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External Hazards PRA Peer Review Process Guidelines

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Guidelines**

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ACKNOWLEDGEMENTS

This report is a summary of work made possible by the cooperative efforts of a diverse group of participants. The External Hazards PRA Peer Review Process was developed based on the Fire Probabilistic Risk Assessment (FPRA) Peer Review process documented in Nuclear Energy Institute (NEI) 07-12, developed by the Boiling Water Reactor Owners Group (BWROG), Pressurized Water Reactor Owners Group (PWROG) and industry participants. The adapted External Hazards PRA Peer Review process in this document was developed by Nataliya Povrozyk (Westinghouse) and David Finnicum (Westinghouse), with support from the PWROG.

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EXECUTIVE SUMMARY

This document provides guidance material for use in conducting and documenting an External Hazards Probabilistic Risk Assessment (PRA) Peer Review. The PRA Peer Review process provides a written method for reviewing an External Hazards PRA against the applicable Parts of the ASME/ANS PRA Standard, ASME/ANS RA-Sa-2009 [6].

The Peer Review process and guidance material was developed using the guidance in NEI 00-02, “Probabilistic Risk Assessment Peer Review Process Guidance,” [1], NEI 05-04, “Process for Performing PRA Peer Reviews Using the ASME PRA Standard (Internal Events),” [2], and NEI 07-12, “Fire Probabilistic Risk Assessment Peer Review Process Guidelines,” [3].

The External Hazards PRA Peer Review guidance document is a written process that satisfies the requirement in the ASME/ANS PRA Standard to use a documented peer review process. With a process available and implementation by the External Hazards PRA owners, it is expected that the regulatory review of risk-informed applications for which External Hazards are a relevant risk contributor will be streamlined. Thus, an attempt has been made in this guidance to maintain consistency with the original internal hazards, at-power Peer Review process to the extent feasible, while incorporating External Hazards PRA specific issues.

After some exercising of this process by the industry, lessons learned will be incorporated to produce Revision 1 of this guidance document.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	i
ACRONYMS	V
1 INTRODUCTION.....	1
1.1 OVERVIEW AND PURPOSE	1
1.2 SCOPE	3
1.3 BACKGROUND	4
1.4 PROCESS OVERVIEW	5
1.5 MULTI-UNIT SITE PEER REVIEW.....	11
2 PEER REVIEW PROCESS	13
2.1 EXTERNAL HAZARDS PRA PEER REVIEW PROCESS DESCRIPTION	13
2.2 EXTERNAL HAZARDS PRA PEER REVIEW TEAM	20
2.3 HOST UTILITY PREPARATION AND PARTICIPATION REQUEST	23
2.4 REVIEW WEEK AGENDA	23
3 EXTERNAL HAZARDS PRA PEER REVIEW PROCESS ELEMENTS AND GUIDANCE	24
3.1 OVERVIEW	24
3.2 PEER REVIEW PROCESS CRITERIA	24
3.3 ASSIGNMENT OF CAPABILITY CATEGORIES	29
3.4 ADDITIONAL GUIDANCE ON THE TECHNICAL ELEMENTS REVIEW.....	31
3.5 FOLLOW-ON EXTERNAL HAZARDS PRA PEER REVIEW.....	32
4 PEER REVIEW PROCESS RESULTS AND DOCUMENTATION.....	34
4.1 PEER REVIEW REPORT.....	34
4.2 PROCESS SUMMARY FORMS AND INFORMATION	35
4.3 PROCESS FEEDBACK.....	35
4.4 FOLLOW-ON PEER REVIEW.....	35
5 REFERENCES.....	37
APPENDIX A PREPARATION MATERIAL FOR THE PEER TEAM REVIEW	A-1
APPENDIX B PEER REVIEW SAMPLE SUMMARY SHEETS	B-1
APPENDIX C MAINTENANCE AND UPDATE PROCESS REVIEW CHECKLIST	C-1

APPENDIX D SUMMARY OF PART 2 REQUIREMENTS REFERENCED IN PARTS 5 THROUGH 10 OF THE ASME/ANS PRA STANDARD..... D-1

APPENDIX E EXAMPLE PRA PEER REVIEW LESSONS LEARNED FORM E-1

APPENDIX F SAMPLE FACT AND OBSERVATION FORM..... F-1

APPENDIX G EXAMPLE F&O SEQUENTIAL NUMBER SELECTION LOG G-1

APPENDIX H EXTERNAL HAZARDS SCREENING AND CONSERVATIVE ANALYSIS H-1

ACRONYMS

ANS	American Nuclear Society
AS	Accident Sequence Analysis (Part 2 Technical Element)
ASME	American Society of Mechanical Engineers
B&WOG	Babcock & Wilcox Owners Group
BWR	Boiling Water Reactor
BWROG	BWR Owners Group
CEOG	Combustion Engineering Owners Group
JCNRM	Joint Committee on Nuclear Risk Management
EPRI	Electric Power Research Institute
EXT	Screening and Conservative Analysis (Part 6 Technical Element)
F&O	Fact & Observation (form)
GL	Generic Letter
HLR	High Level Requirement
HRA	Human Reliability Analysis
IE	Initiating Event; also Initiating Events (Part 2 Technical Element)
N/A	Not Applicable
NEI	Nuclear Energy Institute
NRC	Nuclear Regulatory Commission
PRA	Probabilistic Risk Assessment
PSA	Probabilistic Safety Analysis
PWR	Pressurized Water Reactor
PWROG	Pressurized Water Reactor Owners Group
SC	Success Criteria
SFR	Seismic Fragility Analysis (Part 5 Technical Element)
SHA	Seismic Hazard Analysis (Part 5 Technical Element)
SM	Seismic Margin Assessment (Part 10 Technical Element)
SPR	(Seismic) Systems Analysis (Part 5 Technical Element)

SR	Supporting Requirement
SSC	System, Structure, and Component
WFR	Wind Fragility Analysis (Part 7 Technical Element)
WHA	Wind Hazard Analysis (Part 7 Technical Element)
WOG	Westinghouse Owner's Group
WPR	High Wind Plant Response Model and Quantification (Part 7 Technical Element)
XFFR	External Flood Fragility Analysis (Part 8 Technical Element)
XFHA	External Flooding Hazard Analysis (Part 8 Technical Element)
XFPR	External Flood Plant Response Model (Part 8 Technical Element)
XFR	External Hazard Fragility Analysis (Part 9 Technical Element)
XHA	Other External Hazard Analysis (Part 9 Technical Element)
XPR	Other External Hazard Plant Response Model and Quantification (Part 9 Technical Element)

EXTERNAL HAZARDS PRA PEER REVIEW PROCESS GUIDELINES

1 INTRODUCTION

1.1 OVERVIEW AND PURPOSE

The objectives of the External Hazards Probabilistic Risk Assessment (PRA)¹ Peer Review process are to:

- provide a consistent and uniform method for establishing the technical adequacy of an External Hazards PRA that addresses risk from a particular set of hazards, for a spectrum of potential risk-informed plant licensing applications for which the External Hazards PRA assessment may be used
- provide a means for identifying, over time, areas of consistency or inconsistency in the treatment of issues important to understanding plant external event risk and implementing risk-informed applications.

The External Hazards PRA Peer Review employs a team of engineers and other technical specialists who collectively are industry experts in external event hazard development, fragility analysis, and plant response analysis applicable to the External Hazards PRA undergoing a peer review. The Peer Review Team is guided by the high level requirements (HLRs) and supporting requirements (SRs) in the applicable Parts of the ASME/ANS PRA Standard [5]. A Peer Review provides both an objective review of the External Hazards PRA technical elements (against the ASME/ANS PRA Standard), and an assessment, based on the Peer Review Team members' experience, of the technical adequacy of the External Hazards PRA elements to support risk-informed applications. The team uses a set of Capability Category Summary Sheets as a framework within which to characterize the scope, comprehensiveness, completeness, and fidelity of the External Hazards PRA being reviewed.

Among the key inputs to the review is the completion of a previous Internal Events PRA Peer Review, the resolution of the facts and observations (F&Os) from that review, and the results of any self-assessment that has been performed on the External Hazards PRA. The Internal Events PRA model is normally used as the systems model foundation to develop an external hazard (e.g., seismic, high winds, external flood) plant response PRA model, providing the ability to rely on the Internal Events PRA Peer Review for aspects of the External Hazards PRA plant response model that are similar to the Internal Events PRA model (i.e., system modeling, data, etc.).

A desired outcome of using the External Hazards PRA Peer Review process is to show conformance with the applicable part(s) of the ASME/ANS PRA Standard to the extent that certain risk-informed applications can be supported. A byproduct of using the ASME/ANS PRA Standard (and this External Hazards PRA Peer Review process) is that the regulatory review

¹ Note that, while the term PRA is used throughout this document, no distinction is made between PRA and PSA (probabilistic safety analysis). These terms are used interchangeably.

process for risk-informed applications may be expedited. Thus, in this process an attempt has been made to maintain consistency with the original PRA Peer Review Process Guidance [1], the Follow-on Internal Events Peer Review Process [2], and the Fire PRA Peer Review Process [3] to the extent feasible². Consistency with the Internal Events PRA Peer Review is desirable to ensure that conclusions reached for that process can continue to be used for the External Hazards PRA. Consistent with this industry objective, substantial portions of the Internal Event PRA Peer Review and Follow-on Peer Review and documentation process have been incorporated directly into this document. The peer review process offers a forum for reviewers and the PRA staff of host utilities to facilitate the exchange of ideas and techniques for effective use of External Hazards PRA methodologies. This is accomplished by the participation of knowledgeable utility personnel on the External Hazards PRA Peer Review Teams.

The External Hazards PRA Peer Review process discussed below also includes a Follow-on Peer Review. In general, a Follow-on Peer Review implies that an initial External Hazards PRA Peer Review has already been conducted, and at least the F&Os classified as “Findings” from the initial peer review have been addressed. A Follow-on Peer Review would be needed as a result of an External Event PRA upgrade, performed either in response to a peer review or as a result of the normal evolution of the External Hazards PRA model. A change that constitutes a PRA upgrade is defined in Part 1 of the ASME/ANS PRA Standard [6]. In some cases, a Follow-on Peer Review may be requested for an entire External Hazards PRA model because of changes made to the methodology throughout the PRA model. Thus, a Follow-on Peer Review’s scope can be as narrow as a single External Hazards PRA technical element or single external event hazard, or as expansive as a peer review of the entire External Hazards PRA.

An External Hazards PRA Peer Review requires the completion of an Internal Events PRA Peer Review (using NEI 00-02 and/or NEI 05-04) and addressing the F&Os. The Internal Events PRA Peer Review encompasses both the models and the methods used to develop the Internal Events PRA, which is heavily relied upon by the External Hazards PRA plant response model. As such, these models and methods should not need to be reviewed again during the External Hazards PRA Peer Review. Exceptions to this conclusion include:

- F&Os that were not addressed prior to the External Hazards PRA Peer Review
- disposition of Internal Events PRA F&Os that are likely to have an impact on the External Hazards PRA
- recent updates affecting the External Hazards PRA
- unique system models, event trees, and other PRA model inputs developed as a part of the External Hazards PRA.

The review of Internal Events PRA model issues pertinent to the External Hazards PRA undergoing the peer review is addressed in the self-assessment discussion in Section 1.4 below. A Follow-on Peer Review of the Internal Events PRA is not required prior to performing a

² The original peer reviews were either based on NEI 00-02 or directly against the ASME PRA Standard. When done against NEI 00-02, a self-assessment is necessary to bridge the “gap” between NEI 00-02 and the ASME PRA Standard.

Follow-on Peer Review of the External Hazards PRA, unless the model upgrade or changes affect both the Internal Events PRA and the External Hazards PRA. If the most recent Internal Events PRA Peer Review was performed against an older version of the ASME/ANS PRA Standard and RG 1.200 [7] (prior to Revision 1, Addendum B, or Revision 0 of the Standard), a gap assessment is needed to assess whether the Internal Events PRA meets the latest NRC-endorsed ASME/ANS PRA Standard [6], per the guidance in NEI 05-04.

1.2 SCOPE

An External Hazards PRA Peer Review is a one-time³ evaluation of the applicable (e.g., seismic, external flood, or high winds) External Hazards PRA that examines both the current External Hazards PRA, and the associated Configuration Control process (maintenance and update process) (see Section 1-5 of the ASME/ANS PRA Standard). Using the External Hazards PRA Peer Review process, reviewers assign Capability Categories to each of the SRs of the various technical elements of the External Hazards PRA. The Capability Categories denote the relative capability of the SRs for use in External Hazards PRA applications.

Among the most important factors to ensure a usable and successful External Hazards PRA for applications are:

- External Hazards PRA development and support organizations
- management attention to the process
- communication between the PRA group and other parts of the organization, such as the Seismic Protection Staff or the External Flood Protection Staff
- external Hazards PRA technical adequacy
- external Hazards PRA process, including configuration control.

The first three elements are plant-specific management issues that should be addressed by each utility to ensure successful use of the applicable External Hazards PRA in applications. The last two items are External Hazards PRA-specific items, which are the focus of the Peer Review.

The general scope of the implementation of this External Hazards PRA Peer Review process includes review of the applicable part(s) of the ASME/ANS Combined PRA Standard [6], using tables shown in Appendix B to cover the HLRs and SRs, plus a review of PRA maintenance and update SRs shown in Appendix C.

An issue potentially applicable to External Hazards PRA Peer Reviews is that for specific applications, a plant may request a peer review of a future configuration, e.g. the "as-built, as-operated in 20XX" (projected) plant as opposed to the "as-built, as-operated" (current) plant.

³ Note that "one-time" in this context means once for the existing External Events PRA scope and approach. It is not expected that any additional full peer review would be required unless substantial changes are made to an External Hazards PRA. Similarly, substantial modifications to the methodology used in the existing Internal Events or External Hazards PRA, such as changing from a large event tree (support system modeling) to a large fault tree (fault tree linking) approach might warrant additional peer review, even if the current PRA scope were unchanged.

Either configuration should be allowed for peer review, but the basis needs to be clearly stated in the Peer Review report and provided for the Peer Review Team in advance of the review.

1.3 BACKGROUND

In 1997, the Boiling Water Reactor Owners Group (BWROG) developed a process for performing a peer review of a plant's Level 1 at-power PRA models that would assess the capability of the PRA for various risk-informed applications and also assess whether a process was in place to provide a means for the long-term maintenance of that level of capability. The key features of the BWROG process were a highly structured schedule for a focused review of the PRA and a set of 11 tables to be used to document the review of ten technical elements of an Internal Events PRA, plus the program in place for maintenance of the PRA models, and a four-level grading scheme for the 11 technical areas.

The Combustion Engineering Owners Group (CEOG) adopted the BWROG Peer Review process with some slight modifications. In parallel, the Nuclear Energy Institute (NEI), working with the Westinghouse Owners Group (WOG), the Babcock & Wilcox Owners Group (B&WOG) and the CEOG, adopted the BWROG Peer Review process and revised the checklists to incorporate pressurized water reactor (PWR) specific items, as needed. NEI issued NEI 00-02 [1] as the industry standard for performing PRA Peer Reviews. The industry Peer Review process presented in NEI 00-02 was intended to cover a single peer review of a utility's PRA with on-going maintenance of the capability of the PRA covered by reviewing the utility's PRA Maintenance and Update process to ensure that it was sufficient to maintain the PRA at the appropriate capability level.

In April 2002, the American Society of Mechanical Engineers (ASME) issued ASME RA-S-2002, the ASME PRA Standard; this was updated with Addendum A in December 2003 [3], and Addendum B in December 2005 [5]. Section 1-5.4 of the ASME PRA Standard requires a peer review for PRA upgrades. (Note: The ASME PRA Standard defines PRA upgrade as "the incorporation into a PRA model of a new methodology or significant changes in scope or capability. This could include items such as new human reliability analysis methodology; new data update methods, new approach to quantification or truncation, or new treatment of common cause failure.") NEI 05-04, "Process for Performing Follow-on Peer Reviews using the ASME PRA Standard" was developed because the overall scope and set of detailed requirements in the ASME PRA Standard are somewhat different than that of NEI 00-02. Thus, peer reviews conducted in accordance with NEI 00-02 do not cover the full scope of the ASME PRA Standard. In Appendix B of Regulatory Guide 1.200 (RG 1.200) [7], the Nuclear Regulatory Commission (NRC) recognized the validity of the peer reviews conducted in accordance with NEI 00-02 as partially covering the scope of the ASME PRA Standard and they endorsed the concept of performing a self-assessment to show compliance with ASME PRA Standard requirements, including those not covered by the NEI 00-02 Peer Reviews.

In March 2009, the ASME/ANS PRA Standard was updated with Addendum A [6], which includes the requirements to assess the technical adequacy of External Hazards PRAs in Parts 5 through 10 of the Standard. Also in March 2009, the NRC issued Revision 2 of RG 1.200 [7], which provides guidance to licensees to determine the technical adequacy of External Hazards PRA to support risk-informed regulatory activities. RG 1.200 also provides an endorsement of

the 2009 Addendum A to the ASME/ANS PRA Standard, which is one acceptable way to meet the technical elements set forth in RG 1.200.

1.4 PROCESS OVERVIEW

The overall peer review process includes two main steps, as illustrated in Figure 1-1.

These are:

1. preparatory activities, including a review of previous Internal Events PRA Peer Review F&Os, an External Hazards PRA self-assessment, and other activities conducted by the host utility prior to the peer review
2. the on-site External Hazards PRA Peer Review itself.

Figure 1-1 Host Utility Preparations for External Hazards PRA Peer Review

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External Hazards PRA Peer Review Preparatory Review and Self-Assessment

Prior to the performance of the Peer Review Team preparatory review, the host utility should perform a self-assessment against the guidance in this document and the applicable parts of the ASME/ANS PRA Standard (see Section A.3.2). This self-assessment will help identify any known issues with the existing External Hazards PRA and allow the utility a chance to either correct any issues or to disposition any self-assessed F&Os. The self-assessment should also identify all External Hazards PRA documentation to support specific SRs.

The self-assessment is key to ensuring that the overall Peer Review process is completed within the scheduled time and that all of the required review is completed. Depending on the complexity of the External Hazards PRA undergoing a peer review and the number of SRs being reviewed, it can be challenging to complete the peer review during the one-week on-site visit by the Peer Review team. If the peer reviewers do not have a good road map of the External Hazards PRA documentation, or encounter considerable problems during the review, the Peer Review team will have difficulty completing the review.

An overall objective of the recommended preparatory self-assessment is for the host utility to identify areas where the baseline External Hazards PRA should be improved to support risk-informed applications. This self-assessment is largely based on the peer review guidance and, although not an independent review, provides a basis and opportunity for a critical re-evaluation of how well the External Hazards PRA has been constructed and maintained.

Specifically, objectives of the preparatory review and self-assessment are:

- to review the Internal Events PRA Peer Review results including open and closed/dispositioned Internal Events PRA F&Os, and document the effect of these on the External Hazards PRA
- to have an opportunity to identify and address, prior to the arrival of the Peer Review Team, using guidance similar to that used by the peer reviewers, areas where the External Hazards PRA may require:
 - additional technical analysis
 - process improvements
 - additional or alternative documentation
- to review documentation and ensure that as complete a set of documentation as feasible is available for the reviewers, including a description (roadmap) of where the bases for meeting the External Hazards PRA SRs for each technical element are documented to streamline the peer review and allow for a more effective review.

As part of the self-assessment, utilities are expected to complete a self-assessment of the referenced Internal Events SRs listed in Table D-1 as applicable. For SRs where the methodology uses the same or similar process as used in the Internal Events PRA, the self-assessment should reference the previously completed Internal Events PRA Peer Review. Specific areas for which the Internal Events PRA cannot be relied upon (e.g., results review and uncertainty analysis) would need to be specifically evaluated in the self-assessment. The portion of the self-assessment involving Table D-1 should focus on changes made for the development of the External Hazards PRA plant response model and any departures from the process used for Internal Events PRA development. For example, because initiating events are grouped, there may be an initiator that was included in the Internal Events PRA model (and thus peer reviewed) but not explicitly treated or modeled in detail. If this initiator then becomes a separate event tree as part of an External Hazards PRA, then a self-assessment should be performed against the pertinent SRs in the internal events PRA Standard. While this may not qualify as a PRA upgrade because the method was not changed, the fact that this is now a separate event tree in the External Hazards PRA may be a significant model change that should be reviewed. Another example occurs in the human reliability element where Level 1 internal events human failure events (HFEs) may be used in the External Hazards PRA. Any new HFEs (post-initiator) that were added to the External Hazards PRA model need to be included in the self-assessment. The degree of review is dependent on whether the human reliability analysis (HRA) approach for the External Hazards PRA HFEs is the same as was used for the Internal Events PRA. If not, the HFEs should be subject to a high degree of scrutiny to ensure that the relevant HRA SRs are met.

Additional guidance and recommendations on the performance of the self-assessment is provided in Appendix A.

Sufficient time should be allocated between the self-assessment/preparatory activity and the External Hazards PRA Peer Review to either address the identified issues, or to formulate plans for how they may be addressed, prior to the peer review.

External Hazards PRA Peer Review Process

Spatial relationships between systems, structures, and components (SSC) are very important when performing a PRA for external hazards such as seismic, high winds, and external flood. Thus, it is necessary to perform on-site walkdowns during an External Hazards PRA Peer Review to confirm the relationships between SSCs and the potential effects of an external hazard. For example, for an External Flood PRA, the peer reviewers would perform walkdowns to examine flood barriers. To support efficient walkdowns, it is strongly recommended that appropriate portions of an External Hazards PRA Peer Review be performed on-site.

The External Hazards PRA Peer Review includes the following steps, which are discussed in the sections below:

1. plant and External Hazards PRA information collection for pre-visit review (see Sections 2.3 and A.3)
2. assembling the Peer Review Team (see Section 2.2)
3. pre-review evaluation of selected material and host utility self-assessment
4. pre-review telecoms, as necessary
5. identification of specific information required during on-site visit
6. pre-review visit (by Team Lead), as necessary
7. on-site visit, including⁴:
 - a) interaction with the host utility External Hazards PRA group to obtain an overview of the External Hazards PRA (see Section A.8)
 - b) examination of each External Hazards PRA SR using questions and review summary sheets (see Section 3.2)
 - c) verification of equipment vulnerable to external hazards by walkdown⁵
 - d) examination of results of an External Hazards PRA sensitivity run(s) performed during the peer review (see Section A.6)
 - e) examination of the External Hazards PRA Maintenance and Update process
8. development of preliminary findings and results
9. closeout meeting
10. follow-up team telecoms
11. follow-up host utility telecoms, as necessary
12. development of draft report
13. review of draft report by host utility
14. delivery of the Final Report of the External Hazards PRA Peer Review.

⁴ It is possible that assessment of hazard characterization may need to be done in advance of the review. The team lead and host utility should address this early in the process.

⁵ Unlike the Internal Events PRA walkdown, the External Events PRA walkdowns may involve most of the Peer Review Team to review vulnerabilities to external flooding, high winds, or seismic hazards.

A flowchart of the External Hazards PRA Peer Review process is shown in Figure 1-2. This figure describes the general approach and process steps used in the application of the External Hazards PRA Peer Review process to an individual External Hazards PRA. The reviewers begin prior to their arrival on-site, by reviewing material provided in advance by the host utility. This review includes:

- internal Events PRA Peer Review (including gap assessment) and F&Os (including both the open and the closed/dispositioned F&Os) – see Appendix A for additional guidance and recommendations
- plant self-assessment performed prior to the peer review, including the review of both open and closed/corrected issues
- documentation provided to the Peer Review Team in support of meeting the External Hazards PRA SRs.

By beginning its initial review of the External Hazards PRA prior to arrival and devoting time equivalent to one work week on preparations, the members of the Peer Review Team can focus on walkdowns and details of the External Hazards PRA during the on-site visit. Note that during the site visit, most or all of the Peer Review Team will likely be involved in one or more walkdowns, and this should be accounted for in the schedule.

The on-site External Hazards PRA Peer Review is a one-week, tiered review in which the reviewers begin with relatively high-level element review summary sheets and criteria, and progress successively to additional levels of detail, as necessary to ensure the robustness of the model. This is an intensive week, following a relatively rigid schedule (see Attachment 3 of Exhibit A-1) so that all of the required elements are adequately covered. This schedule should consider the issues identified in the pre-review.

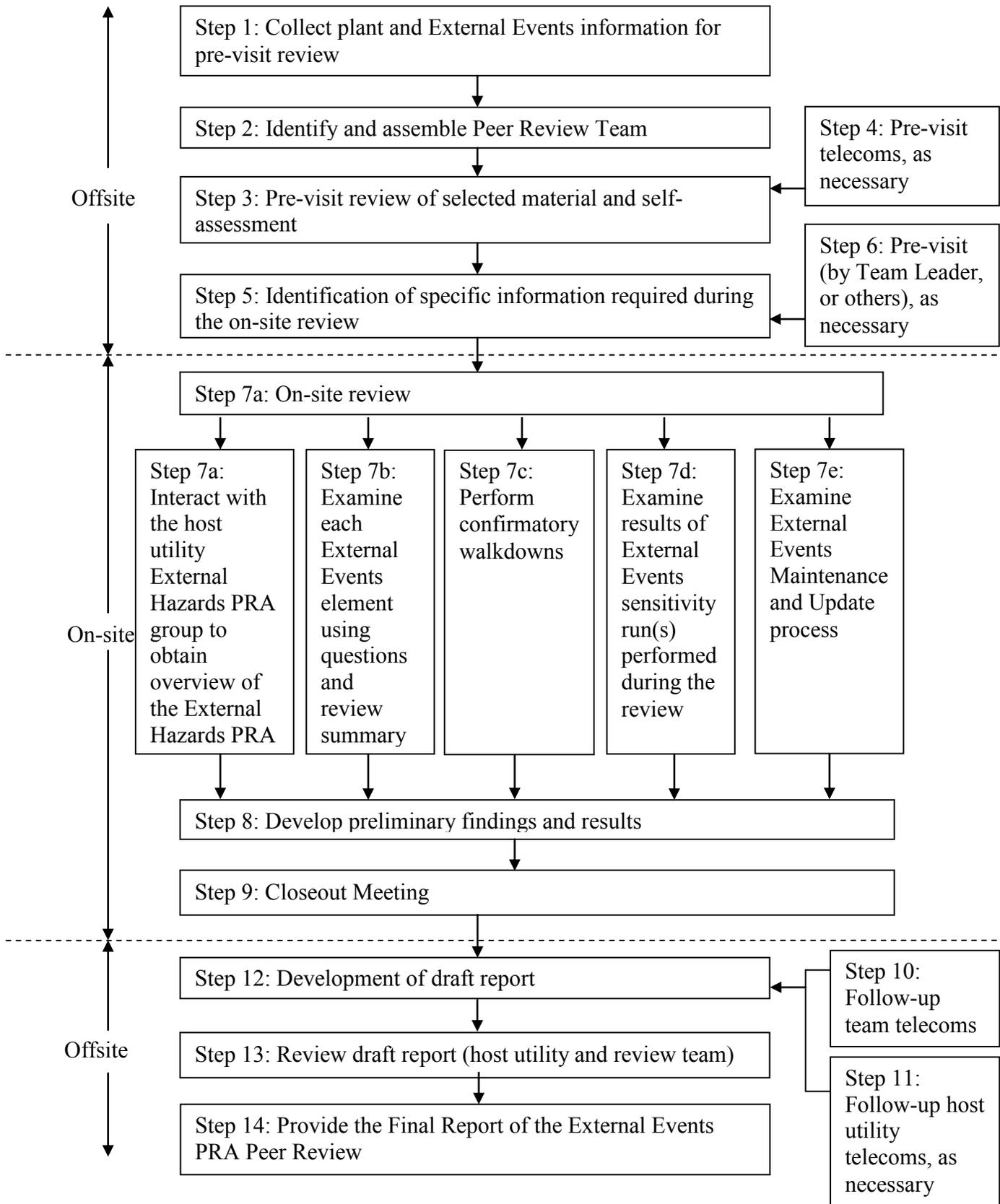
The HLRs and SRs for the External Hazards PRA undergoing a peer review, listed in the respective Part of the Standard, are the criteria used for the External Hazards PRA Peer Review. The External Hazards PRA Peer Review guidance provided in this document does not provide any new technical requirements.

The External Hazards PRA Peer Review is developed as a rational approach to assess External Hazards PRA technical adequacy and provide the necessary focused feedback for External Hazards PRA improvement. The process does not require a 10CFR50 Appendix B program for the review or for the External Hazards PRA. However, the review process includes the principal elements of an effective 10CFR50 Appendix B quality assurance review of documents via:

- use of qualified reviewers
- use of reviewers who are independent of the original External Hazards PRA study
- development of a list of issues to be addressed
- documentation of the review conclusions.

More specific details of the External Hazards PRA Peer Review process are provided in Section 2.

**Figure 1-2
External Hazards PRA Peer Review Process Flow Chart**



1.5 MULTI-UNIT SITE PEER REVIEW

A peer review of a multi-unit site will need to consider unit differences that affect the various External Hazards PRAs. In general, due to the differences between SSCs used for each unit, physical locations of the units, physical differences between the units, separate (different) PRA technical element models (e.g., initiating events, system models, human reliability analysis) are likely to be developed for each unit for each external hazard that is modeled. For example, there may be an impact on flood risk as a result of small spatial differences.

In addition to differences between units, specific multi-unit site considerations are important. These considerations include, but are not limited to, shared equipment, unit-to-unit interaction, asymmetrical impacts of failures and physical location of each of the units.

Planning for the peer review should account for these unit-specific differences and multi-unit considerations, and allow for the additional resources needed to review the unit-specific models and results. This would include additional time for walkdowns and review of analysis and documentation for each SR where unit-specific analysis is performed.

1.6 EXTERNAL HAZARDS PRA PEER REVIEW CAPABILITY CATEGORIES

The External Hazards PRA Peer Review uses Capability Categories to assess the relative technical merits and capabilities of the PRA with respect to each SR reviewed in the applicable part of the ASME/ANS PRA Standard. The Capability Categories were developed considering attributes of an External Hazards PRA necessary to ensure technical adequacy. Three Capability Category levels are used to indicate the relative technical adequacy of the PRA with respect to each SR based on the criteria at hand. In some cases, the assessment may result in a “Not Met” assignment when none of the requirements for an SR capability requirement are met. The assessment process is further described in Section 3.

It is important to note that neither the HLRs, nor any entire External Event PRA, are assigned an overall Capability Category. Each SR is assessed individually. Then, based on the SR Capability Categories, a summary of the technical adequacy is provided for each of the HLRs and the technical elements.

The benefits of this review process include the assignments of Capability Categories for SRs that assess the technical adequacy of the base External Hazards PRA, as well as the recommendations for improvements and the acknowledgment of the strengths of the External Hazards PRA. Additional beneficial outcomes of the review process are the exchange of information regarding the construction of external hazard curves, fragility analyses, external event plant response modeling techniques, experiences, and applications among the host utility and industry reviewer personnel, and an anticipated evolving level of consistency from review to review.

The review process requires that the existing External Hazards PRA meet the SR criteria for one or more Capability Categories, or be assigned a “Not Met” for the SR. Furthermore, documentation methods and External Hazards PRA Maintenance and Update processes must be in place to ensure the long-term technical adequacy of the External Hazards PRA.

As insights are realized from the peer review process efforts, they will be fed back into the External Hazards PRA Peer Review guidance (this document) for revision.

1.7 DOCUMENT ORGANIZATION

The remainder of this document is organized as follows. Section 2 discusses the key elements of the Peer Review process, and the functions and requirements of the Peer Review Team. Section 3 provides guidance on the peer review Capability Categories. Section 4 discusses the peer review reporting process and process forms. Appendix A provides guidance on preparing for the peer review, and review logistics. Appendix B contains the review summary sheets for the technical elements. Appendix C contains the review tables for the maintenance and update of the External Hazards PRA. Appendix D provides a listing of references to the Internal Events PRA SRs (Part 2) within the External Hazards PRA SRs (Parts 5 through 10). Appendices E, F and G provide some example Peer Review documentation forms.

2 PEER REVIEW PROCESS

This section focuses on the key elements of the External Hazards PRA Peer Review and describes the role and function of the Peer Review Team and the requirements governing the team.

2.1 EXTERNAL HAZARDS PRA PEER REVIEW PROCESS DESCRIPTION

A PRA Peer Review is a requirement of the ASME/ANS PRA Standard, and is used to assess the technical adequacy of each External Hazards PRA, and is complementary to the PRA Peer Review Process used by the industry in NEI 00-02 [1], the Internal Events Peer Review process in NEI 05-04 [2], and the Fire PRA Peer Review process in NEI 07-12 [3].

The Peer Review process described in this document is unique from previous Peer Review processes in that it can apply to any or all PRAs covered by Parts 5 through 10 of the ASME/ANS PRA Standard. The actual scope of the peer review performed using this guidance is defined by the host utility prior to requesting a peer review. It is expected that each PRA peer review for an external hazard (e.g., seismic, external flood, high winds) will be performed on a separate schedule, generally with a different peer review lead, peer review team, and timing of the on-site review. Though smaller peer reviews could be coupled, it is recommended that the utilities use their best judgment in deciding how to split up Parts 5 through 10 of the PRA Standard among the number of peer reviews.

For example, if a Seismic PRA is to undergo a peer review, it is most likely that the amount of time and expertise allocated for that peer review will be sufficient to review only the Seismic PRA. The primary reason is that a Seismic PRA Peer Review team will be mainly comprised of seismology experts as well as system modeling engineers with seismic experience; thus, it is not guaranteed that this same pool of individuals will have the sufficient background to review an External Flood or a High Winds PRA. A secondary reason is that a Seismic PRA Peer Review is expected to expend all of the time allotted for a typical peer review described in this guidance, thus logistically, it would not be beneficial to attempt to peer review another External Hazards PRA during the same review.

The screening process governed by Part 6 of the ASME/ANS PRA Standard is different than the External Hazards PRA in the other Parts. Since Part 6 includes HLRs, SRs, and Section 6.3 has screening process-specific requirements for peer review, it is clear that a peer review is expected to be performed for the screening process to satisfy the requirements of the ASME/ANS PRA Standard. To reduce the number of exceptions, footnotes, etc. in this guidance document related to a different process for screening, Appendix H contains the guidance for performing a peer review on the screening process of Part 6 of the PRA Standard.

A flowchart of the External Hazards PRA Peer Review process was shown in Figure 1-2, which describes the general approach and process steps used in the application of the peer review to an individual External Hazards PRA during the same on-site visit.

An External Hazards PRA Peer Review is a tiered review that begins with SR Capability Category reviews documented in the respective summary sheets; the results are then further summarized in the HLR Summary Tables.

The applicability of specific SRs may vary from plant to plant. The Peer Review Team, through its consensus discussions, determines the applicability of specific SRs to the External Hazards PRA being reviewed. For example, SRs that evaluate multi-unit site considerations are not applicable at single-unit sites.

To start the External Hazards PRA Peer Review process, the host utility should request and schedule a peer review through the appropriate Owners Group representative or other responsible organizing entity.⁶ As the External Hazards PRA Peer Review process begins, the host utility should complete the prerequisites discussed in Appendix A and Section 1 above.

Selection of the Peer Review Team Leader should occur prior to gathering the initial information. This selection is based on discussion between the Owners Group representative (coordinator) and the host utility. The process described below assumes the Team Leader responsibilities are assigned to a single individual. However, the responsibilities could be split between two individuals, based on logistics and technical assignments. One person can be designated the Technical Lead and would have the overall technical responsibility for the Peer Review, as well as the preparation of the Final Report. The second person can be designated the Facilitator; the facilitator would be responsible for ensuring the schedule is maintained, moderating discussions, acting as an interface to the host utility, etc.

Selection of a Peer Review Team can also occur prior to collecting all of the initial plant's External Hazards PRA information, including the determination of whether particular expertise (e.g., seismic success path determination, seismic hazards, or seismic fragility) is needed for the Peer Review. As discussed in Section 2.2 below, collectively the Peer Review Team should possess sufficient expertise to cover all technical elements of the External Hazards PRA undergoing the peer review. The host utility can request particular expertise beyond the general expertise identified in the respective "Peer-Review Team Composition and Personnel Qualifications" section of each Part of the ASME/ANS PRA Standard, if more specialized skills are needed. The Team Leader should verify the team skills needed once the External Hazards PRA plant information is reviewed.

The major steps in the External Hazards PRA Peer Review process are described below, with particular emphasis on information pertinent to the Peer Review Team.

Step 1: Collect plant and External Hazards PRA information for pre-visit review

Before the on-site review meeting, the host utility should distribute the pre-review material to the Peer Review Team Leader (and Team, when assigned). Guidance on the types of information required is provided in Section 2.3 and Appendix A.4. This material includes the results from the self-assessment of the External Hazards PRA by the host utility, as well as the results of the limited self-assessment of the Internal Events PRA as discussed in Section 1.4.

⁶ Peer reviews may be conducted by entities outside the Owners Groups by following the guidance in this document beginning with the selection of the team lead. In such a case, the host utility should coordinate with that entity in a manner similar to that used by the Owners Groups.

Step 2: Identify and assemble the Peer Review Team

Based on the plant information collected in Step 1, and the guidance in Section 2.2 below, the Peer Review Team should be identified. Members of the Peer Review Team should be provided to the host utility for concurrence. Information collected in Step 1 will be distributed to the Peer Review Team, and the schedule for the peer review, including completion of pre-site visit reviews, can be completed.

During the selection of the External Hazards PRA Peer Review Team, the Team Leader (or utility) should determine if specific review capabilities are needed. These capabilities are discussed in Section 2.2 below. The determination of need for specific External Hazards PRA Peer Review Team member skills should be performed sufficiently early to allow the scheduling of these team members on the review team.

Step 3: Pre-visit review of selected material and self-assessment

The information collected in Step 1 is provided to the Peer Review Team. The review of this information prepares the Peer Review Team to investigate the details of the External Hazards PRA. This can be accomplished by thoroughly reviewing the External Hazards PRA documentation sent out for study prior to the on-site visit. Individual team members, however, should focus on those areas to which they have been assigned for review. (This assignment will have been made in the scheduling letter sent as the first item in the timetable of Figure 2-1; a sample letter for a Seismic PRA Peer Review is shown in Exhibit A-1.) As needed, information can be sent to a reviewer prior to the on-site visit to supplement the initially prepared information for the Peer Review Team.

The pre-visit review also includes review of the plant's self-assessment and the review of the Internal Events PRA Peer Review, and open and closed/dispositioned F&Os. The pre-visit review also includes a review of any ASME inquiries with responses on the applicable parts of the ASME/ANS PRA Standard.

During this process, it is imperative that there is a sufficient review of the hazard assessment by the relevant experts to ensure that the input to the PRA model is technically adequate. Therefore, the members of the team with expertise in hazard assessment are expected to conduct extensive pre-visit review work to support an efficient overall review process, especially in preparation for the on-site review.

Step 4: Pre-visit telecoms, as necessary

It is expected that there will be several conference calls conducted prior to the on-site visit. These calls should help determine both the makeup of the team, the schedule, and any additional review information needed by the team for the pre-visit review.

As noted in the ASME/ANS PRA Standard Section 3.3, Inquiries on the interpretation of specific SRs may have been forwarded to the Joint Committee on Nuclear Risk Management (JCNRM). The set of Inquiries that have been resolved by JCNRM should be obtained from the JCNRM Secretary and reviewed prior to conducting a Peer Review and discussed in a pre-visit telecom, as necessary.

The host utility should make arrangements for the plant walkdowns in advance of the on-site visit. These arrangements should include participants for each walkdown, and the scheduled dates. Information needed to arrange for site access should be requested from the Team Leader prior to the on-site visit.

Step 5: Identification of specific information required during on-site visit

Based on the pre-visit review and Peer Review Team discussion, the team should identify prior to the on-site visit, a list of specific information that will be needed during the on-site review. This may include references, such as calculations or walkdown documentation that were the basis for each of the steps in the External Hazards PRA, or may include sources of fragility data or other analysis information not provided for the pre-review.

Step 6: Pre-visit (by Team Leader), as necessary

It may be useful for the Team Leader to perform an on-site visit several weeks prior to the Peer Review Team on-site visit. This visit can help finalize the logistics for the on-site visit, and help in the process of transmitting any additional pre-visit review information needed for the on-site review.

Step 7: On-site review

The on-site review⁷ includes a number of steps, discussed below:

Step 7a: Interact with the host utility External Hazards PRA team to obtain overview of the External Hazards PRA

The host utility External Hazards PRA team is expected to prepare detailed presentations on the key elements of the External Hazards PRA, as discussed in Appendix A.7. For the review process to be completely effective, the host utility should be well prepared to present information to the Peer Review Team. The scope of the detailed presentations should be limited and may not require the entire team. Additionally, the Team Leader through discussions with the host utility should establish the scope and schedule for the presentations.

During this step, and also in the subsequent steps, it is imperative that the members of the Peer Review Team and the host utility External Hazards PRA team communicate openly and candidly. A successful review requires efficient and candid communication among review team members, and between the review team and site PRA team members.

Step 7b: Examine each External Hazards PRA element using questions and review summary sheets

The peer review begins with higher-level investigations and progresses to examining detailed technical issues. This involves a combination of a reasonably complete check of all technical elements and more in-depth sampling examination of specific External Hazards PRA technical elements. The review summary sheets (see Appendix B or the External Hazards PRA Peer Review Access Database) provide a structure, which in combination with their individual External Hazards PRA experience provides the basis for examining the SRs of the various applicable External

⁷ Depending on the need for the expertise contributed by specific reviewers, it is possible that some members of the peer review team need not be on-site for the duration of the review to effectively participate. Arrangements for the consensus process should be clearly defined in advance of the on-site review to ensure that the integrity of this process is maintained.

Hazards PRA technical elements. The process also includes a review of the applicable open Internal Events PRA F&Os. Each applicable HLR and SR from Parts 5 through 10 of the ASME/ANS PRA Standard are listed on the review forms in Appendix B or included in the Access database available from the Owners Groups to help ensure completeness in the review. If a reviewer discovers a question or discrepancy, it is expected that a more thorough, detailed search will be conducted.

Thus, in reaching their conclusions regarding the technical adequacy of the various technical elements and the External Hazards PRA undergoing the peer review as a whole, reviewers are expected to investigate the External Hazards PRA at several different levels. The reviewers, working in small teams, will present their views to the entire Peer Review Team, at which time a (team) consensus process will be used to determine the final Capability Category for each SR of the External Hazards PRA. Information regarding the Capability Categories is provided in Section 3.

Step 7c: Confirm equipment vulnerable to external hazards by walkdowns

An important element of each External Hazards PRA Peer Review is the walkdown of the areas of the plant that are deemed to be important by the peer reviewers based on the specific results of that External Hazards PRA and based on their expertise. The walkdowns can be performed by a subset of the Peer Review Team after the specific issues have been identified during the first several days of the review, but may need to be followed up with more specific walkdowns, as needed.

Depending on which External Hazards PRA is being peer reviewed (e.g., seismic, external flood, high winds), the walkdowns may need to be performed in several parts. For example, for a Seismic PRA, a walkdown may be needed to confirm the technical adequacy of the seismic fragility analysis. A second walkdown may be necessary at the end of the on-site visit to consider specific information not initially observed in the initial walkdown but deemed important by the Peer Review Team.

Since most or all of the Peer Review Team may be involved in one or more of the walkdowns, the Team Leader should account for the time needed for walkdowns and preparations for walkdowns in the schedule. The logistics and time required for getting into any critical areas should be accounted for in the schedule, and minimized by preplanning.

Step 7d: Examine results of the External Hazards PRA sensitivity run(s) performed during the review (see Section A.6)

It is likely that during the review, certain issues or questions may arise relative to the PRA results. It may be useful for the host utility to perform, during the on-site review, one or more sensitivity cases with the specified PRA computerized model to investigate these sensitivities and to demonstrate the host utility External Hazards PRA team's approach for solving and applying the External Hazards PRA.

Step 7e: Examine External Hazards PRA Maintenance and Update process

The process for maintaining the External Hazards PRA in a state of fidelity with the physical plant, plant procedures, and utility staff training is a necessary element to ensure that the External Hazards PRA can be effectively used for risk-informed applications. Appendix C provides a review worksheet that can be used in the evaluation of the External Hazards PRA Maintenance and Update

process. The requirements for model maintenance are discussed in Section 1-5 of the ASME/ANS PRA Standard.

Step 8: Develop preliminary findings and results

This step involves the development of the preliminary findings and peer review results, and the compilation of a draft report, which forms the basis for the closeout meeting with the External Hazards PRA group and with the host utility management.

Consensus sessions of the Peer Review Team are required for every technical element to ensure that the summary sheets are completed. The two/three reviewers assigned to a particular technical element may hold mini-consensus sessions in preparation for the full Peer Review Team consensus session. The assignment of a Capability Category for each SR is developed based on a consensus of the members of the Peer Review Team with sufficient expertise to evaluate that aspect of the PRA. Similarly, the assignment of F&Os classified as findings is also based on Peer Review Team consensus. However, a dissenting opinion can be issued, based on one or more Peer Review Team members review. See discussion in Section 3.2.

Step 9: Closeout Meeting

During the closeout meeting (or exit meeting), the External Hazards PRA Peer Review Team presents the results of the preliminary findings to the host utility External Hazards PRA group and management; this is held on the last day of the on-site review. In addition, feedback should be provided to the host utility External Hazards PRA team at some point of each day of the on-site review (daily debrief). Electronic copies of all F&Os, completed forms, and draft write-ups should be provided to the host utility prior to (or at) the closeout meeting to expedite correction of any errors, comment feedback, etc. Additionally, if the team has any open questions that could potentially result in F&Os, the host utility should be made aware of this at the exit meeting. Any Peer Review Team work associated with pursuing these questions should be done on a limited basis. No new review efforts, beyond those open items clearly identified to the host utility at the exit meeting, should take place following the conclusion of the review week. Prior to issuance of the final Peer Review report, the consensus process for any open issues should be completed via post-review week conference call(s) with the entire team. Discussions, as appropriate, should be held with the host utility.

Step 10: Follow-up team telecoms

Telecoms with team members after the on-site visit may be useful to finalize the Peer Review report, and close out any open issues from the on-site review. These telecoms may be performed in conjunction with telecoms with the host utility (see Step 11), as additional information is needed and open questions are answered. These telecoms can also be used for any new consensus sessions required by the addition or re-interpretation of the External Hazards PRA information.

Step 11: Follow-up host utility telecoms, as necessary

Any open questions from the on-site visit can be addressed either by e-mail or by follow-up phone calls between the host utility and selected review team members. New information provided to the team that was not available during the on-site visit can be provided with the telecoms and can be used to answer any questions resulting from review of this new information.

Step 12: Development of draft report

A draft report should be completed shortly after the on-site visit is complete. Section 4.0 below provides the details and contents of this report. Several drafts may be developed, based on the timing of completion for the various documentation tasks for the report. If desired by the Peer Review Team Lead, review of the final draft report by the team can be performed in parallel with Step 13 below (review of the draft report by the host utility).

Step 13: Review of draft report by host utility

The host utility should review the draft report(s), and provide comments to the Peer Review Team prior to Final Report documentation. The comment process should be performed in a timely manner to ensure completion of the Final Report in a reasonable timeframe.

Step 14: Provide the Final Report of the External Hazards PRA Peer Review:

The designated Peer Review Team lead using the information prepared during the on-site review compiles the Final Report and any additional summary comments provided by the Peer Review Team. The report is signed off by each of the members of the External Hazards PRA Peer Review Team. The report will identify the Peer Review Team's Capability Category assignments for each SR, along with appropriate rationale, and may indicate where improvements are required for elements to be accepted at the next higher Capability Category. In general, the Final Report is considered proprietary to the host utility; the appropriate Owners Group may maintain a copy for historical reasons, to develop summary information (statistics/metrics), and to develop lessons learned. Report documentation is discussed in additional detail in Section 4.0.

**Table 2-1
External Hazards PRA Peer Review Process Suggested Timeline**

Review Week	Task
Week 0:	Team lead and review team identified
Week 4:	Team lead defines reviewer responsibilities and transmits information request to host utility
Week 7:	Host utility transmits pre-review material to reviewers
Week 8:	Review team conference call
Week 9:	Logistics conference call with review team and utility
Week 10:	On-site review
Week 11:	Team lead assembles draft report and transmits for review team review
Week 14:	Team lead assembles final draft report and transmits for utility review
Week 20:	Team lead issues final report to utility

2.2 EXTERNAL HAZARDS PRA PEER REVIEW TEAM

The single most important aspect of the External Hazards PRA Peer Review process is the selection of the Peer Review Team that carries out the review process. The Peer Review Team is composed of utility, vendor, and contractor personnel knowledgeable in External Hazards PRA issues and experienced in the performance and application of External Hazards PRA. The Peer Review Team will include peers knowledgeable in the particular External Hazards PRA (e.g., seismic, external flood, or high winds). The Team Leader and the host utility determine the specific composition of the Peer Review Team. However, due to the variability of External Hazards PRAs and the analysis tools used to support the PRA, team member capability will vary based on the external hazard undergoing a peer review.

Section 1-6 of the ASME/ANS PRA Standard [6] provides guidance for PRA Peer Reviews. Section 1-6.2 of the ASME/ANS PRA Standard provides specific peer review team requirements that must be met.⁸ Specifically, Section 1-6.2.4 allows a single expert to perform the peer review of a single PRA technical element, given that the expert has appropriate knowledge and experience. With regard to the independence requirement of Section 1-6.2.1, reasonable and practicable interpretation should be made, as needed, concerning the use of non-involved utility personnel from other sites for multi-site utilities, use of current contractors (on-site or otherwise) involved in other work, etc. With the exception of individuals who have worked on or directly supervised the subject PRA, there are no automatic exclusion criteria; however, the host utility may question the independence of any proposed Peer Review Team member. A requirement of absolute independence coupled with the need for adequate technical expertise can be difficult to achieve in some situations. Involvement of reviewers who may have some association with a portion of the External Hazard PRA, but not with the specific portions that they are reviewing,

⁸ In addition to the requirements in Section 1-6, each Part of the PRA Standard includes requirements for team member qualifications; the review team should be assembled to meet those requirements.

may be deemed appropriate by the host utility, but should be documented in the peer review report.

Any External Hazards PRA includes three critical parts:

1. hazard assessment and characterization
2. fragility analysis
3. plant response model development.

The hazard assessment basically involves determining the likelihood of challenges of varying magnitudes for the hazard of concern (e.g., the frequency of an earthquake greater than 1 g peak ground acceleration). The fragility analysis involves determining the probability that a component or structure will fail given an external event of a given magnitude (e.g., probability of wall collapse due to straight-line winds greater than 120 mph). The plant response model development is the development and quantification of the event tree and fault tree(s) needed to evaluate risk associated with challenges due to the modeled external hazards. Note that the skills and experience needed for hazards and fragility analysis vary with the subject External Event PRA being reviewed. Thus, a Peer Review team reviewing a PRA for a given external event will need hazard and fragility expertise specific to the external event PRA being reviewed.

The desired attributes of the Peer Review Team, as a whole, are as follows:

- independent of the External Hazards PRA being reviewed
- expert in all phases of the External Hazards PRA
- experienced in performance and application of External Hazards PRA.

The actual number of members on any specific team will be a function of the skill sets required, as per the analytical methods used in the External Hazards PRA. The team should be sized to ensure overlap in skills key to the External Hazards PRA process listed below. The intent is to ensure that there is more than one peer reviewer with experience in each key External Hazards PRA process, but not necessarily to require two experts in each skill set. Additional team members may need to be added for multi-unit site External Hazards PRA, depending on the amount of plant-specific analysis performed for each unit. The following is a brief description of the attributes of the Peer Review Team:

Expert in all phases of External Hazards PRA: A broad experience base *for the team* is essential to effectively implement the External Hazards PRA Peer Review process. However, it is somewhat difficult to translate this into requirements for individual members of the team. Nevertheless, the following guidance is provided to ensure that individual members are qualified, and that the team as a whole possesses *sufficient expertise to cover all of the External Hazards PRA technical elements*:

- **Experience Expectations for Peer Review Team Lead**
 - 10+ years of experience in nuclear power PRA
 - Bachelor’s degree in Engineering, Science, or Mathematics
 - Experience in one or more of the three key External Hazards PRA elements (i.e., hazard analysis, fragility analysis, and/or plant response model development)
 - Additionally, it may be helpful for the team lead to have experience leading a prior peer review (including Fire PRA or Internal Events PRA Peer Reviews) and experience managing an equivalent External Hazards PRA
- **Experience Expectations for Individual Peer Review Team Members**
 - Bachelor’s Degree in Engineering/Science/Mathematics⁹ or equivalent experience
 - At least five years of nuclear plant experience or nuclear power PRA experience
 - Experience in performance of subject External Hazards PRA being reviewed: Each member of the team should have participated in the performance of or technically managed at least one external hazard PRA. This experience should have involved explicit development of the PRA technical area being reviewed.¹⁰
- **Additional Experience Expectations for the Team as a Whole**
 - The team should be selected such that the team, as a whole, has experience in the following key areas of the process, as applicable to the subject External Hazards PRA being reviewed:
 - hazard evaluations as appropriate for the External Hazards PRA being reviewed
 - evaluation of how relevant hazards could damage the nuclear plant’s SSCs
 - systems engineering
 - plant capability engineering sufficient to address seismic, high winds, external flood, or other external hazards as appropriate for the peer review being performed
 - experience with assessment of fragilities
 - for seismic PRA peer reviews, reviewer(s) focusing on the seismic fragility work should have successfully completed the SQUG Walkdown Screening and Seismic Evaluation Training Course or have demonstrated equivalent experience or training in seismic walkdowns.
 - The Peer Review Team should have at least two utility participants. Specialized expertise in seismic, high winds, external flood or other External Hazards PRAs should be strongly considered if these hazards are being reviewed.

⁹ Significant experience may be substituted for an engineering degree, consistent with guidelines used by licensing bodies (varies by state). For example, a reviewer with engineering degree coursework and 20 years experience in the nuclear field would be considered to have met the requirements for degree/experience. Additionally, an advanced degree in Engineering/Science/Mathematics can be counted towards years of experience.

¹⁰ Specialists with relevant expertise in external hazard or fragility analysis may not have participated in development of an External Hazards PRA. Training on external hazard PRA methods may be used in lieu of External Hazard PRA expertise for these specialists.

The process requires the reviewers to follow a very tight schedule and is most likely to be successful if the team consists of fully qualified members. A training session should be held at the outset of each review to ensure that all of the reviewers share a common understanding of the process, review summary sheets, and Capability Category criteria. This training session should be held by phone during the meeting preparation to optimize on-site review time.

Peer Review observers who are participating as a part of a learning process are not considered a part of the Peer Review Team. Observer skills cannot be considered in determining the skills of the Peer Review Team.

2.3 HOST UTILITY PREPARATION AND PARTICIPATION REQUEST

The host utility should initiate the review process. A request for an External Hazards PRA Peer Review should be made to the appropriate Owners Group contact or other responsible entity. The Owners Group will send a letter to the host utility management outlining the process, the goals, and the expectations for the host utility. An example letter is provided as Exhibit A-1 in Appendix A.

The resource needs by the host utility are summarized in Table A-1.

Additional guidance for the host utility regarding information requirements and interactions as they relate to the Peer Review is provided in Appendix A.

2.4 REVIEW WEEK AGENDA

The example agenda for the initial review meeting hosted by the utility is provided in Attachment 3 to Exhibit A-1 in Appendix A.

3 EXTERNAL HAZARDS PRA PEER REVIEW PROCESS ELEMENTS AND GUIDANCE

3.1 OVERVIEW

External Hazards PRA for a nuclear power plant is an extensive and detailed engineering and probabilistic analysis of natural phenomena and the response of complex systems to these phenomena. The intent of the review process is to ascertain the level of technical adequacy of the External Hazards PRA to support risk-informed applications by assessing its use of assumptions, degree of conservatism, realism of analysis, completeness, reasonableness of results, and documentation. This section provides guidance on peer review criteria and the establishment of levels, or Capability Categories, to be used during the peer review.

3.2 PEER REVIEW PROCESS CRITERIA

The Peer Review Team will focus on the host utility's self-assessment of elements against the applicable parts of the ASME/ANS PRA Standard [6] and the degree to which the External Hazards PRA meets the applicable SRs.

The Peer Review Team is divided into sub-teams to review the various aspects of the External Hazards PRA. The composition of the sub-teams will vary from day-to-day to meet the review needs for each day. As the Peer Review process is very intense and focused because of the amount of material to cover in a limited period of time, schedules and element assignments should be considered flexible, though the Team Leader (or Team Facilitator) needs to ensure that all the material is adequately reviewed.

Prior to the start of the review, the Peer Review Team members will perform a "refresher" review of the applicable portions of the ASME/ANS PRA Standard, with emphasis on Section 2 (Technical Requirements) of each Part, and establish a common perspective regarding the general assignment philosophy. The applicable HLRs will also be briefly reviewed to ensure the team is familiar with the high level scope of the review.

At the beginning of the review for each technical element, the reviewer(s) should review the HLRs for the element and review the individual SRs. In Tables A-5 through A-9 (Appendix A) of RG 1.200 [7], the NRC has provided a Regulatory Position relative to some specific SRs in Parts 5 through 9 of the ASME/ANS PRA Standard. The peer reviewer(s) should consider these NRC clarifications and qualifications, where applicable, during the review, and note the extent to which the External Hazards PRA SRs being reviewed address these positions. The reviewer(s) should provide an assessment relative to the NRC's clarifications and qualifications in Tables A-5 through A-9 of RG 1.200.

The recommended starting point for the review of each SR is typically the host utility's self-assessment. This will provide the utility's assessment of the Capability Category that has been assigned to the External Hazards PRA SRs and the basis for this assessment. As part of performing a self-assessment, the host utility should prepare an External Hazards PRA "road map," which

provides pointers to the associated PRA documentation for each SR. Thus, the reviewers can more easily examine the documented basis for an SR being met at a sufficient level of detail to make their own assessment. However, the reviewers are not limited to the referenced documents; they may request review of any pertinent documentation they believe is needed to make their assessment. Assessment of the SRs can be recorded in tables such as provided in Appendix B of this document. Databases to facilitate the Peer Review process, consensus process, and recording of peer reviewer's assessment and rationale are also available.

As part of the review, the review team may review a limited set of referenced Internal Events SRs that are relevant to the External Hazards PRA being reviewed. The purpose of this review is to confirm that changes made to the Internal Events PRA to support the development of the External Hazards PRA are consistent with the SRs in Part 2 of the ASME/ANS PRA Standard. This portion of the review should rely heavily upon the previously conducted Internal Events PRA peer review and should focus on specific changes made. The depth of this review will depend upon the extent to which the Internal Events PRA was updated to support development of the External Hazards PRA.

As the SRs are purposefully open to some interpretation, there may need to be some discussion to determine the appropriate assignment of a Capability Category, or even determine if a SR is considered to be "Met." The reviewers must consider the "whole" of the PRA and not be overly focused on a specific discrepancy. To declare that an SR is "Not Met," a preponderance of evidence must be observed. In cases where an SR description includes an example, the reviewers should be cautioned that conformance with the example is not necessary to meet that SR. Determination of the status of an SR should be guided by the following approach from RG 1.200 [7]:

...[If] there are a few examples in which a specific requirement has not been met, it is not necessarily indicative that this requirement has not been met. If, the requirement has been met for the majority of the systems or parameter estimates, and the few examples can be put down to mistakes or oversights, the requirement would be considered to be met. If, however, there is a systematic failure to address the requirement (e.g., component boundaries have not been defined anywhere), then the requirement has not been complied with.

For example, application of this approach would be important if, by error of omission, a seismic fragility was not developed for an SSC but otherwise seismic fragilities were developed for all other SSCs. In this case, if the analysis that is complete is performed in a manner that meets the appropriate SRs of the ASME/ANS PRA Standard, a single F&O referencing the applicable SRs should be issued stating that the incomplete analysis needs to be completed. Preponderance of the evidence, as discussed above, should be the criterion for assigning the Capability Category. For example, if the SR(s) for the completed analysis meets CC II and the majority of the analysis is complete, assessing CC II for that SR(s) may be appropriate.

During the review of each SR, any applicable ASME Inquiries should be considered during the evaluation. The ASME Inquiries represent the latest interpretation of the ASME/ANS PRA Standard SRs. The Peer Review Team should consider the ASME Inquiry information in

determining the appropriate assignment of a Capability Category for the SR. Similarly, supplemental industry guidance should be reviewed and considered in the same manner.

During the review of an SR, if the reviewers identify any issues/problems that impact the capability of the PRA, they will document these problems using an F&O form equivalent to that presented in Appendix D of this report. The F&Os specify the PRA element and SR of concern, and describe the PRA level of compliance with the criteria. The issue documented may be a weakness (finding), a strength (best practice), an observation (suggestion), or one regarding methods unfamiliar to the team (Unreviewed Analysis Method (UAM)). It should be noted that the review team may document an F&O finding regardless of the Capability Category assessment. Such findings are typically for systemic discrepancies that the PRA Peer Review team judges require correction. Individual (i.e., non-systemic) issues might be documented as a suggestion. The F&O includes an assessment of the importance of the observation on the level of capability of the SR, and, for weaknesses, a proposed resolution for the weakness. The importance of each observation is classified as a:

Finding – an observation (an issue or discrepancy) that is necessary to address to ensure:

- the technical adequacy of the PRA (relative to a Capability Category)
- the capability/robustness of the PRA update process
- the process for evaluating the necessary capability of the PRA technical elements (to support applications).

Suggestion – an observation considered desirable to maintain maximum flexibility for PRA applications and consistency with industry practices. Failing to resolve a suggestion should have no appreciable impact on the PRA results or the integrity of the PRA. Some examples of a suggestion include:

- editorial and minor technical items
- recommendations regarding incorporation of recently-developed methods
- recommendations for consistency with industry practices (e.g., replacing a given consensus model with a more widely used model)
- recommendations to enhance the PRA's technical capability as time and resource permit
- observations regarding PRA technical adequacy that may affect one or more risk-informed applications.

Best Practice – an observation of a practice that utilities throughout the industry would want to emulate.

Unreviewed Analysis Method – an observation regarding the use of methods that are new or beyond the expected expertise of the review team, and for which the review would exceed the time and capability of the External Hazards PRA Peer Review team.

When an F&O is written with this classification, the method would need to be reviewed by a separate body of experts.¹¹

Each technical element in Parts 5 through 10 has HLRs and a number of associated SRs. In general, the documentation of the HLRs has to be such that it is sufficient to facilitate peer reviews by describing the processes used, providing the assumptions used and their bases, and providing the associated SRs specific details for each technical element. Assessing the Capability Category for the documentation SRs does not require a separate review for each SR. At the start of the review for a given technical element, the Peer Review Team should review the documentation HLR and SRs for that technical element to identify any unique documentation aspects. At the completion of the review of the technical element, the reviewers for that technical element may assess the PRA compliance with the documentation SRs based on availability, scope and completeness of the documentation that they used to review the technical SRs for the technical element.

At the end of the review for each technical element, the team members will conduct consensus discussions to assign Capability Categories to the SRs. The Lead Reviewer for each technical element will lead the consensus session for a particular technical element.

When writing the F&Os, it is important to note that the reviewers need not match F&Os to SRs one-to-one. F&Os on common SRs that cross several PRA technical elements should be combined into a single F&O (i.e., uncertainty, documentation for peer review and applications). It should also be noted that for different technical issues affecting a single SR, it may be appropriate to write separate F&Os.

As stated in Section 1-6 of the ASME/ANS PRA Standard [6], “The peer review need not assess all aspects of the PRA against all requirements in the Technical Requirements Section of each respective Section of this Standard; however, enough aspects of the PRA shall be reviewed for the reviewers to achieve consensus on the adequacy of methodologies and their implementation for each PRA Element.” Parts 5 through 10 of the ASME/ANS PRA Standard adopt the requirements of Section 1-6, thus requiring the peer review to achieve consensus. The set of key review areas identified in Sections 3.3 of Parts 5 through 10 of the ASME/ANS PRA Standard for the technical element(s) being peer reviewed must be addressed.

During the review of a given technical element, the Lead Reviewer may elect to skip selected SRs if the other reviewers determine that they can achieve consensus on the adequacy of the PRA with respect to the HLR without the identified (skipped) SRs. Before electing to skip any SRs, the Lead Reviewer should consult Section 3 of the Part being reviewed in the ASME/ANS PRA Standard (e.g. Section 6-3 for Seismic PRA) to ensure that the review will be consistent with the appropriate requirements in this section. The review sub-team must document their basis for not reviewing the given SR.

¹¹ An External Events PRA expert panel may be formed by the industry to evaluate Unreviewed Analysis Method F&Os to assist utilities in dispositioning these items. As yet, the industry has not agreed to form such an expert panel.

The reviewers should specifically address sources of model uncertainty and related assumptions in the elements being reviewed. Such assumptions and uncertainties, and their potential impact on the baseline PRA results and PRA applications, should be reviewed. The host utility should provide at least a qualitative characterization of uncertainty. Their opinions and suggestions regarding these key assumptions and uncertainty sources, as well as where the issue arises in the model, should be documented.

Section 1-5 of the ASME/ANS PRA Standard provides the requirements for a PRA configuration control program, and should be used by all PRA Peer Review Teams. The External Hazards PRA Peer Review Team should provide a summary assessment of how well the PRA maintenance program satisfies ASME/ANS PRA Standard Section 1-5 requirements relative to the technical element(s) being reviewed for the External Hazards PRA. The requirements defined by the Maintenance and Update (MU) checklist in NEI 00-02 (see Appendix C) may be used as guidance for this summary assessment for the specific technical element(s).

EPRI's DocAssist tool [8], for example, can be used to review the results of the original NEI 00-02 Peer Review, status of F&Os, and results of the host utility's self-assessment. EPRI's tool can also be used by the External Hazards PRA Peer Review Team, at the direction and discretion of the host utility, to record their findings; e.g., new F&Os as a result of the peer review. The tables in Appendix B can also be used to record PRA Peer Review results. Regardless of the tool used, all Capability Category assignments, comments, and F&Os should be made available in an electronic form to the Team Leader (to prepare the final report) and the host utility (for review). Methods for this need to be determined prior to the on-site visit and must be acceptable to the Peer Review Team and the host utility. It is further suggested that a sequential F&O log be maintained throughout the review, with the identification format of TE-SR-## being used throughout, where TE identifies the technical element, SR identifies the supporting requirement, and ## is the sequential number for the F&O for that SR. Appendix D contains a sample F&O log that can be used during reviews.

During the External Hazards PRA Peer Review process, assignment of Capability Categories for the individual SRs is established by a consensus process that requires that all reviewers agree with the final assignment. If a condition arises where there is not a consensus, then, at the request of any peer reviewer, differences or dissenting views among peer reviewers should be documented with any recommended alternatives for resolution of these differences. The dissenting opinion is provided for information to the host utility, and should not be characterized as an F&O. This process should only be used in the most exceptional situations, as, from the perspective of the host utility, this is a highly undesirable situation. Therefore, the Peer Review Team should strive to achieve a consensus position on all review elements.

It is recommended that (except for a one-day visit) there is a daily debrief with the host utility. The purpose of a debrief is to (a) inform the host utility of any expected concerns with the PRA, (b) clearly delineate any "owed" information from the host utility, (c) identify any new requested information, (d) as appropriate, seek clarification or confirmation on prepared F&Os, and (e) exchange any other relevant information. The timing and duration of such meetings should be mutually agreed to by the Peer Review Team lead and the host utility.

In the course of performing the PRA Peer Review, insights will be developed related to the process (as described in this guidance document) or practices (e.g., identification of a “best practice”). Such insights (i.e., lessons learned) should be documented and transmitted to NEI, with the host utility’s approval, for subsequent updates. Appendix E provides an example Lessons Learned form that can (optionally) be used.

3.3 ASSIGNMENT OF CAPABILITY CATEGORIES

The Capability Categories assigned during the Peer Review are based on the ASME/ANS PRA Standard Capability Categories. A Capability Category will be assigned for each SR reviewed. A summary of the SR review is then provided for each HLR. It is important to note that neither the HLRs, nor the entire External Hazards PRA, are assigned an overall Capability Category.

The major benefit of the review process, however, is not the SR assignments, but rather the recommendations for improvements and the acknowledgments of the unique strengths of the PRA. Additional beneficial outcomes of the review process are the exchange of information regarding PRA techniques, experiences, and applications among the host utility and industry review personnel, and an anticipated evolving level of consistency from review to review.

Process for Peer Reviews against Parts 5 through 10 of the ASME/ANS PRA Standard
Section 2 of each Part of the ASME/ANS PRA Standard presents the risk assessment SRs for each external hazard. These requirements are specified in terms of Capability Category requirements with increasing scope and level of detail, increasing plant-specificity, and increasing realism as SRs satisfy Capability Category I through Capability Category III. See Table 1-1.3-2 of the ASME/ANS PRA Standard.

For each Capability Category, the SRs define the minimum requirements necessary to meet that Capability Category. Some of the SR action statements apply to only one Capability Category, while others extend across two or three Capability Categories. When an action statement spans multiple categories, it applies equally to each Capability Category. When necessary, the differentiation between Capability Categories is made in other associated SRs. The interpretation of a SR whose action statement spans multiple categories is stated in Table 3-1. It is intended that, by meeting all the SRs under a given HLR, a PRA will comply with that HLR.

**Table 3-1
Interpretation of Supporting Requirements**

Action Statement Spans	Peer Review Finding	Interpretation of the Supporting Requirement
All Three Capability Categories (I/II/III)	Meets SR	Capable of supporting applications in all Capability Categories
	Does not meet SR	Does not meet minimum standard
Single Capability Category (I or II or III)	Meets Individual SR	Capable of supporting applications requiring that Capability Category or lower
	Does not meet any SR	Does not meet minimum standard
Lower Two Capability Categories (I/II)	Meets SR for CC I/II	Capable of supporting applications requiring Capability Category I or II
	Meets SR for CC III	Capable of supporting applications in all Capability Categories
	Does not meet SR	Does not meet minimum standard
Upper Two Capability Categories (II/III)	Meets SR for CC II/III	Capable of supporting applications in all Capability Categories
	Meets SR for CC I	Capable of supporting applications requiring Capability Category I
	Does not meet SR	Does not meet minimum standard

If there are instances where it appears that this approach leads the reviewer(s) to question the adequacy of the requirement for the higher Capability Categories, the reviewer(s) will document the interpretation of the SR that has been applied, and the host utility or any member of the Peer Review Team may submit an Inquiry to the JCNRM requesting a clarification.¹²

The host utility may request that the Peer Review Team review against Capability Category I or Capability Category II; this choice may be made on a per-technical element basis. If the host utility chooses to be reviewed against Capability Category I for a given SR, an F&O need not be written for those SRs if assessed as Capability Category I. Further, it is important to note that the team may write an F&O regardless of the Capability Category assessment for a given SR. It is expected that a “Finding” F&O is written for an SR assessed as Not Met, regardless of whether the utility has requested a review against Capability Category I or II, and either a “Suggestion” or “Finding” F&O is written for an SR assessed at CC-I when the SR is being assessed against CC-II.

No Capability Category will be assigned to HLRs, but a qualitative assessment of the HLRs will be made based on the associated SR assignments.

¹² This assumes that the External Events PRA Standard is published as part of the ASME/ANS PRA Standard for which ASME maintains the interpretation responsibility.

Where expert judgment (as defined in the ASME/ANS PRA Standard) has been used in a significant manner in the External Hazard PRA, the applicable portions of the PRA and associated documentation will also be reviewed for conformance to the expert judgment requirements of Section 1-4.3 of the ASME/ANS PRA Standard as part of the overall review.

It should be noted that the requirements for the development of the plant response model for each external hazard include an SR that invokes Part 2 of the ASME/ANS PRA Standard. The following is repeated as an SR in Parts 5, 7, 8 and 9 under SRs SPR-B1, WPR-A4, XFPR-A4, and XPR-A4, respectively:

“In each of the following aspects of the ‘hazard’-PRA systems-analysis work, SATISFY the corresponding requirements in Part 2, except where they are not applicable or where this Part includes additional requirements. DEVELOP a defined basis to support the claimed nonapplicability of any exceptions. The aspects governed by this requirement are:

- (a) initiating-event analysis
- (b) accident-sequence analysis
- (c) success-criteria analysis
- (d) systems analysis
- (e) data analysis
- (f) human-reliability analysis
- (g) use of expert judgment.

When the Part 2 requirements are used, FOLLOW the Capability Category designations in Part 2, and for consistency USE the same Capability Category in this analysis.”

The intent of these SRs is that the Internal Events PRA model meets the requirements presented in Part 2, and that any F&Os from the Internal Events PRA Peer Review applicable to the External Hazards PRA model development have been dispositioned. Part 2 F&Os that impact or are directly related to the development of an External Hazards PRA response model should also be referenced to the affected External Hazards PRA SRs. A specific SR from Part 2 can be referenced upon utility request. Multiple F&Os can be written against one SR. In most cases, these are evaluated only when the External Hazards PRA involves the technical steps that are covered by the applicable Part 2 SRs.

3.4 ADDITIONAL GUIDANCE ON THE TECHNICAL ELEMENTS REVIEW

The following general information applies to the use and interpretation of the summary sheets in Appendix B. These are provided as additional input to understanding the nature of the criteria.

- The “independent review” identified for evaluation as part of the checklist for each element under “Documentation” is a review sponsored by the host utility to make an

assessment of the specified External Hazards PRA element. The Peer Review Team will review the results of that independent review process.

- The review sheets are not prescriptive with respect to the assignment of specific probabilities or frequencies. A reviewer commenting on either the strength or the inadequacy of an element in the External Hazards PRA should make an effort to provide a generally accepted reference to support the comment, where appropriate.
- For each SR, assumptions and uncertainties associated with the SR are to be factored into the criteria of that element.
- Sections 2 of Parts 5 through 10 of the ASME/ANS PRA Standard include some high level considerations to be assessed in the peer review for each HLR and SR.
- Maintenance and updates: External Hazards PRA maintenance encompasses the identification and evaluation of new information, and the incorporation of this information into the External Hazards PRA on an as-needed basis. External Hazards PRA maintenance typically refers to minor model modifications and effort. More extensive maintenance may be performed if a specific application requires refinement of certain parts of the model. An External Hazards PRA update is a comprehensive revision to the External Hazards PRA model and associated documentation.
- A certain level of subjectivity is expected when determining if an SR has been met. For example, when there are many instances of compliance, and there are a few instances where compliance is lacking, this does not necessarily mean that the SR is considered not met. Any non-compliance should be documented with an F&O. However, there should be a preponderance of evidence to conclude that an SR is not met.

3.5 FOLLOW-ON EXTERNAL HAZARDS PRA PEER REVIEW

The Follow-on Peer Review will cover the set of HLRs and SRs for the External Hazards PRA technical elements in Section 2 of the applicable Part of the ASME/ANS PRA Standard. Further, the scope may be limited within an External Hazards PRA technical element to only the SRs that are germane to a specific External Hazards PRA upgrade (e.g., re-evaluation of hazard frequency). The Follow-on Peer Review may be limited to a single External Hazards PRA technical element, or may include multiple (or all) technical elements.

External Hazards PRA updates are scheduled to be performed periodically. In addition, they may also be performed on an as-needed basis as determined by the External Hazards PRA group leader. External Hazards PRA maintenance should serve to keep the External Hazards PRA reasonably current between External Hazards PRA updates. Additionally, it should be noted that the performance of an update does not generally require the performance of a Follow-on Peer Review, as discussed in Section 1-5 of the ASME/ANS PRA Standard. Performance of an External Hazards PRA upgrade will, however, require performance of a Follow-on Peer Review. (Note: The PRA Standard defines PRA upgrade as “the incorporation into a PRA model of a new methodology or changes in scope or capability that impact the significant accident sequences or the significant accident progression sequences. This could include items such as new human error analysis methodology, new data update methods, new approaches to quantification or

truncation, or new treatment of common cause failure.”) In terms of External Hazards PRA, an upgrade may include the use of new methods.

The host utility should initially determine the scope of the intended Follow-on Peer Review. This should be sent early enough to the Peer Review Team Leader to permit feedback to resolve any issues prior to performing the review. (Scope may have been discussed during the planning stages, but the actual reviewers should be very clear on the scope details.)

The performance of the Follow-on Peer Review would then be relatively similar to the initial peer review, with a modified scope, schedule, etc., based on the intended scope of the Follow-on Peer Review. Similarly, the Peer Review Team may be smaller, since some review skills may not be needed for the Follow-on Peer Review. For example, if the seismic fragility analysis was not upgraded in a Seismic PRA, a seismic fragility expertise is not needed for the Follow-on Peer Review.

4 PEER REVIEW PROCESS RESULTS AND DOCUMENTATION

4.1 PEER REVIEW REPORT

The output of the PRA Peer Review is a written report documenting both the details and the summary findings of the review. The checklists, F&Os, and other forms prepared during the on-site review constitute the largest portion of the report. The principal results, conclusions, and recommendations of the Peer Review Team are communicated to the host utility at the completion of the on-site review, and included in the report. Also included are the resumes of the Peer Review Team members.

The Peer Review report will clearly state the following:

- The Capability Category assigned for each External Hazards PRA SR and the basis of the assignment.
- The conclusions of the Peer Review Team.
- Any recommendations to achieve the next higher Capability Category (if applicable). For example, if a majority of the SRs for an External Hazards PRA are assessed as Capability Category II, then where recommendations can be made for SRs assessed as Capability Category I, these should be provided in the report. This may not be possible in all cases.

The host utility should only expect one round of comments (i.e., there will not be multiple draft reports provided for utility review), and should not expect that the Peer Review Team will hold teleconferences or other meetings with the utility to review comment resolutions. Additionally, as time does not allow for the External Hazards PRA Peer Review Team to provide the host utility with early results and then to meet to discuss interpretations, etc. during the on-site review, consensus/debate meetings with the host utility during the on-site review should be avoided outside the context of any daily debriefs. However, the review team should do their best to communicate questions and issues of missing or difficult to interpret information during the review week, so that the host utility can follow up with additional clarifying information if available.

The utility is welcome and encouraged to comment on the draft External Hazards PRA Peer Review report. Such comments can address factual technical issues, as well as interpretations of the ASME/ANS PRA Standard. The Team Lead is responsible for resolving these comments with the Peer Review Team and issuing a final report. Note, however, that interpretation of the ASME/ANS PRA Standard SRs needs to be addressed via the ASME Inquiry process – this can be done by either the Team Lead or the host utility. It is recommended the Inquiry be submitted by the host utility due to needed follow-up on the PRA when the Inquiry is answered. The host utility should not expect that the review team will rescind an F&O or revise an SR Capability Category assessment based on the host utility stating they will address the issue. The review is to determine the state of the External Hazards PRA at the time of the review; the team does not have the time either on-site or during the report development stage to reconsider issues based on revised work transmitted by the host utility.

The Peer Review report should be made part of the host utility's External Hazards PRA documentation file for future internal and external reference. The sponsoring Owners Group will maintain a record copy of the Peer Review report, but it should not be accessible to others than the host utility. Team members should retain documentation of their participation in the PRA Peer Review, but should not redistribute any notes or utility documentation.

4.2 PROCESS SUMMARY FORMS AND INFORMATION

There are a number of tables and forms that have been developed for use as part of the process to help make effective use of the limited time available, and to document the results of the External Hazards PRA Peer Review. These forms are included in Appendix B.

It is not the intent of this process to assign an overall Capability Category to the External Hazards PRA. The strength of the process is in the derivation and assignment of Capability Category for each SR, which serves to focus future External Hazards PRA update activities or for use in strengthening specific applications with additional deterministic assessments.

This External Hazards PRA Peer Review is focused principally on formal documented models, results, and their inputs. Notes or partial update results can be considered as an indication of the intent of the process, however, the review must be tied to the formal documentation that is available to describe the model and its results, and any documented and interpreted sensitivities.

An overall evaluation of the External Hazards PRA by the Peer Review Team is included in the report, using the form shown in Appendix B. This overall evaluation indicates the per-technical element basis for the evaluation, to allow focusing resources on those items that can be modified to improve the External Hazards PRA. An additional perspective on the Capability Category assignments is provided in the summary provided using Tables B-7 through B-12 that show a more in-depth breakdown of the Capability Categories assigned to the External Hazards PRA SRs.

4.3 PROCESS FEEDBACK

It is anticipated that, as reviews are performed using this process, the participants will identify additional insights and suggestions for improving the quality and the efficiency of the Peer Review process. Appendix E provides an example of a process feedback form that can be used to report such improvements to the Owners Group Peer Review program coordinator. This will allow the process to be maintained as a "living" process, such that if incremental improvements are identified in subsequent peer reviews, the guidelines can be updated to reflect these enhancements.

4.4 FOLLOW-ON PEER REVIEW

The Follow-on Peer Review, as discussed in Section 3.5 above, will be documented in a similar manner to the original Peer Review, but with changes to account for the focused scope of this review. The final report should include a discussion on the reason for the Follow-on Peer Review, and the impact of the changes on the External Hazards PRA. Because of the limited scope of the review, not all tables in Appendix B would need to be completed. However, an overall evaluation

NEI 12-13
August 2012

of the External Hazards PRA would be based on a combination of the Follow-on Peer Review and the previous Peer Review (for sections not reviewed during the Follow-on Peer Review).

5 REFERENCES

1. NEI 00-02, Revision 1, “Probabilistic Risk Assessment (PRA) Peer Review Process Guidance,” Nuclear Energy Institute, May 2006.
2. NEI 05-04, Revision 2, “Process for Performing PRA Peer Reviews Using the ASME PRA Standard (Internal Events),” November 2008.
3. NEI 07-12, Revision 1, “Fire Probabilistic Risk Assessment (FPRA) Peer Review Process Guidelines, June 2010.
4. ASME RA-Sa-2003, “Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications, Addendum A,” American Society of Mechanical Engineers, December 2003.
5. ASME RA-Sb-2003, “Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications, Addendum B,” American Society of Mechanical Engineers, December 2005.
6. ASME/ANS RA-Sa-2009, “Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications, Addendum A,” American Society of Mechanical Engineers, March 2009.
7. Regulatory Guide 1.200, “An Approach For Determining the Technical Adequacy of Probabilistic Risk Assessment Results For Risk-Informed Activities,” U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, Revision 2, March 2009.
8. ePSA PRA Documentation Module (DocAssist), Beta Version 2, Electric Power Research Institute, May 2003.

APPENDIX A PREPARATION MATERIAL FOR THE PEER TEAM REVIEW

This Appendix provides the following information referenced in the Guidelines:

- an estimate of the anticipated host utility resources for the External Hazards PRA Peer Review process
- an example letter to be sent to the host utility for initiating the External Hazards PRA Peer Review process
- a list of the material to be sent by the host utility to the Peer Review Team
- a list of the material to be available during the on-site visit
- the agenda for the on-site visit.

A.1 Estimated Host Utility Resources

The External Hazards PRA Peer Review includes a detailed review of the External Hazards PRA specified by the host utility. This detailed review is not only of the External Hazards PRA results, but also of the basis for decisions made in the development of the External Hazards PRA. Of particular interest are assumptions regarding the development of hazard analyses, fragility factors, and the plant response model (including event trees, quantification, recovery and sequences/cutsets). Given the depth and breadth of the review, it is important that all documentation of the External Hazards PRA development process be available and in a reviewer-friendly format. As a result, the Peer Review Team will require access to any and all External Hazards PRA documentation and supporting plant information, and also access to members of the host utility External Hazards PRA group. This, in turn, requires a considerable amount of preparation effort and support from the host utility.

An estimate of host utility required resources appears in Table A-1.

A.2 Example Letter

An example letter from the Owners Group to the host utility is included as Exhibit A-1. This letter explains what is required of the host utility in preparing for the review, including the following:

- review material to be sent to the Peer Review Team
- material to be available during the on-site review period
- the proposed agenda for the week
- self-assessment report for the External Hazards PRA (optional but recommended)
- roadmap of documentation used to support each individual SR

- assessment of the Internal Events PRA open and closed F&Os for impact on the subject External Hazards PRA.

Additional explanation of what is required of the host utility is provided in the following sections.

A.3 Host Utility Preparation and Participation Guidance

A considerable amount of host utility involvement is critical to ensure that the process can be accomplished successfully. The host utility should plan to spend a minimum of two person-weeks preparing documentation for the External Hazards PRA Peer Review Team, in addition to time required for the duplication or transmittal of requested information or for the preparation of the backup or support documents. Documentation should be provided electronically, if possible. Additional effort is required if documentation is not readily retrievable. In the current process, this documentation preparation will likely occur as part of the self-assessment, but the general requirements and considerations are the same.

Host Utility Information Requirements

There are several types of information that the host utility is required to provide for a successful review:

- information to be available during the on-site review (Section A.3.1)
- information for reviewers prior to the on-site review (Section A.4)
- interpretation of information and models during the review, and responses to reviewer questions (Section A.5)
- preparation of sensitivity studies to demonstrate the robustness of the External Hazards PRA (Section A.6)
- presentations to explain details of the model that would otherwise require extended study by the reviewers for full understanding (Section A.7).

A.3.1 Information Availability and Preparation via the Self-Assessment

A list of information that should typically be available or readily accessible during the on-site review is provided in Attachment 1 of Exhibit A-1. However, having the required documentation available requires more than simply having the information available in a file drawer. The host utility should, as part of the self-assessment or preparatory activities, review any and all pertinent backup information and documentation in its files to ensure that the information is current and pertinent. The self-assessment/road map should also provide a description of what information supports each of the SRs from the applicable part of the ANS/ASME PRA Standard, and should also include a limited evaluation of the applicable SRs from Part 2, as discussed in Section 1.4. Extraneous information and documents, such as draft copies, editorial comments and outdated information or information no longer pertinent, should not be presented to the Peer Review Team. Such information should be removed and placed in an archive file. In this way, the External Hazards PRA Peer Review Team can concentrate on the pertinent documentation. It is important to

note that, although the External Hazards PRA Peer Review following this process is not a certification of the documentation, inadequate documentation is a factor in External Hazards PRA technical adequacy, and inadequate or inscrutable documentation affects the ability of the reviewers to determine External Hazards PRA technical adequacy and can affect the assigned Capability Categories.

In instances where limited backup information is available, the host utility should document, in outline form, what they believe was assumed in the analysis. Using this approach allows the reviewers to comment on the technical rationale and provides a forum for discussion of what other utilities have done regarding the same or similar issues. In this way, the host utility receives the maximum benefit from the External Hazards PRA Peer Review.

In addition, as part of the preparatory review/self-assessment process, the host utility may be requested to fill out the checklists of the External Hazards PRA Peer Review process elements and sub-elements. When performing a self-assessment, the host utility should be asking the question *"What information or basis is available to support the assignment for the sub-element Capability Category?"* The host utility should prepare a list or a collection of documents that were used in the development of the element and, where appropriate, the sub-element. This activity greatly enhances the likelihood that adequate documentation will be made available to the Peer Review Team and puts the host utility in a better position to appropriately respond to preliminary findings of the reviewers.

A.3.2 Suggested Performance of the External Hazards PRA Self-Assessment

A thorough and objective self-assessment of the External Hazards PRA against the applicable part of the ASME/ANS PRA Standard can help ensure the External Hazards PRA Peer Review is completed with minimal F&Os (see Section 1.4). The requirements listed above focus on the development of supporting documentation or a road map for the External Hazards PRA, basically discussing where the documentation supporting an SR is provided. However, the Peer Review Team may not agree with the self-assessment conclusions, especially if the Peer Review Team determines the self-assessment did an incomplete job of assessing the External Hazards PRA documentation against the ASME/ANS PRA Standard.

To fully benefit from a self-assessment, the host utility can perform the assessment in a manner that ensures the results provide useful results to the plant. Points to consider on the self-assessment include:

- 1) The self-assessment should be performed and initially completed with sufficient time to incorporate any findings into the External Hazards PRA prior to the peer review. Depending on the available External Hazards PRA personnel support, this may require the self-assessment to be generally completed up to two months prior to the completion of the peer review.
- 2) Completion of the self-assessment in parts may ensure the schedule of the External Hazards PRA is not greatly impacted by the results of the self-assessment. Tasks completed early in the External Hazards PRA, such as site hazard analysis and fragility evaluations can be reviewed well in advance of the peer review. This will allow corrections to be made to the

External Hazards PRA early in the process, resulting in less impact to the overall schedule. For example, if the self-assessment determines a particular component vulnerable to seismic events was not included in the PRA, the time to add the new components and analyze the effects on the plant response can be considerable. Therefore, it may be beneficial to perform the self-assessment in two to three phases, as several of the External Hazards PRA tasks are completed.

- 3) If items identified during the self-assessment are corrected, this should be reflected in the self-assessment. This can either be done through disposition of any identified items (similar to F&Os), or by updating the self-assessment to reflect the latest documentation.
- 4) The self-assessment may be documented in a database or spreadsheet, which can be easily reviewed by the Peer Review Team. The Owners Group Peer Review database can be used for the self-assessment, which would allow the Peer Review team to directly correlate the self-assessment results with the peer review results.
 - When using the Owners Group Peer Review database or a similar product, the documentation should include the “roadmap” documentation for each SR, i.e., basically pointing to the document and location supporting the SR. Typical peer review databases do not include a separate data entry for documents supporting each SR, while a self-assessment database would likely include this information.

Use of some of the above guidance can help minimize the number of F&Os identified during the peer review.

A.4 Information for Reviewers Prior to the Review

A specific list of information to be sent by the host utility to the Peer Review Team in preparation for the on-site review is provided in Attachment 1 of Exhibit A-1. This information is primarily a subset of the information required to be available during the on-site review. The listed information should be provided to each reviewer at least four weeks before the review, to allow sufficient preparation time. There are some items that should be provided to every reviewer, while other items may only need to be provided to those specific reviewers who will be responsible for their review. Examples of a limited distribution of documents might include external flood hazard development, seismic fragility analysis, or the high winds plant response model. The distribution requirements should be discussed with the Owners Group review coordinator.

An initial review by the Peer Review Team Lead will be performed to ensure that team members are selected that can adequately review the supporting External Hazards PRA information. For example, if a particular seismic methodology is used in the Seismic PRA and it is key to the results, then a reviewer with familiarity of the methodology would be needed for the peer review.

It is assumed that a review of the open Internal Events PRA Peer Review F&Os has been performed prior to the External Hazards PRA Peer Review. This review should document the potential impact of the F&Os on the External Hazards PRA undergoing the peer review. The disposition of these F&Os is to be provided to the review team, prior to the review. Additionally, the results of the review of opened, closed and dispositioned F&Os from the Internal Events PRA Peer Review should be provided to the review team.

A.5 Information Transfer and Interpretation during the Review

The optimum benefits to the host utility are derived from the presence of the "owner(s)" of the External Hazards PRA (i.e., the staff member(s) most aware of the details of the development and current implementation of the External Hazards PRA) during the on-site visit. Otherwise, a set of other knowledgeable personnel needs to be present to provide support for the review team. These individuals and their areas of expertise need to be identified to the Peer Review Team members at the outset of the visit and available to respond promptly to questions during the review.

A.6 Preparation of Sensitivity Calculations

As part of the preparation process, it is requested that the results of several External Hazards PRA runs also be performed by the host utility and made available to the Peer Review Team prior to the on-site visit. The selected sensitivity cases are meant to demonstrate:

- factors and assumptions that are important to the site hazard
- for Seismic PRA, seismic hazard estimation was carried out to large-enough values so that when convolved with the plant or component level fragility, the resulting failure frequencies are robust estimates and do not change if the range is extended
- the sensitivity of the CDF and LERF results to the assumptions used
- the method provided to exercise the model and provide interpretation of results.

Note that the actual CDF and LERF numerical results of the sensitivity cases may be of limited relevance for the peer review.

Additional or alternative sensitivities that may be more appropriate to the specific External Hazards PRA can be identified by the host utility.

A.7 Presentations

Several presentations by the host utility to the Peer Review Team are recommended during the on-site review. These informal presentations are considered crucial to success of the peer review and to generate valuable feedback to the host utility, and include: an initial presentation to the Peer Review Team to provide an overview of the important plant design features; and subsequent presentations on specific aspects of the External Hazards PRA.

Initial Presentation

The initial presentation is intended to provide the reviewers with an overview of the important plant features that influence the External Hazards PRA results, and also to help focus the Peer Review Team resources by highlighting specific areas of the External Hazards PRA for which the host utility desires review emphasis. This presentation may be made prior to the on-site visit via conference call. Similarly, it is valuable for the Peer Review Team to be made aware of any technical review elements and criteria that may not be applicable to a given plant (and the reason why), at the outset of the review so that the reviewers have a basis for not considering these items.

The overview presentation by the host utility should include the following detailed information:

- a brief summary of the scope, methods, and key results of the subject External Hazards PRA
- a brief summary of any unique design features of the plant
- a brief summary of the External Hazards PRA Maintenance and Update process, including examples of current uses of the External Hazards PRA
- a brief overview of where the PRA group fits into the utility organization, and an indication of utility/plant management views on use and maintenance of the External Hazards PRA
- a summary of the types of risk-informed applications for which the External Hazards PRA has been used or is planning to be used
- the location of the External Hazards PRA documents, and of information in the documents, covered briefly in a manner that allows the Peer Review Team to be able to find the necessary information quickly throughout the week
- a description of any elements of the External Hazards PRA that would benefit from other External Hazards PRA practitioners' insights.

Subsequent Presentations

The host utility is also expected to provide focused presentations on technical topics pertinent to the External Hazards PRA. These may vary from review to review, but will typically include one-hour discussions of the hazard analyses, fragility evaluations, and modeling of the plant response.

A.8 Administrative Details

Prior to the inception of the review at the plant site, there is a need for extensive planning and scheduling offsite to ensure that the review can be performed efficiently and effectively. The most important administrative details include the meeting location and report reproduction support.

Choosing a good meeting location is necessary to efficiently perform the review. Distractions must be minimized. Since long hours will likely be required, comfortable meeting rooms should be provided. At least two separate meeting rooms (one large enough for meetings with all of the team members plus several members of the host utility staff), and individual work areas (if possible) should be available for use by the Peer Review Team during the entire week. It is also useful to have quiet areas where team members can collect thoughts, and prepare or summarize findings. The Peer Review Team may request arrangements for box lunches to save time, or if there is no convenient cafeteria service. The host utility should supply to the reviewers a map and hotel list for the team to make logistical arrangements. Additionally, information on the accessibility of computers, printers, Internet, etc., should be provided. Due to the number of necessary walkdowns that have to be performed to review an External Hazards PRA, it is highly recommended that the peer review is performed at the plant site. The location should also provide the best access to relevant documentation, as delays due to document retrieval difficulties are not acceptable during on-site reviews.

A.9 Host Utility Preparation Summary

In summary, the host utility should not request an External Hazards PRA Peer Review until the following tasks are accomplished¹³:

- perform a self-assessment or other preparatory activities sufficiently in advance of the peer review so that there is time to address missing or inaccurate information
- provide information to the Peer Review Lead on the importance of the external hazards applicable to the site in time to support the Peer Review Team selection
- ensure that all necessary information for the review is available on-site in reviewer-friendly format
- provide initial information to be reviewed prior to the Peer Review Team visit, including sensitivity studies (at least four weeks in advance of the visit)
- prepare for and host the Peer Review Team during the one week visit:
 - provide facilities for the use of the review team while on-site
 - provide an overview presentation and presentations on selected topics, and responses to reviewer questions
 - provide a proof test run of the various External Hazards models and sensitivity runs as needed
 - provide access to the management chain to discuss the External Hazards PRA process
 - provide selected focused walkdown(s) of the plant to augment the fragility assessments
 - provide necessary capability for the Peer Review Team's computers.

¹³ The decision on whether the host utility has completed these tasks will be made by a representative of the respective Owners Group, for Owners Group-sponsored peer reviews, such as the PRA peer review coordinator or the proposed PRA team leader.

Table A-1 Host Utility Involvement and Resource Estimates	
Item	Resource Estimate
Support a pre-review visit by a member of the Peer Review Team to identify the level of documentation that should be made available to the reviewers, and to help in coordinating the on-site review logistics	0.2 person-week
Supply initial information, which includes: <ul style="list-style-type: none"> • External Hazards PRA summary documents • Other material at the discretion of the host utility • Sensitivity cases, if any have been requested by the Peer Review Team Lead prior to the review • Internal Events PRA Peer Review F&Os (open and closed/dispositioned), and their effect on the subject External Hazards PRA (may need to add time in the schedule for this) 	1 person-week
Conduct External Hazards PRA Self-Assessment/External Hazards PRA Preparatory Activities*	3-4 person-weeks
Host the Peer Review Team during the one-week visit (including focused plant walkdowns)	1-2 person-weeks
Prepare initial presentation information <ul style="list-style-type: none"> • Initial expectations regarding peer review assessment of Capability Categories, and basis for the expectations • Summary of plant and principal design features • Summary of the External Hazards PRA Maintenance and Update process • Application examples • PRA Group Management Role in Use of External Hazards PRA 	0.5 person-week
Assemble all supporting documentation for the on-site visit	1 person-week
Provide responses to questions during the on-site visit	1 person-week
Provide presentations on selected topics	0.4 person-week
Provide a proof test run of the model during on-site visit	0.1 person-week
Provide access to the management chain to discuss the External Hazards PRA process	0.1 person-week
Resolution of F&Os/comments	This effort can vary appreciably thus no estimate is given here.
Closeout Meeting	~ 0.3 person-week
Total host utility Resource Requirement for Peer Review	~ 11 to 15 person-weeks¹⁴

*Time estimate does not include possible model improvements following the self-assessment prior to the peer review.

¹⁴ This estimate is associated with an External Events with good documentation and technical bases. With excellent documentation and Technical Bases, this estimate could be reduced, and with reduced levels of documentation, the estimate could be higher.

Exhibit A-1

Example Peer Review Planning Letter From
Owners Group to Host Utility

Peer Review Planning Letter

PRA Manager
Host Utility

SUBJECT: External Hazards PRA Peer Review

Dear Manager:

Thank you for your participation in the External Hazards PRA Peer Review program. In addition to the direct benefits of this peer review to your organization's applications of the External Hazards PRA, this program will provide benefits to the _____ (Fill in) Owners Group and its individual member utilities. The External Hazards PRA Peer Review should provide valuable insights for your use to assess the overall technical adequacy of your External Hazards PRA for future use in risk-informed applications and in planning for External Hazards PRA update and maintenance activities.

This letter outlines the following:

- expectations for the review process
- proposed agenda for the peer review
- information about the reviewers
- key dates
- commitment to support peer reviews of other sites.

A considerable amount of External Hazards PRA information is being requested for the review team. Attachment 1 provides a list of information that is needed before the on-site review and information that would be desirable to have during the visit.

The members of the External Hazards PRA Peer Review Team for *Plant X* are:

	<u>Reviewer</u>	<u>Affiliation</u>
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____
6.	_____	_____
7.	_____	_____

{For this review, we would also like to include participation by several observers who will not be official reviewers or have official peer review responsibilities, but who either represents one of other Owners Groups or an organization with which we are cooperating in conducting this program.}

The addresses and other information for these people are enclosed as Attachment 2. Attachment 3 provides the proposed agenda for the Peer Review meeting the week of _____. If you need to make any modifications to this agenda, please notify me as soon as possible. Please arrange to have at least two separate meeting rooms (one large enough for meetings with all of the Peer Review Team members plus several members of your staff), and individual work areas (if possible) available for use by the team members during the entire week. Also, the Peer Review Team will need computer and printer access, as well as assistance for lunch. Finally, please note that the Peer Review Team will require extended hours on-site during the review.

The pre-visit information for the review should be sent so that the reviewers receive it four weeks prior to the on-site review, i.e., by _____. This is important so that the Peer Review Team has adequate preparation time. Also note that the Peer Review team would like to discuss with you the anticipated types of planned risk-informed applications and any expectations for the External Hazards PRA.

The Peer Review Team includes members from other utilities, as coordinated through the _____ Owner's Group process. To ensure success of this program, the host utility should identify review team members that will be available for reciprocal support of other peer reviews, and the general time frame each team member will be available.

In summary, the key dates for the review are as follows:

- _____ receipt of information from host utility by the reviewers
- _____ initial day of the peer review meeting at host utility offices
- _____ final Report on the External Hazards PRA Peer Review.

Your input on all phases of the process, both before-hand and as a post-review critique, are encouraged. Evaluation of the process provides a valuable feedback mechanism for improving the quality of the review and the process.

If you have any questions, please call at any time.

Sincerely,

Coordinator, Owners Group External Hazards PRA Peer Review Program

cc: _____ (Review Team Member)
_____ (Review Team Member)
_____ (Review Team Member)
_____ (Review Team Member)
_____ (Review Team Member)

Attachment 1 to Peer Review Planning Letter

**Information to be Available for
Review by the Peer Review Team**

Information to be sent for review in preparation for the on-site visit includes the following:

- external Hazards PRA summary document
- the self-assessment of the External Hazards PRA (optional but recommended).
- roadmap of documentation used to support individual SRs
- example detailed External Hazards PRA documentation, such as:
 - results of previous peer reviews including open Internal Events F&Os, and the utility disposition of F&OS and their effect on the subject External Hazards PRA
 - applicable site hazard analyses
 - applicable hazard fragility evaluations
 - applicable plant response model documentation
 - sensitivity and uncertainty methodology and results
 - example analysis guidance documents
- other material at the discretion of the host utility
- sensitivity cases, if any have been requested by the Peer Review Team leader prior to the review.

In general, the material supplied to the Peer Review team is the host utility's decision. However, the more information that can be provided in advance, the more the on-site visit will be facilitated. Providing documentation and/or the External Hazards PRA computer model prior to the visit may permit the reviewer(s) to become more familiar with the External Hazards PRA model and conduct a more effective on-site review.

Information to be available on-site in (or in close proximity to) the meeting room(s) for the Peer Review Team (All Tier 1, 2, and 3 documents related to the following):

GENERAL PLANT INFORMATION

- * System Descriptions
- * External Hazards PRA plans (seismic, flood, high winds, etc., as applicable)
- * Abnormal Operating Procedures for subject External Hazards PRA
- * Emergency Operating Procedures
- * Technical Specifications
- * Updated Final Safety Analysis Report
- * P&IDs and General Arrangement Drawings

GENERAL PRA INFORMATION

- * Subject External Hazards PRA
- * Internal Events PRA
- * Guidance Documents
- * Staff Evaluation Report for the IPEEEE, if applicable
- * Responses to the IPEEE Request for Additional Information (If applicable)
- * Previous Internal Events PRA Peer Review results and status of F&Os.
- * Documentation of Independent Review
- * Documentation of Plant Walkdowns for the subject External Hazards PRA (signoff/check off sheets or comment forms)

SEISMIC

Seismic Hazard Analysis

- * Methods used for source characterization
- * Inputs and results
- * Model uncertainty

Seismic Fragility Analysis

- * Development of Seismic Safe Shutdown Equipment List
- * Screening Criteria
- * Plant Walkdowns
- * Fragility Data and Calculations

Seismic Plant Response Analysis

- * Success Criteria
- * P&IDs and Layout Drawings
- * Seismic PRA model or similar
- * Uncertainty evaluation
- * Sensitivity studies

Seismic Margin Assessment

- * Review Level Earthquake Selection
- * Success Path Selection
- * Seismic Response Analysis
- * Seismic Walkdown
- * Component Method and Data
- * Seismic Margin Assessment Methodology

SCREENING OF EXTERNAL HAZARDS

Screening and Conservative Analysis of Other External Hazards

- * List of other external hazards considered
- * Screening criteria
- * Any assessment of external hazards performed

HIGH WINDS

High Wind Hazard Analysis

- * High wind hazard selection
- * List of wind-induced initiating events
- * Input data and results
- * Uncertainty analysis

High Wind Fragility Analysis

- * Screening Criteria
- * Missile analysis (?)
- * Plant walkdowns
- * Fragility data and calculations

High Wind Plant Response Model

- * Quantifications methods
- * PRA Model used to quantify high winds risk or similar
- * Uncertainty evaluation
- * Sensitivity studies

EXTERNAL FLOOD

External Flood Hazard Analysis

- * External flood hazard selection
- * List of external flood-induced initiating events
- * Methods used for modeling flood sources
- * Input data and results
- * Uncertainty analysis

External Flood Fragility Analysis

- * Screening Criteria
- * Fragility data and calculations
- * Plant walkdowns

External Flood Plant Response Model

- * Quantifications methods
- * PRA model used to quantify risk or similar
- * Uncertainty evaluation
- * Sensitivity studies

OTHER EXTERNAL HAZARDS

External Hazard Analysis

- * External Hazard Selection
- * External Hazard-Caused Initiating Events
- * Input data and results

- * Uncertainty analysis

External Hazard Fragility Analysis

- * Screening Criteria
- * Fragility Analysis Methods and Data
- * Plant Walkdowns

External Hazard Plant Response Model

- * Quantification Methods
- * PRA model used to quantify risk or similar
- * Results, uncertainty, sensitivity evaluations

Attachment 2 to Peer Review Planning Letter

Reviewer Addresses and Contact Information

NAME:	<i>Reviewer #1</i>
COMPANY:	
ADDRESS:	
Telephone:	Email:
Fax:	SSN (if needed for site access):

NAME:	Reviewer #2
COMPANY:	
ADDRESS:	
Telephone:	Email:
Fax:	SSN (if needed for site access):

NAME:	Reviewer #3
COMPANY:	
ADDRESS:	
Telephone:	Email:
Fax:	SSN (if needed for site access):

NAME:	Reviewer #4
COMPANY:	
ADDRESS:	
Telephone:	Email:
Fax:	SSN (if needed for site access):

NAME:	Reviewer #5
COMPANY:	
ADDRESS:	
Telephone:	Email:
Fax:	SSN (if needed for site access):

NAME:	Reviewer #6
COMPANY:	
ADDRESS:	
Telephone:	Email:
Fax:	SSN (if needed for site access):

Attachment 3 to Peer Review Planning Letter

Review Schedule and Agenda

Note: The schedule provided is a rough estimate until after the pilot External Hazards PRA Peer Review is held. However, the general steps of the External Hazards PRA can be listed, with slightly more time given to the latter steps.

AGENDA ITEM	REVIEWER	TIME
<u>SUNDAY</u>		
Recommended Pre-Review Meeting of Peer Reviewers to Review the Process/Schedule, and for Calibration	(All)	(Evening)
<u>MONDAY</u>		
Overview Meeting of Team <ul style="list-style-type: none"> Initial Observations and Changes in Focus 	(All)	8–9 a.m.
Overview Presentation by host utility <ul style="list-style-type: none"> Unique Plant Capabilities Location of Reference Material (use Information Request as checklist) Overview of subject External Hazards PRA Methodology used for the evaluation of the applicable hazard 	(All)	9–10 a.m.
General Review of Documents	(All)	10 a.m.–12 p.m.
Demonstration of Methodology <ul style="list-style-type: none"> General Approach Philosophy/Assumptions Nomenclature, etc. 	Reviewers 1, 2, 4, 5, & 6	10 a.m.–12 p.m.
<u>LUNCH</u>		
Walkdowns	Reviewers 1, 4, 5, & 6	1–4 p.m.
<u>MONDAY - FRIDAY</u>		
Detailed review of All Technical Elements	All	See high level Schedule in Attachment 4

Attachment 3 to Peer Review Planning Letter

Review Schedule and Agenda

Note: The schedule provided is a rough estimate until after the pilot External Hazards PRA Peer Review is held. However, the general steps of the External Hazards PRA can be listed, with slightly more time given to the latter steps.

<u>FRIDAY</u>	AGENDA ITEM	REVIEWER (All)	TIME 8–11 a.m.
	Focused Study of Open Items		
	Considerations of Utility on Feedback Findings	(All)	11 a.m.–Noon
	LUNCH		
	Exit Meeting	(All)	1–4 p.m.

Attachment 4

GRAPHICAL OVERVIEW OF REVIEW SCHEDULE⁽¹⁾					
Monday ⁽²⁾	Tuesday	Wednesday	Thursday	Friday ⁽³⁾	Element Lead
SHA					Reviewer 1
SFR					Reviewer 2
SHA			SPR		Reviewer 3
SFR			SPR		Reviewer 4
SPR					Reviewer 5
SPR					Reviewer 6
SPR			MU	SPR	Reviewer 7

Notes:

- (1) Bars indicate days that include scheduled review hours for the PRA technical element in question.
- (2) The host utility presentations are conducted on Monday morning.
- (3) The exit meeting and presentation by the Team Leader are conducted on Friday morning.

APPENDIX B PEER REVIEW SAMPLE SUMMARY SHEETS

Note: Users should confirm that the structure of the tables below conforms to the version of the PRA standard being applied, and make any changes as necessary.

Table B-1 Sample Summary Table for Part 5 HLRs – Requirements for Seismic Events At-Power PRA		
High Level Requirement	Summary of High Level Requirement	Summary of Assessment Capability
HLR-SHA-A	Base frequency of earthquakes at the site on a site-specific probabilistic hazard analysis that reflects the composite distribution of the informed technical community.	
HLR-SHA-B	Compile a comprehensive up-to-date database to provide inputs to the probabilistic seismic hazard analysis.	
HLR-SHA-C	Examine all credible sources of potentially damaging earthquakes and address the aleatory and epistemic uncertainties when characterizing the sources.	
HLR-SHA-D	Examine credible mechanisms influencing estimates of vibratory ground motion.	
HLR-SHA-E	Account for the effects of local site response	
HLR-SHA-F	Propagate and display the uncertainties in each step of the hazard analysis in the final quantification of hazard estimates.	
HLR-SHA-G	Base spectral shape on site-specific evaluations taking into account the contributions of deaggregated magnitude-distance results of the hazard analysis.	
HLR-SFA-A	Perform the seismic fragility evaluation to estimate plant-specific, realistic fragilities of SSCs whose failure can lead to core damage or large early release.	
HLR-SFA-B	Fully describe the basis for any screening of high-seismic-capacity components.	
HLR-SFA-C	Base the fragility evaluation on realistic seismic response that the SSCs experience at their failure levels.	

Table B-1		
Sample Summary Table for Part 5 HLRs – Requirements for Seismic Events At-Power PRA		
High Level Requirement	Summary of High Level Requirement	Summary of Assessment Capability
HLR-SFA-D	Perform the fragility evaluation for critical failure modes of SCCs, supplemented as needed by additional data.	
HLR-SFA-E	Incorporate the findings of a detailed walkdown of the plant.	
HLR-SFA-F	Base calculation of seismic-fragility parameters on plant-specific data, supplemented as needed by additional data. Justify use of generic data.	
HLR-SFA-G	Documentation.	
HLR-SPR-A	Include seismic-caused initiating events and other failures in the seismic-PRA systems models that give rise to significant accident or accident progression sequences.	
HLR-SPR-B	Adapt the seismic-PRA systems model to incorporate seismic analysis aspects that are different from the corresponding internal events PRA systems model.	
HLR-SPR-C	Reflect the as-built, as-operated plant being analyzed in the seismic-PRA systems model.	
HLR-SPR-D	In the list of SSCs, include all SSCs that participate in accident sequences included in the seismic-PRA systems model.	
HLR-SPR-E	Integrate the seismic hazard, seismic fragilities, and systems-analysis aspects in the analysis to quantify core damage and large early release frequencies.	
HLR-SPR-F	Documentation.	

Table B-2		
Sample Summary Table for Part 6 HLRs – Requirements for Screening and Conservative Analysis of Other External Hazards At-Power		
High Level Requirement	Summary of High Level Requirement	Summary of Assessment Capability
HLR-EXT-A	Identify all potential external hazards that may affect the site.	
HLR-EXT-B	Use a defined set of screening criteria if performing a preliminary screening.	
HLR-EXT-C	Use defined quantitative screening criteria if performing a bounding or demonstrably conservative analysis screening.	
HLR-EXT-D	Confirm the basis for the screening out of external hazards through a walkdown of the plant and its surroundings.	
HLR-EXT-E	Documentation.	

Table B-3		
Sample Summary Table for Part 7 HLRs – Requirements for High Wind Events At-Power PRA		
High Level Requirement	Summary of High Level Requirement	Summary of Assessment Capability
HLR-WHA-A	Base the frequency of high winds on a site-specific probabilistic wind hazard analysis that reflects recent available regional and site-specific information.	
HLR-WHA-B	Documentation.	
HLR-WFR-A	Perform the wind fragility evaluation to estimate plant-specific, realistic fragilities for SSCs whose failure contributes to core damage or large early release.	
HLR-WFR-B	Documentation.	
HLR-WPR-A	Include in the high wind PRA systems model wind-caused initiating events and other failures that can lead to core damage or large early release. The model should be adapted from the internal events PRA systems model.	
HLR-WPR-B	Integrate the wind hazard, fragilities, and systems analysis aspects into the analysis to quantify core damage and large early release frequencies.	
HLR-WPR-C	Documentation.	

Table B-4		
Sample Summary Table for Part 8 HLRs - Requirements for External Flood Events At-Power PRA		
High Level Requirement	Summary of High Level Requirement	Summary of Assessment Capability
HLR-XFHA-A	Base the frequency of external flooding on site-specific probabilistic hazard analysis that reflects recent available regional and site-specific information.	
HLR-XFHA-B	Documentation.	
HLR-XFFR-A	Perform the external flood fragility evaluation to estimate plant specific, realistic susceptibilities and fragilities for SSCs whose failure contributes to core damage or large early release.	
HLR-XFFR-B	Documentation.	
HLR-XFPR-A	Include in the external flooding PRA systems model flood-caused initiating events and other failures that can lead to core damage or large early release. The model should be adapted from the internal events PRA systems model.	
HLR-XFPR-B	Integrate the external flood hazard hazard, fragilities, and systems analysis aspects into the analysis to quantify core damage and large early release frequencies.	
HLR-XFPR-C	Documentation.	

Table B-5
Sample Summary Table for Part 8 HLRs - Requirements for Other External Hazards At-Power PRA

High Level Requirement	Summary of High Level Requirement	Summary of Assessment Capability
HLR-XHA-A	Base the analysis of the hazards on site-specific probabilistic hazard analysis that reflects recent available regional and site-specific information.	
HLR-XHA-B	Documentation.	
HLR-XFR-A	Evaluate the fragility of SSCs using plant-specific and SSC-specific information and an accepted engineering method for evaluating the postulated failure.	
HLR-XFR-B	Documentation.	
HLR-XPR-A	Include in the external hazard PRA plant model external hazard-caused initiating events and other failures that can lead to core damage or large early release. The model should be adapted from the internal events PRA systems model.	
HLR-XPR-B	Integrate the external hazard, fragilities, and plant response aspects into the analysis to quantify core damage and large early release frequencies.	
HLR-XPR-C	Documentation.	

Table B-6		
Sample Summary Table for Part 8 HLRs - Seismic Margin Assessment Requirements At-Power		
High Level Requirement	Summary of High Level Requirement	Summary of Assessment Capability
HLR-SM-A	Select a review level earthquake characterized by a ground motion spectrum to facilitate screening of SSCs and performance of seismic margin calculations.	
HLR-SM-B	Develop a minimum of two diverse success paths that can be used to bring the plant to a safe state and maintain this condition for at least 72 hours following a review level or larger earthquake.	
HLR-SM-C	Seismic responses calculated for the review level earthquake should be median centered, based on current state-of-the-art methods, and include effects of soil-structure interaction where applicable.	
HLR-SM-D	Incorporate the findings of the plant walkdown into the screening of components and subsequent seismic margin calculations.	
HLR-SM-E	Perform seismic margin calculations for critical failure modes of SSCs identified through the review of plant design documents and the results of a plant walkdown supplemented by additional data.	
HLR-SM-F	Base calculation of seismic margins on plant-specific data supplemented by generic data. Justify use of such generic data.	
HLR-SM-G	Report plant seismic margin based on margins calculated for the success paths.	
HLR-SM-H	Documentation.	

Table B-7						
External Hazards PRA Peer Review Sheets for Part 5: Requirements for Seismic Events At-Power PRA						
SR	External Hazards PRA Capability Categories			Assignment of CC	Basis	Associated Facts and Observations
	I	II	III			
HLR SHA: Seismic Hazard Analysis						
SHA-A1	I	II/III				
SHA-A2	I/II		III			
SHA-A3	Met/Not Met					
SHA-A4	Met/Not Met					
SHA-A5	Met/Not Met					
SHA-B1	I/II		III			
SHA-B2	I/II		III			
SHA-B3	I	II/III				
SHA-C1	Met/Not Met					
SHA-C2	Met/Not Met					
SHA-C3	I	II/III				
SHA-C4	Met/Not Met					
SHA-D1	Met/Not Met					
SHA-D2	Met/Not Met					
SHA-D3	I	II/III				
SHA-D4	Met/Not Met					
SHA-E1	I	II/III				
SHA-E2	I	II/III				
SHA-F1	I	II/III				
SHA-F2	Met/Not Met					
SHA-F3	I	II	III			
SHA-G1	I	II	III			
SHA-H	I	II	III			

Table B-7						
External Hazards PRA Peer Review Sheets for Part 5: Requirements for Seismic Events At-Power PRA						
SR	External Hazards PRA Capability Categories			Assignment of CC	Basis	Associated Facts and Observations
	I	II	III			
SHA-I	No Requirement					
SHA-J1	Met/Not Met					
SHA-J2	Met/Not Met					
SHA-J3	Met/Not Met					
HLR SFR: Seismic Fragility Analysis						
SFR-A1	Met/Not Met					
SFR-A2	I	II	III			
SFR-B1	I/II		III			
SFR-B2	Met/Not Met					
SFR-C1	I/II		III			
SFR-C2	I/II		III			
SFR-C3	I/II		III			
SFR-C4	I/II		III			
SFR-C5	I/II		III			
SFR-C6	I/II		III			
SFR-D1	Met/Not Met					
SFR-D2	Met/Not Met					
SFR-E1	Met/Not Met					
SFR-E2	Met/Not Met					
SFR-E3	Met/Not Met					
SFR-E4	Met/Not Met					
SFR-E5	Met/Not Met					
SFR-F1	I/II		III			
SFR-F2	I/II		III			
SFR-F3	I	II/III				

**Table B-7
External Hazards PRA Peer Review Sheets for Part 5: Requirements for Seismic Events At-Power PRA**

SR	External Hazards PRA Capability Categories			Assignment of CC	Basis	Associated Facts and Observations
	I	II	III			
SFR-F4	Met/Not Met					
SFR-G1	Met/Not Met					
SFR-G2	Met/Not Met					
SFR-G3	Met/Not Met					
HLR SPR: Seismic Plant Response Analysis						
SPR-A1	Met/Not Met					
SPR-A2	Met/Not Met					
SPR-A3	Met/Not Met					
SPR-A4	Met/Not Met					
SPR-B1	Met/Not Met					
SPR-B2	Met/Not Met					
SPR-B3	Met/Not Met					
SPR-B4	I/II	III				
SPR-B5	Met/Not Met					
SPR-B6	I	II/III				
SPR-B7	Met/Not Met					
SPR-B8	Met/Not Met					
SPR-B9	I	II/III				
SPR-B10	Met/Not Met					
SPR-B11	Met/Not Met					
SPR-C1	Met/Not Met					
SPR-D1	Met/Not Met					
SPR-E1	Met/Not Met					
SPR-E2	I	II/III				
SPR-E3	Met/Not Met					

Table B-7
External Hazards PRA Peer Review Sheets for Part 5: Requirements for Seismic Events At-Power PRA

SR	External Hazards PRA Capability Categories			Assign-ment of CC	Basis	Associated Facts and Observations
	I	II	III			
SPR-E4	I/II		III			
SPR-E5	I	II/III				
SPR-E6	Met/Not Met					
SPR-F1	Met/Not Met					
SPR-F2	Met/Not Met					
SPR-F3	Met/Not Met					

Table B-8				
External Hazards PRA Peer Review Sheets for Part 6: Requirements for Screening and Conservative Analysis of Other External Hazards At-Power				
SR	Requirement	Assign- ment of CC	Basis	Associated Facts and Observations
HLR EXT: Screening and Conservative Analysis				
EXT-A1	Met/Not Met			
EXT-A2	Met/Not Met			
EXT-B1	Met/Not Met			
EXT-B2	Met/Not Met			
EXT-B3	Met/Not Met			
EXT-B4	Met/Not Met			
EXT-C1	Met/Not Met			
EXT-C2	Met/Not Met			
EXT-C3	Met/Not Met			
EXT-C4	Met/Not Met			
EXT-C5	Met/Not Met			
EXT-C6	Met/Not Met			
EXT-C7	Met/Not Met			
EXT-D1	Met/Not Met			
EXT-D2	Met/Not Met			
EXT-E1	Met/Not Met			
EXT-E2	Met/Not Met			

Table B-9						
External Hazards PRA Peer Review Sheets for Part 7: Requirements for High Wind Events At-Power PRA						
SR	External Hazards PRA Capability Categories			Assignment of CC	Basis	Associated Facts and Observations
	I	II	III			
HLR WHA: Wind Hazard Analysis						
WHA-A1	I	II/III				
WHA-A2	I	II/III				
WHA-A3	I	II/III				
WHA-A4	I	II/III				
WHA-A5	I	II	III			
WHA-B1	Met/Not Met					
WHA-B2	Met/Not Met					
WHA-B3	Met/Not Met					
HLR WFR: Wind Fragility Analysis						
WFR-A1	I	II/III				
WFR-A2	Met/Not Met					
WFR-B1	Met/Not Met					
WFR-B2	Met/Not Met					
WFR-B3	Met/Not Met					
HLR WPR: High Wind Plant Response Model and Quantification						
WPR-A1	Met/Not Met					
WPR-A2	Met/Not Met					
WPR-A3	Met/Not Met					
WPR-A4	Met/Not Met					
WPR-A5	Met/Not Met					
WPR-A6	Met/Not Met					
WPR-A7	I/II		III			
WPR-A8	Met/Not Met					

Table B-9						
External Hazards PRA Peer Review Sheets for Part 7: Requirements for High Wind Events At-Power PRA						
SR	External Hazards PRA Capability Categories			Assignment of CC	Basis	Associated Facts and Observations
	I	II	III			
WPR-A9	Met/Not Met					
WPR-A10	Met/Not Met					
WPR-A11	I	II/III				
WPR-B1	I	II/III				
WPR-B2	I	II/III				
WPR-C1	Met/Not Met					
WPR-C2	Met/Not Met					
WPR-C3	Met/Not Met					

Table B-10						
External Hazards PRA Peer Review Sheets for Part 8: Requirements for External Flood Events At-Power PRA						
SR	External Hazards PRA Capability Categories			Assignment of CC	Basis	Associated Facts and Observations
	I	II	III			
HLR XFHA: External Flooding Hazard Analysis						
XFHA-A1	I	II/III				
XFHA-A2	I	II/III				
XFHA-A3	I	II/III				
XFHA-A4	I	II/III				
XFHA-A5	I	II/III				
XFHA-A6	I	II/III				
XFHA-B1	Met/Not Met					
XFHA-B2	Met/Not Met					
XFHA-B3	Met/Not Met					
HLR XFFR: External Flood Fragility Analysis						
XFFR-A1	I	II/III				
XFFR-A2	Met/Not Met					
XFFR-B1	Met/Not Met					
XFFR-B2	Met/Not Met					
XFFR-B3	Met/Not Met					
HLR XFPR: External Flood Plant Response Model and Quantification						
XFPR-A1	Met/Not Met					
XFPR-A2	Met/Not Met					
XFPR-A3	Met/Not Met					
XFPR-A4	Met/Not Met					
XFPR-A5	Met/Not Met					
XFPR-A6	Met/Not Met					
XFPR-A7	I/II		III			

Table B-10						
External Hazards PRA Peer Review Sheets for Part 8: Requirements for External Flood Events At-Power PRA						
SR	External Hazards PRA Capability Categories			Assignment of CC	Basis	Associated Facts and Observations
	I	II	III			
XFPR-A8	Met/Not Met					
XFPR-A9	Met/Not Met					
XFPR-A10	Met/Not Met					
XFPR-A11	I	II/III				
XFPR-B1	I	II/III				
XFPR-B2	I	II/III				
XFPR-C1	Met/Not Met					
XFPR-C2	Met/Not Met					
XFPR-C3	Met/Not Met					

Table B-11						
External Hazards PRA Peer Review Sheets for Part 9: Requirements for Other External Hazards At-Power PRA						
SR	External Hazards PRA Capability Categories			Assignment of CC	Basis	Associated Facts and Observations
	I	II	III			
HLR XHA: Other External Hazard Analysis						
XHA-A1	Met/Not Met					
XHA-A2	Met/Not Met					
XHA-A3	Met/Not Met					
XHA-A4	Met/Not Met					
XHA-B1	Met/Not Met					
XHA-B2	Met/Not Met					
XHA-B3	Met/Not Met					
HLR XFR: Other External Hazard Fragility Analysis						
XFR-A1	Met/Not Met					
XFR-A2	Met/Not Met					
XFR-A3	Met/Not Met					
XFR-A4	Met/Not Met					
XFR-B1	Met/Not Met					
XFR-B2	Met/Not Met					
XFR-B3	Met/Not Met					
HLR XPR: External Hazard Plant Response Model						
XPR-A1	Met/Not Met					
XPR-A2	Met/Not Met					
XPR-A3	Met/Not Met					
XPR-A4	Met/Not Met					
XPR-A5	Met/Not Met					
XPR-A6	Met/Not Met					
XPR-A7						

Table B-11						
External Hazards PRA Peer Review Sheets for Part 9: Requirements for Other External Hazards At-Power PRA						
SR	External Hazards PRA Capability Categories			Assignment of CC	Basis	Associated Facts and Observations
	I	II	III			
XPR-A8	Met/Not Met					
XPR-A9	Met/Not Met					
XPR-A10	Met/Not Met					
XPR-A11	I	II/III				
XPR-B1	Met/Not Met					
XPR-B2	Met/Not Met					
XPR-B3	Met/Not Met					
XPR-C1	Met/Not Met					
XPR-C2	Met/Not Met					
XPR-C3	Met/Not Met					

Table B-12				
External Hazards PRA Peer Review Sheets for Part 10: Seismic Margin Assessment Requirements At-Power				
SR	Requirements	Assign- ment of CC	Basis	Associated Facts and Observations
HLR SM: Seismic Margin Assessment				
SM-A1	Met/Not Met			
SM-A2	Met/Not Met			
SM-B1	Met/Not Met			
SM-B2	Met/Not Met			
SM-B3	Met/Not Met			
SM-B4	Met/Not Met			
SM-B5	Met/Not Met			
SM-B6	Met/Not Met			
SM-B7	Met/Not Met			
SM-B8	Met/Not Met			
SM-C1	Met/Not Met			
SM-C2	Met/Not Met			
SM-C3	Met/Not Met			
SM-C4	Met/Not Met			
SM-D1	Met/Not Met			
SM-D2	Met/Not Met			
SM-D3	Met/Not Met			
SM-D4	Met/Not Met			
SM-D5	Met/Not Met			
SM-D6	Met/Not Met			
SM-E1	Met/Not Met			
SM-E2	Met/Not Met			
SM-F1	Met/Not Met			
SM-F2	Met/Not Met			
SM-G1	Met/Not Met			

Table B-12				
External Hazards PRA Peer Review Sheets for Part 10: Seismic Margin Assessment Requirements At-Power				
SR	Requirements	Assign- ment of CC	Basis	Associated Facts and Observations
SM-H1	Met/Not Met			
SM-H2	Met/Not Met			
SM-H3	Met/Not Met			

APPENDIX C MAINTENANCE AND UPDATE PROCESS REVIEW CHECKLIST

Note: The Checklist Criteria presented in this appendix were extracted from the ASME PRA Standard.

DESIGNATOR	CRITERIA	COMPLIANCE
HLR-MU-A: The PRA configuration control process shall include monitoring of PRA inputs and collection of new information.		
MU-A1	The PRA configuration control process shall include monitoring of changes in design, operation, and maintenance that could affect the PRA. Such changes shall include operating procedures, design configuration, initiating event frequencies, unavailabilities.	
MU-A2	The PRA configuration control process shall include monitoring of changes in PRA technology and industry experience that could change the results of the PRA.	
HLR-MU-B: The PRA configuration control process shall include maintenance and upgrades to the PRA to be consistent with the as-built, as-operated plant.		
MU-B1	Changes in PRA inputs or new information (as obtained per MU-A1 and MU-A2) shall be assessed and incorporated as appropriate in PRA maintenance activities (i.e., PRA update) or a PRA Upgrade.	
MU-B2	Changes that would impact risk-informed decisions should be prioritized to ensure that the most significant changes are incorporated as soon as practical.	
MU-B3	PRA changes shall be performed consistent with the previously defined Supporting Requirements.	
MU-B4	PRA Upgrades shall receive a peer review (in accordance with the requirements specified in Section 1.6 of the Combined PRA Standard) and the peer review section of each respective part of the standard for those aspects of the PRA that have been upgraded.	
HLR-MU-C: The PRA configuration control process shall include evaluation of the cumulative impact of pending changes on risk applications.		
MU-C1	The PRA configuration control process shall consider the cumulative impact of pending changes in the performance of risk applications.	

HLR-MU-D: The PRA configuration control process shall include evaluation of PRA changes on previously implemented risk-informed decisions that have used the PRA.		
MU-D1	The PRA configuration control process shall include evaluation of the impact of changes on previously implemented risk-informed decisions that have used the PRA AND that affect the safe operation of the plant.	
HLR-MU-E: The PRA configuration control process shall include a process for maintaining control of computer codes used to support PRA quantification.		
MU-E1	The PRA configuration control process shall include a process for maintaining control of computer codes used to support PRA quantification.	
HLR-MU-F: The PRA configuration control process shall be documented.		
MU-F1	The PRA configuration control process shall be documented. Documentation typically includes: (a) Description of the process used to monitor PRA inputs and collect new information (b) Evidence that the aforementioned process is active (c) Descriptions o	

Notes to Table MU

- 1) PRA maintenance encompasses the identification and evaluation of new information, and the incorporation of this information into the PRA on an as-needed basis. PRA maintenance typically refers to minor model modifications and effort. More extensive maintenance may be performed if a specific application requires refinement of certain parts of the model. The on-going maintenance of the PRA can be performed on a resource-available basis when not driven by specific application needs. PRA maintenance should serve to keep the PRA reasonably current between PRA updates.

A PRA update is a comprehensive revision to the PRA models and associated documentation. PRA updates are scheduled to be performed periodically. In addition, they may also be performed on an as needed basis as determined by the PRA Group leader. It is recommended that the update frequency should be no greater than once per year and no less than once per every three years (or every other fuel cycle).

The need for an update prior to a specific application is dependent upon the needs of the specific application (e.g., greater detail in specified areas) and the effect of new information on the assessment of the fidelity of the model to the current plant and procedures.

- 2) The purpose of the monitoring and data collection process is to identify information that could impact the PRA models. Monitoring implies a vigilant attitude towards industry and plant experiences, information, and data with the purpose of identifying inputs pertinent to the PRA. Collection refers to the process of logging the information and collecting explanatory information to evaluate its importance to the PRA.
- 3) An evaluation of the results of the PRA update need to be performed to ensure that the plant design and procedural changes have been accurately reflected and that biases have not been introduced into the accident sequence quantification.
- 4) The update of the PRA may result in a dramatically changed risk profile. Changes to the risk profile can in turn affect the results of past PRA applications. Possible examples are the safety significance determination in the Maintenance Rule, the in-service test interval for IST evaluations, or the on-line safety matrix to support on-line maintenance safety evaluations. PRA Application re-evaluations can be performed in a rigid fashion that involves a complete re-analysis. However, in general, a qualitative review of the applications would appear to be sufficient for many applications. A complete reanalysis may be needed only on a selected basis.

APPENDIX D
SUMMARY OF PART 2 REQUIREMENTS REFERENCED IN PARTS 5
THROUGH 10 OF THE ASME/ANS PRA STANDARD

The following SRs of Parts 5 through 10 of the ASME/ANS PRA Standard require that in each of the following aspects of an external event PRA systems-analysis work, the corresponding requirements should be satisfied in Part 2, except where they are not applicable or where the specific section includes additional requirements:

Table D-1: Part 2 Requirements Referenced in Parts 5 through 10		
High Level Requirement	Supporting Requirement	Referenced Elements from the Internal Events PRA System Model
HLR-SPR, Part 5	SPR-B1	<ul style="list-style-type: none"> a) Initiating event analysis (IE) b) Accident sequence analysis (AS) c) Success criteria analysis (SC) d) Systems analysis (SY) e) Data analysis (DA) f) Human reliability analysis (HR) g) Use of expert judgment
HLR-WPR, Part 7	WPR-A4	<ul style="list-style-type: none"> a) Initiating event analysis (IE) b) Accident sequence analysis (AS) c) Success criteria analysis (SC) d) Systems analysis (SY) e) Data analysis (DA) f) Human reliability analysis (HR) g) Use of expert judgment
HLR-XFPR, Part 8	XFPR-A4	<ul style="list-style-type: none"> a) Initiating event analysis (IE) b) Accident sequence analysis (AS) c) Success criteria analysis (SC) d) Systems analysis (SY) e) Data analysis (DA) f) Human reliability analysis (HR) g) Use of expert judgment
HLR-XPR, Part 9	XPR-A4	<ul style="list-style-type: none"> a) Initiating event analysis (IE) b) Accident sequence analysis (AS) c) Success criteria analysis (SC) d) Systems analysis (SY) e) Data analysis (DA) f) Human reliability analysis (HR) g) Use of expert judgment

APPENDIX E
EXAMPLE PRA PEER REVIEW LESSONS LEARNED FORM

PRA Peer Review Team LESSONS LEARNED INPUT FORM
Process Lessons Learned:
PRA Lessons Learned:
Review Team Member (optional): _____

**APPENDIX F
SAMPLE FACT AND OBSERVATION FORM**

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS	
OBSERVATION (ID: _____) ¹⁵ / Technical Element _____ / Supporting Requirement _____	
LEVEL OF SIGNIFICANCE:	
BASIS FOR SIGNIFICANCE	
POSSIBLE RESOLUTION	

LEVELS OF SIGNIFICANCE FOR FACTS AND OBSERVATIONS

Finding	An observation (an issue or discrepancy) that is necessary to address to ensure the technical adequacy of the PRA, the capability of the PRA, or the robustness of the PRA update process.
Suggestion	An observation considered desirable to maintain maximum flexibility in PRA applications and consistency with Industry practices, or simply to enhance the PRA's technical capability as time and resources permit, at the discretion of the host utility. Also includes editorial or minor technical item left to the discretion of the host utility.
BP	Represents "best industry practice," to the extent that other PRA owners would want to emulate.

¹⁵ A suggested format for F&O ID number is *TE-SR-##*, where *TE* is the 2 letter code for the PRA Technical Element (e.g., SHA for Seismic Hazard Analysis), *SR* is the identifier for the specific supporting requirement (e.g., A3), and *##* is a sequential number for F&Os for the given SR. For example, *SHA-A3-02* would be the second F&O referring to supporting requirement SHA-A3.

APPENDIX H

EXTERNAL HAZARDS SCREENING AND CONSERVATIVE ANALYSIS

This appendix provides details and information for performing a peer review of the External Hazards Screening and Conservative Analysis (Part 6 of ASME/ANS RA-Sa-2009).

The Peer Review of Part 6 (“Hazard Screening Peer Review”) should nominally require 1 to 3 person-days effort, depending on the amount of quantitative analysis and screening that was performed. Since it is likely that at least one non-seismic external hazard will not screen, the Peer Review for Hazard Screening can be performed in conjunction with the peer review for one of the non-seismic external hazards. In the event that all hazards screen, then the Hazard Screening Peer Review would be the performed by itself.

At least two persons are recommended for performing the Hazard Screening Peer Review. In general, most tasks should be able to be adequately reviewed by PRA analysts that have performed or managed external hazards screening analyses or external hazards PRAs. PRA analysts with 10 or more years of PRA experience, but without direct external hazards experience, should also be capable of supporting this peer review. It is recommended that the technical lead for this Peer Review have at least 10 years PRA experience, and have performed or managed external hazards screening analyses or PRAs.

In some cases, a peer reviewer with experience in hazard assessment or fragilities may be required to support the review of analyses used in quantitative screening. Although this is not expected to be the case for most Hazard Screening Peer Reviews, the Peer Review Team Leader should consult with the utility prior to the peer review, in order to determine the level of expertise needed to perform the quantitative screening reviews.

A confirmatory walkdown, similar to the one required in HLR-EXT-D, should be performed by at least one member of the Peer Review Team.

The Peer Review should focus on the five major tasks in the identification and screening of external hazards:

1. external hazards identification
2. identification of screening criteria
3. qualitative screening of external hazards
4. bounding or conservative analyses and quantitative screening of external hazards
5. confirmatory walkdowns.