient approach to identify weaknesses in PRAs?

The results of the pilot program suggest that peer review is an effective and efficient approach to identify weaknesses in PRAs because, as discussed in Section 4.1, there was generally good agreement between the staff's assessments and the licensees' self-assessments. The comments made in Section 5.6 concerning the integrity and objectivity of the self-assessment process also apply to the peer review process. Of primary interest are the F&Os generated through peer reviews, which identify specific aspects of the PRA that may need revision. The overall or summary score received for each PRA technical element received on a peer review is of secondary interest.