NEI 00-02
Probabilistic Risk Assessment (PRA)
Peer Review Process Guidance

Revision 1

May 2006

NOTICE

Executive Summary

This document provides guidance material for use in conducting and documenting a Probabilistic Risk Assessment (PRA) Peer Review.

The Peer Review Process and guidance material was adapted from the review process originally developed and used by the Boiling Water Reactor Owners Group (BWROG), which was provided to the industry by BWROG through the Nuclear Energy Institute (NEI) Risk Based Applications Task Force (RBATF). Adaptation of this material was initially done as a joint technical program between the Westinghouse Owners Group (WOG) and the B&W Owners Group (B&WOG), and technical information exchanges have taken place, both directly and through the NEI RBATF, with input from the Combustion Engineering Owners Group (CEOG) and the BWROG.

One desired outcome of having a peer review process is to streamline regulatory review of risk-informed applications. Thus, an attempt has been made, in this program, to maintain consistency with the original BWROG process to the extent feasible, so that the result is a single industry process for PRA peer review, rather than a set of different approaches.

In addition, the individual Owners Groups have also developed various PRA self-assessment processes, intended to be used as optional adjunct parts of the PRA Peer Review, whereby utilities can evaluate the technical adequacy of their plant PRAs on their own prior to the peer review. Self assessment guidance is provided in separate Owners Group documents.

Revision 1 was issued in May 2006. This revision incorporates Appendix D, which provides a self assessment process to compare previous peer review results to the requirements of the ASME PRA Standard, RA-Sb-2005, as endorsed by NRC Regulatory Guide 1.200. The only changes made to the main document and existing Appendices by Revision 1 are to the Table of Contents, this Executive Summary, and the page headings are revised to reflect the revision number and date.

Acknowledgments

This report is a summary of work made possible by the cooperative efforts of a diverse group of participants. In particular, the BWR Owners' Group (BWROG) defined the BWROG PSA Peer Review Certification Process and the original guidance material upon which this program is based, and made this information available to the other Owners Groups, through the auspices of the NEI Risk-Based Applications Task Force. The contributions of Mr. Greg Krueger of PECO Energy and Mr. Richard Hill of GE Nuclear Energy are acknowledged for encouraging and assisting in the adaptation to an industry process of the BWROG process, which was originally developed under contract to GE Nuclear Energy by Ed Burns of Erin Engineering and Research, Inc.

An initial version of the process adapted to be applicable to PWRs was prepared by Barry Sloane and Richard Haessler of Westinghouse, and Stanley Levinson of Framatome Technologies, Inc. Additional review and input was provided by David Finnicum and Raymond Schneider of ABB/CE, and by numerous utility personnel involved in the applications of this process.

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Section 1
INTRODUCTION

1.1 OVERVIEW AND PURPOSE

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

- provide a consistent and uniform method for establishing the technical quality and adequacy of a PRA for a spectrum of potential risk-informed plant licensing applications for which the PRA may be used;
- provide a forum for the exchange of ideas and techniques for effective use of PRAs among participating utilities; and
- provide a means for identifying, over time, areas of consistency or inconsistency in the treatment of issues important to understanding plant risk and implementing risk-informed applications.

The PRA Peer Review process employs a team of PRA and system analysts, each with significant expertise in PRA development and PRA applications, and guided by a standardized set of review guidelines, to provide both an objective review of the PRA technical elements, and an assessment, based on the peer review team members' PRA experience, of the acceptability of the PRA elements. The team uses a set of checklists as a framework within which to evaluate the scope, comprehensiveness, completeness, and fidelity of the PRA being reviewed.

One of the key aspects of the review is an assessment of the maintenance and update process used to ensure that the PRA continues to reflect the configuration of the plant over time, so that the results and conclusions of PRA applications also continue to reflect the plant. This is a necessary aspect of a quality PRA.

This Peer Review Process was adapted, in a cooperative program, from the review process originally developed and used by the Boiling Water Reactor Owners Group (BWROG).[2] That original process was provided to the rest of the industry by BWROG

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

[2] BWROG-97026, "Transmittal of BWR Owners' Group Document BWROG/PSA-9604, 'PSA Peer Review Certification Implementation Guidelines,'" Boiling Water Reactor Owners Group, January 31, 1997.

through the Nuclear Energy Institute (NEI) Risk Based Applications Task Force (RBATF). Technical information exchanges regarding the PRA Peer Review process have taken place, both directly and through the NEI RBATF, with all of the domestic light water reactor Owners Groups.

One desired outcome of having a peer review process is to streamline regulatory review of risk-informed applications. Thus, an attempt has been made, in this program, to maintain consistency with the original BWROG process to the extent feasible, so that the result is a single industry process for PRA peer review, rather than a set of different approaches. Consistent with this industry objective, substantial portions of the BWROG process and documentation have been incorporated directly into the resulting PRA Peer Review Guidance.

1.1 SCOPE

The PRA Peer Review process is a one-time[3] evaluation process that examines both the current PRA, and the PRA maintenance and update process. Using this process, reviewers assign grades to the various technical elements of the PRA. By including an examination of the maintenance and update process, the Peer Review process addresses the mechanism by which the PRA will continue to adequately reflect the as-operated plant to support risk-informed applications. The process grades denote the relative capability of the technical elements for use in PRA applications.

Among the most important elements to ensure a usable and successful PRA for applications are:

- PRA organization
- Management attention
- Communication between the PRA group and other parts of the organization
- PRA technical adequacy
- Living PRA process including maintenance and updates

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

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

The general scope of this implementation of the PRA Peer Review includes review of eleven main technical elements, which are described in Section 3, using checklist tables (to cover the elements and sub-elements) shown in Appendix B, for an at-power PRA including internal events, internal flooding, and containment performance, with focus on large early release frequency (LERF).

1.2 HISTORICAL PERSPECTIVE

There are many current industry-wide activities that make it important to have the ability to determine a standard level of PRA quality. These activities are being performed by both the NRC and the industry. The NRC has just finished a two-year process to develop Regulatory Guides/Standard Review Plans to support risk-informed applications, and continues to apply risk-informed insights into their performance assessment, inspection, and enforcement processes, as well as proposed risk-informed changes to 10 CFR 50.59. The industry has been pursuing a number risk-informed applications: risk-informed graded QA, risk-informed inservice testing, and a variety of Tech. Spec. changes based on risk-informed insights, etc. These applications and regulatory shifts have placed an increased burden on demonstrating the quality of plant PRAs.

Recognizing the trend towards incorporating risk-informed insights from plant-specific PRAs, the industry, via Nuclear Energy Institute (NEI), proposed a process for plant-specific PRAs that would assess the quality of the PRA for various applications and also assess whether a process is in place to provide a means for the long-term maintenance of that level of quality. This process divides the U.S. nuclear power plants based on the NSSS design, and employs the resources of the individual Owners Groups in a two-part approach: results comparison and peer review/certification. Each of the NSSS Owners Groups have performed some type of PRA comparison project, involving the review and comparison of Level 1 and 2 PRA results for similar plant designs. The purpose of these efforts was to identify key results differences and investigate whether those differences are due to plant-specific features or modeling differences.

The BWROG developed a peer review/certification process that was consistent with the proposed industry approach. The process was developed by the BWROG to provide a consistent methodology that could be applied uniformly for the purpose of:

- Assessing for external organizations that an individual PRA meets a recognized and consistent level of quality that can support its use for risk-informed applications. If one of these external organizations is the NRC, the developed process should reduce the review time and number of requests for additional information for risk-information application submittals.
- Providing a forum for cross-fertilization of ideas among participating utilities.

The BWROG program consisted of three pilot plants, during which the process was honed, refined, and improved. The BWROG generously invited other industry representatives (e.g., INPO, other Owners Groups, NRC, etc.) to attend these pilots (and other subsequent PRA reviews). The other Owners Groups, recognizing the value of the certification process, endorsed the BWROG approach. Using the BWROG effort as the basis, the methodology was adapted to handle PRAs for both BWRs and PWRs. This Peer Review Process Guidance document is the result of that adaptation. Thus, with its origins in the BWROG developed for BWRs, the process has been developed and evolved into this single document that serves all of NSSS Owners Groups.

1.3 PROCESS

The overall process includes two main steps, as illustrated in Figure 1-1. These are:

1. a recommended PRA self-assessment or other preparatory activity, conducted by the host utility prior to the peer review; and
2. the peer review itself.

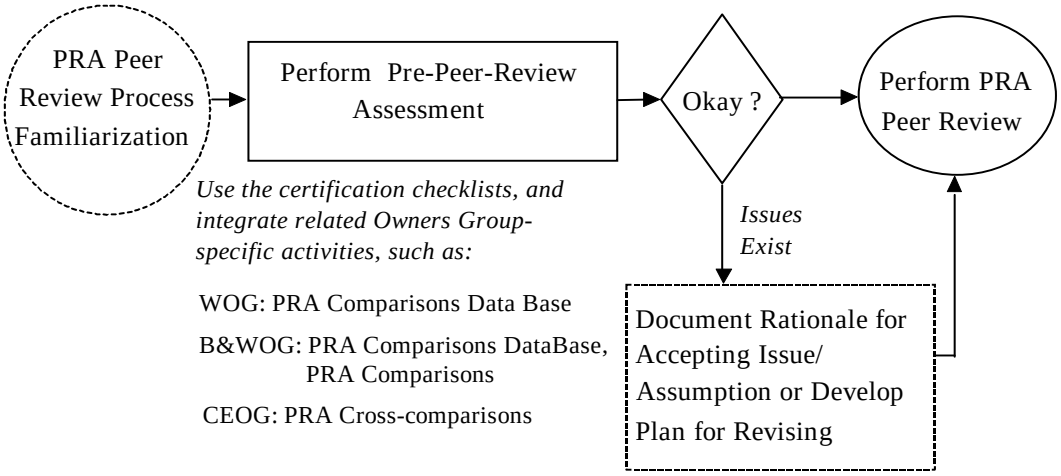


Figure 1-1. Overall PRA Peer Review Process

PRA Peer Review Preparatory Review

The primary objective of the recommended preparatory activity, which may take the form of a self-assessment or some other appropriate review process, is for the host utility to identify areas where the baseline PRA should be improved before being used for particular risk-informed applications. For example, a general flowchart of the particular self-assessment process defined for the WOG[4] is shown in Figure 1-2. 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 PRA has been constructed and maintained.

Additional objectives of the preparatory review or self-assessment are:

- 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 PRA may require
  - additional or alternative documentation,
  - technical upgrades, or
  - process improvements;

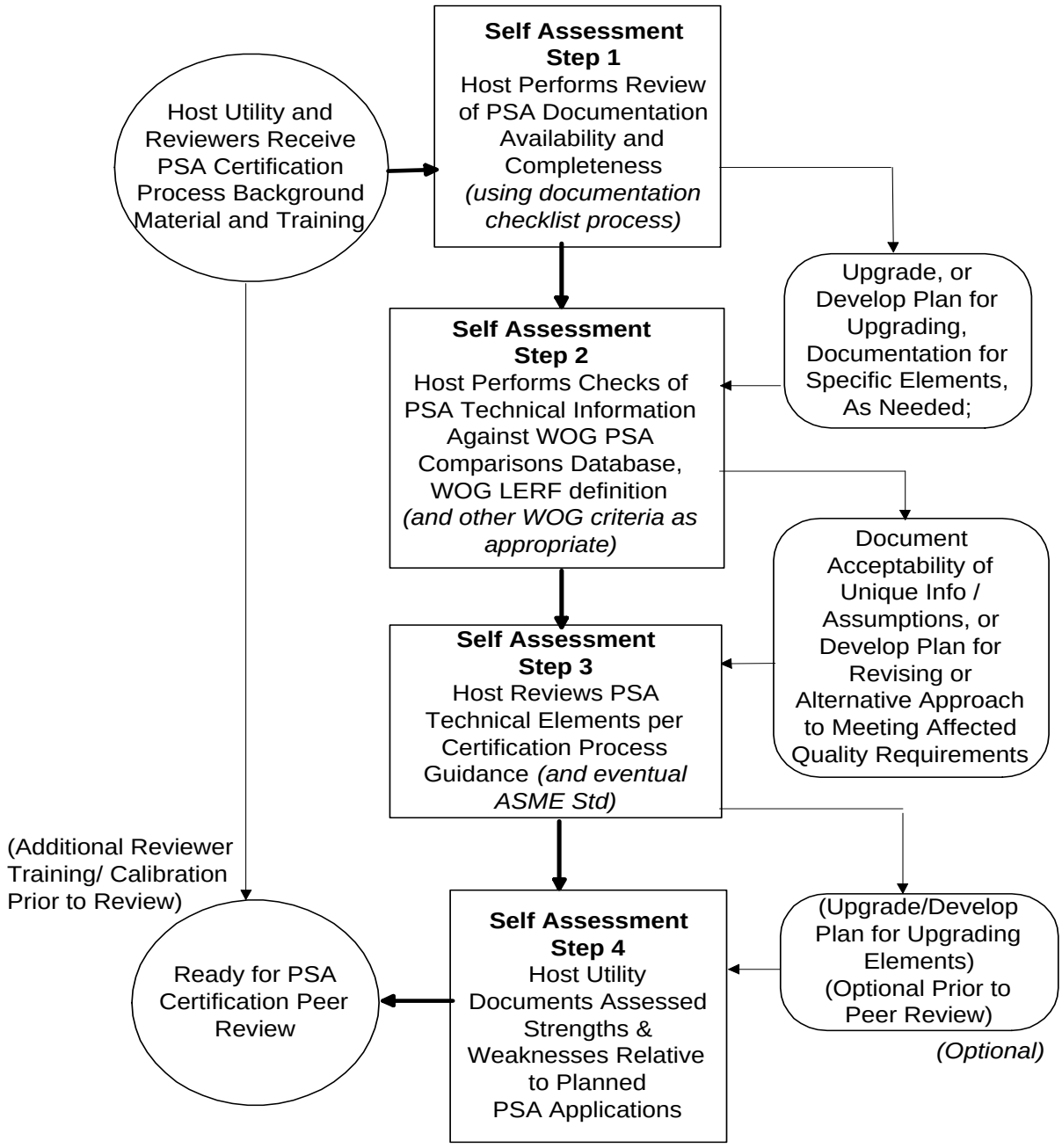
and

- to review documentation, and ensure that as complete a set of documentation as feasible is available for the reviewers, to streamline the peer review week and allow for a more effective review.

It is not necessary to complete each step of a self-assessment in order to derive benefits from it. By performing any portion of a self-assessment, or other similar preparatory activity, the host utility can obtain an indication of areas for potential improvement. Sufficient time should be allocated between the self-assessment/preparatory activity and the peer review to either address such areas, or to formulate plans for how they may be addressed, prior to the peer review.

[4] "Probabilistic Safety Assessment (PSA) Peer Review Certification: PSA Self-Assessment Process," Westinghouse Electric Co., 1998.

Figure 1-2. Overview of a Recommended PRA Peer Review Self-Assessment Process (Example from the Westinghouse Owners Group)



PRA Peer Review Process

A flowchart of the Peer Review Process is shown in Figure 1-3. This figure describes the general approach and process steps used in the application of the peer review process to an individual PRA. The reviewers begin the week prior to their arrival onsite, by reviewing material provided in advance by the host utility.

The onsite PRA Peer Review Process is a one-week tiered review process in which the reviewers begin with relatively high level element checklists 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 so that all of the required elements are adequately covered.

The PRA elements, the quality attributes, the grades of the process and insights from past PRA reviewers have been used to establish specific criteria for each element and sub-element of the PRA. The specific criteria are based on past peer review experiences and engineering judgment .

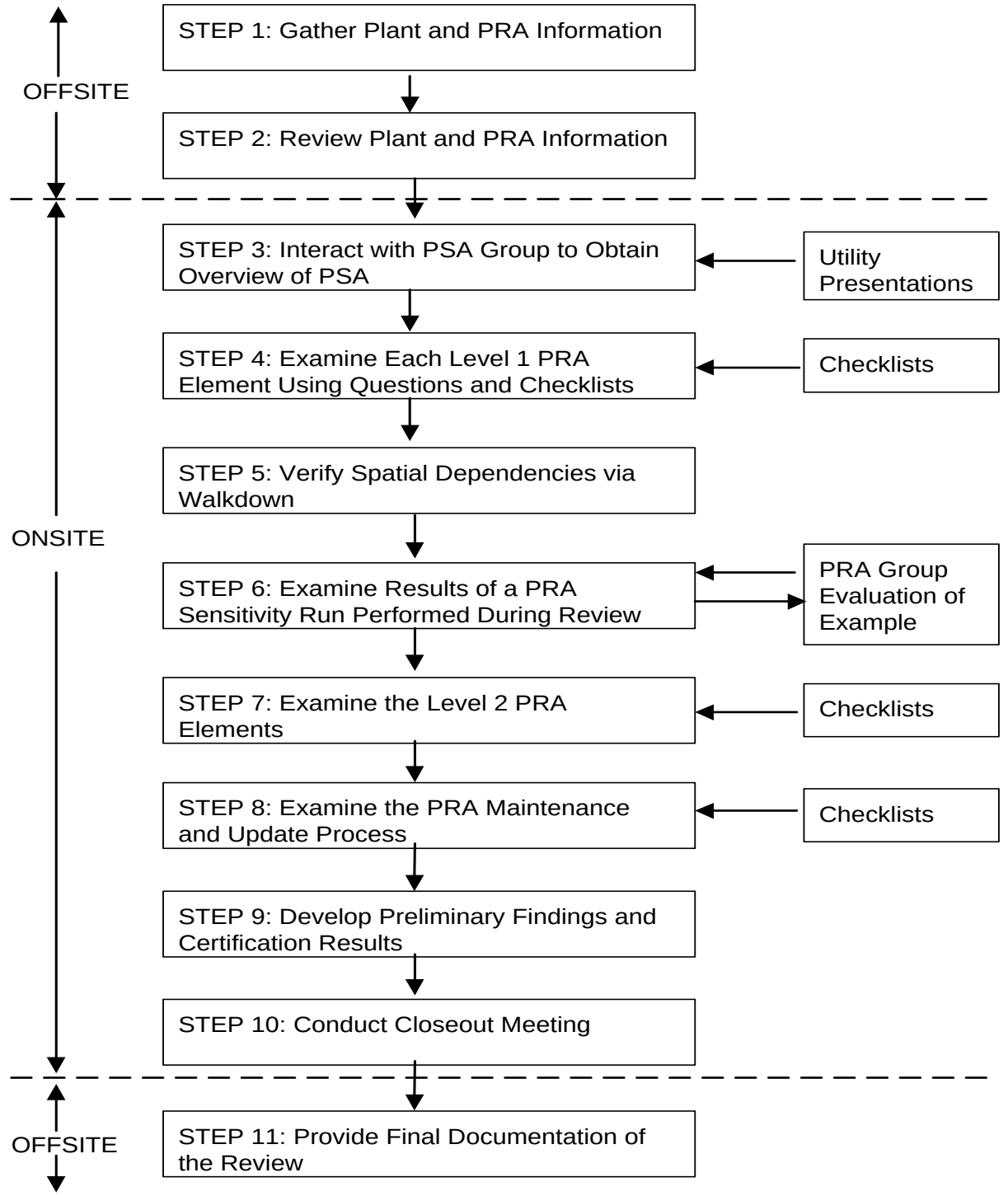
The applicability of specific criteria may vary from plant to plant. This variance results from the differences in the PRA techniques and models being evaluated, including the computer modeling methodology used at the plant. The applicability of specific criteria to the plant PRA being reviewed is determined by the peer review team through their consensus discussions.

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

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

More specific details of the process are provided in Section 2.

Figure 1-3
PRA Peer Review Process Flow Chart



1.4 PRA PEER REVIEW CRITERIA AND GRADES

The Peer Review process uses grades to assess the relative technical merits and capabilities of each technical element and sub-element reviewed. The grades and criteria were developed, in the BWROG program, considering attributes of a PRA necessary to ensure quality, elements of a PRA that are critical to its technical adequacy, and elements needed to support PRA applications. The grades and criteria, which have been adopted for this program, provide guidance on appropriate use of the information covered by the sub-element for risk-informed applications, and convey the ability of the PRA sub-element to support particular types of applications. Four grade levels are used to indicate the relative quality level of each technical element and sub-element based on the criteria at hand. The grading and criteria are further described in Section 3.

It is important to note that the PRA does not receive one overall grade. Each sub-element is graded. Then, based on the sub-element grades, a summary grade is provided for each of the eleven technical elements.

The major benefits of this review process, therefore, *are not the element grades*, but rather the recommendations for improvements and the acknowledgments of the 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 utility reviewer personnel, and an anticipated evolving level of consistency from review to review.

The process requires that the existing PRA meet the process criteria or that enhancements necessary to meet the criteria have been specifically identified by the peer reviewers and committed to by the host utility. Furthermore, documentation methods and PRA maintenance and update processes must be in place to ensure the long term quality of the PRA.

As insights are gleaned from the peer review efforts, they will be fed back into the peer review process.

1.5 ROADMAP TO THE REST OF THIS DOCUMENT AND PROCESS

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 criteria and grades. 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 peer review checklists for the technical elements. Appendix C provides some guidance for the peer review team, along with review documentation forms.

Section 2
PEER REVIEW PROCESS

This section briefly states the objectives of the PRA peer review process and focuses on the key elements of the process. This section also describes the role and function of the peer review team and the requirements governing the team.

2.1 PRA PEER REVIEW PROCESS OBJECTIVES

The purpose of the PRA Peer Review process is to provide a method for establishing the technical quality and adequacy of a PRA for the spectrum of potential risk-informed plant licensing applications for which the PRA may be used. The PRA Peer Review process uses a team composed of PRA and system analysts, each with significant expertise in both PRA development and PRA applications, to provide both an objective review of the PRA technical elements and a subjective assessment, based on their PRA experience, regarding the acceptability of the PRA elements. The team uses a set of checklists as a framework within which to evaluate the scope, comprehensiveness, completeness, and fidelity of the PRA products available.

2.2 PRA PEER REVIEW PROCESS DESCRIPTION

The peer review process is considered a supplement and is complementary to the internal review process of the utility to ensure the technical adequacy of the PRA for applications.

A flowchart of the PRA Peer Review process was shown in Figure 1-3. That figure describes the general approach and process steps used in the application of the peer review process to an individual PRA. The PRA Peer Review Process is a tiered review process that begins with relatively high level element checklists and criteria and progresses successively to additional levels of detail to ensure the robustness of the model.

The PRA elements, the quality attributes, the review process grades and insights from past PRA reviewers have been used to establish specific criteria for each

element and sub-element of the PRA. The specific criteria are based on past peer review experiences and engineering judgment.

The applicability of specific criteria may vary from plant to plant. This variance results from the differences in the PRA techniques and models being evaluated, including the computer modeling methodology used at the plant. The applicability of specific criteria to the plant PRA being reviewed is determined by the peer review team through their consensus discussions.

The major steps in the process are described below, with particular emphasis on information pertinent to the peer review team.

Step 1: Gather Plant and PRA Information

At least one week before the on-site review meeting, the host utility PRA project manager should distribute the pre-review material to the peer review team. Guidance on the types of information required is provided in Appendix A.

Step 2: Review Plant and PRA Information

The Peer Review Team must be prepared to investigate the details of the PRA. This can be accomplished by thoroughly reviewing the PRA documentation sent out for study prior to the review meeting. 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; an example letter is shown in Exhibit A-1.)

Step 3: Interact with the Host Utility PRA Group to Obtain Overview of the PRA

The host utility PRA team is expected to prepare detailed presentations on the key elements of the PRA, as discussed in Appendix A. For the review process to be completely effective, the host utility should be well prepared for presenting information to the Team.

During this step, and also the subsequent steps, it is imperative that the members of the peer review team and the host utility PRA team communicate openly and candidly. *A successful review requires efficient and candid communication among review team members, and between the review team and project team members.*

Step 4: Examine Each Level 1 PRA Element Using Questions and Checklists

Implementing the review begins with higher-level investigations and progresses to examining detailed technical issues. This involves essential a combination of a breadth (wide) and depth (deep) examination of the PRA elements. The checklist criteria (see Appendix B) provide a structure, which in combination with their individual PRA experience provides the basis for examining the various PRA elements. The checklist criteria help to ensure completeness in the review. If a reviewer discovers a question or discrepancy, it is expected that a more through, detailed search will be conducted.

Thus, in reaching their conclusions regarding the relative quality of the various technical elements and the PRA as a whole, reviewers are expected to investigate the PRA a several different level. The reviewers, working in small teams, will present their views to the entire team, at which time a (team) consensus process will be used to determine the final grade for each PRA sub-element. In general, it is essential to focus the review on the specific conclusions of the PRA to assure that the review directly addresses intended plant applications of the PRA.

Information regarding the grade levels and criteria is provided in Section 3. Additional reviewer guidance is provided in Appendix C.

Step 5: Verify Spatial Dependencies by Walkdown

An element of the PRA review that can prove important in certain studies is the ability to perform a walkdown of the areas of the plant that may be subject to spatial dependencies that can create new accident sequences or increase the frequency or change the sequence progression of previously identified sequences. This walkdown can be performed by a subset of the peer review group after the specific issues have been identified during the first several days of the review.

Step 6: Examine Results of a PRA Sensitivity Run Performed During the Review

It is likely that during the review certain issues or questions may arise relative to the PRA results. It may be useful to perform, during the onsite review, one or more sensitivity cases with the PRA computerized model to investigate these sensitivities and to demonstrate the host utility PRA team's approach to applications.

Step 7: Examine the Level 2 PRA Elements

The Level 2 PRA is investigated to ascertain that the calculation of large early release frequency (LERF) represents the plant response to such challenges based on the various Level 1 accident scenarios and includes the applicable phenomena and dependencies possible under severe accident progression.

Step 8: Examine the PRA Maintenance and Update Process

The process for maintaining the PRA in a state of fidelity with the plant, plant procedures and utility staff training is a necessary element for ensuring that the PRA can be effectively used for applications. Additional guidance for this aspect of the review is provided in the notes to Table MU in Appendix B.

Step 9: 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. This preliminary report forms the basis for the close out meeting with the PRA group and with host utility management. (See Step 11 for a discussion on Forms and Grading.)

Consensus working sessions are required for every technical element review team (i.e., the 2 or 3 reviewers that will typically be assigned to review a particular technical element) to ensure that the summary grade checklists are completed prior to the scheduled daily discussions with the full Review Team.

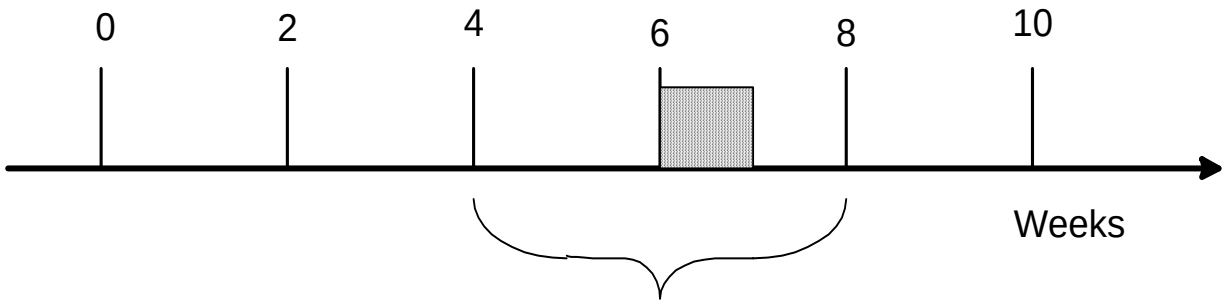
Step 10: Close-out Meeting

This is the presentation of the results of the preliminary findings and Review Team Report to the host utility PRA group and management, held on the last day of the onsite review.

Step 11: Provide Final Documentation of the Review

The final report is compiled by the designated review team member using the information prepared during the onsite review and any additional summary comments provided by the review team, and signed off by each of the members of the PRA Peer Review Team. The report will identify the review team's grading assignments for each technical element, along with appropriate rationale, and indicate where improvements are required in order for elements to be accepted at the next higher levels. Report documentation is discussed in additional detail in Appendix C, sections 6 and 7.

Figure 2-1
PRA PEER REVIEW PROCESS SUGGESTED TIMELINE



Review Month for Host Utility

EVENTS:

Week 0:	Letter Identifying Schedule Sent to Host Utility
Week 2:	Pre-Peer Review Site Visit in Preparation for Peer Review Meeting (Self Assessment Completed Prior to This Time)
Week 4:	Host Utility Transmits PSA Review Information to Peer Review Group Members
Week 6:	Site Review by Peer Review Group
Week 8:	Draft Peer Review Report Issued
Week 10:	Final Peer Review Report Issued

ONSITE REVIEW

2.3 PRA PEER REVIEW TEAM

The single most important aspect of the peer review process is the make-up and selection of the Peer Review Team that carries out the review process. The peer review team is composed of utility and contractor personnel knowledgeable in PRA issues and experienced in the performance and application of PRAs. The peer review teams will include peers, knowledgeable in PRAs for plants similar to the plant being reviewed. The specific composition of the Peer Review Team is determined by the Owners Group program coordinator and the host utility.

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

- Independent of the PRA being reviewed
- Expert in all phases of PRA
- Experienced in performance of PRAs
- Inclusion of other utility representatives from the Owners Group (one useful by-product of the peer review process is the technology transfer to the utility personnel involved as the reviewers)

The BWROG has indicated, in its PRA Peer Review guidance material based on its pilot program and in subsequent information, that an optimum team size is 5 or 6 members. The team may be augmented by specialists in specific technical areas (e.g., containment analysis, HRA) on a limited basis to provide additional expertise.

The following is a brief description of the quality attributes of the peer review team:

- Independence: Members of the team will not be members of the utility responsible for the PRA.
  - The availability of qualified technical reviewers who are familiar with the PRA Peer Review Process is a consideration in the selection of the contractor reviewers. The ethics and integrity of the contractors is considered to be a necessary element in the selection process.
  - An individual contractor cannot review work that he or she has performed for the utility.
  - A statement of the "independence" of the team members will be added to the individual report.

- Expert in All Phases of PRA: A broad experience base *for the team* is required to effectively implement the 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 that must be satisfied for members of the team, such that *the overall team expertise must be sufficient to cover all of the PRA elements*:

  - **Experience Requirements for Review Team Members from Contractor Organizations**

    - Bachelors Degree in Engineering/Science/Mathematics[6] ; AND
    - At least 10 years experience in the nuclear field; AND
    - Special focus experience of at least 5 years in one of the key areas of the process:
      - HRA; OR
      - PRA (Level 1 or Level 2 modeling or quantification); OR
      - Organization/Management in the PRA process area; OR
      - Plant Systems Analysis for PRA Applications

  - **Experience Requirements for Review Team Members from Utilities**

    - Bachelors Degree in Engineering/Science/Mathematics[5]; AND
    - At least 5 years experience in the nuclear field; AND
    - Special focus experience of at least 3 years in one of the key areas of the process:
      - HRA ; OR
      - PRA (Level 1 or Level 2 modeling or quantification); OR
      - Plant Systems Analysis for PRA Applications

- Experience in Performance of PRAs: Each member of the team will have participated in the performance of or managed at least 1 PRA.

[5] Significant experience may be substituted for an engineering degree, consistent with guidelines used by professional engineering societies and licensing bodies. For example, a reviewer with engineering degree coursework and at least 10 years experience in the nuclear field would be considered to have met the requirements for degree/experience.

- Members of Utilities: The Peer Review Team must have adequate outside utility participation. The team may be augmented by contractors to provide specific areas of expertise and to provide continuity and consistency across reviews.

The process requires the reviewers to follow a very tight schedule and cannot be completed effectively if the team consists mainly of peer reviewers inexperienced in the Peer Review Process (or very similar processes). A training session is held at the outset of each review to ensure that all of the reviewers share a common understanding of the process, checklists, and grading criteria.

2.4 HOST UTILITY PREPARATION AND PARTICIPATION REQUEST

The review process is initiated by an owners group 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 resources anticipated to be needed 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 Process is provided in Appendix A.

2.5 REVIEW WEEK AGENDA

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

Section 3
PRA PEER REVIEW PROCESS ELEMENTS AND GUIDANCE

3.1 OVERVIEW

A PRA for a nuclear power plant is an extensive and detailed engineering and statistical analysis of complex systems and uncertain physical processes. The intent of the review process is to enhance the level of quality of the PRA by verifying its accuracy, realism of analysis, completeness, and documentation. This section provides guidance on peer review criteria and the establishment of levels, or grades, to be used during the peer review.

3.2 PEER REVIEW PROCESS CRITERIA

The peer review criteria assigned to each PRA element and sub-element provide the basis on which the overall peer review process is accomplished and documented. The specification of these criteria is a key step in the process. The criteria are derived from the recognition that use for applications is the primary motivation for the PRA peer review. The review therefore concentrates on attributes that are necessary or desirable to achieve different levels of acceptability or usability. These attributes then lead to the criteria included in Tables IE through MU in Appendix B. These criteria are derived based on the work performed by the BWROG (Reference 1). Table 3-1 lists the PRA elements and their associated checklists which contain the criteria.

The criteria are stated in a manner that still requires substantial interpretation by the peer review team, based on their collective PRA experience and knowledge of PRA good practices and standard methods, to establish the plant specific PRA grade for each of the PRA technical elements.

The review criteria are designed for real-time use. Therefore, the reviewer is expected to look over the questions during the review to ensure that appropriate issues have been raised. Further, the review criteria can be used to help summarize the day's work, especially for the report documentation. The reviewer probably will not actually ask these criteria questions verbatim. In general, the

reviewers tend to react to presented material, either written or verbal, and also to an existing set of expectations for a PRA. Upon identifying something new or potentially wrong, or not finding an expected result or piece of information, the reviewer may actively search out additional information. The review criteria help identify issues missing from the presentation and documentation and help guide the search for additional information. Additional reviewer guidance is provided in Appendix C.

TABLE 3-1

Listing of PRA Technical Elements

Table No.	PRA Element
IE	Initiating Events
AS	Accident Sequence Evaluation
TH	Thermal Hydraulic Analysis
SY	System Analysis
DA	Data Analysis
HR	Human Reliability Analysis
DE	Dependencies
ST	Structural Response
QU	Quantification
L2	Containment Performance
MU	Maintenance and Update Process

The approach to PRA element and sub-element review is to provide both:

a) A broad overview examination of each sub-element to ensure that it is treated from those perspectives that are judged to be essential for applications (sometimes referred to as a "horizontal slice" technique); and

b) A more detailed examination within specific technical elements or selected examples to establish whether all the necessary PRA models, data, interfaces, and documentation support the PRA results (sometimes referred to as a "vertical slice" technique).

3.3 PROCESS GRADING

One of the important outcomes of the peer review process is the assignment of "grades." These grades are used to indicate the relative quality level of each sub-element based on the criteria at hand. The grade is meant to convey the ability of the PRA sub-element to support particular types of applications. This section provides general guidance on the assignment of grades.

The implementation of the PRA peer review process uses checklists that include the criteria to be used to grade each of the elements of the PRA.

The check marks in the tables providing the grades for each sub-element indicate those criteria that are necessary to achieve the grade for that sub-element. The checklists are based on high level criteria for which the peer review group must exercise their expertise in determining the applicability to the PRA.

The checklists have been developed to indicate, with check marks, the criteria appropriate to each grade for each sub-element. The following guidance is provided to qualitatively assess a grade associated with the sub-element, progressing from the lowest grade to highest.

The distinctions in grade level are assigned based on example applications. However, it is important to note that all the PRA applications will likely be a blend of probabilistic and deterministic assessments. Therefore, the grades will also implicitly define the required level of deterministic assessments that are needed in conjunction with the PRA.

There is no overall grade associated with the PRA Peer Review process. The strength of the process is in the derivation and development of the grades by sub-element and the identification of the sub-element grades to the host utility as a means of focusing future PRA update activities or for use in strengthening specific applications with additional deterministic assessments.

Grade 1

This grade corresponds to the attributes needed for identification of plant vulnerabilities, i.e., responding to NRC Generic Letter 88-20. Most PRAs are expected to be capable of meeting these requirements.

There may be substantial conservatisms included in the modeling, analysis, and data for PRA Grade 1. These conservatisms may still allow the identification of outliers, vulnerabilities, and prioritize certain issues, but they limit the ability to use a PRA with Grade 1 grades for its sub-element for most other applications.

A PRA with mostly Grade 1 elements is considered acceptable for:

- Satisfying the GL 88-20 requirement
- Assessing Severe Accident Vulnerabilities
- Resolving selected generic issues (e.g., A-45)
- Prioritizing Licensing Issues

Grade 2

Grade 2 corresponds to the attributes needed for risk ranking of systems, structures, and components. A PRA with elements certified at this grade would provide assurance that, on a relative basis, the PRA methods and models yield meaningful rankings for the assessment of systems, structures, and components, when combined with deterministic insights (i.e., a blended approach). Grade 2 is thus acceptable for Grade 1 applications and for applications that involve the risk ranking. Examples of such applications include the following:

- MOV ranking for GL 89-10
- NRC Inspection Activities
- Maintenance Rule Support

Grade 3

This review grade extends the requirements to ensure that risk significance determinations made by the PRA are adequate to support regulatory applications, when combined with deterministic insights. Therefore, a PRA with

elements certified at Grade 3 can support physical plant changes when it is used in conjunction with other deterministic approaches that ensure that defense-in-depth is preserved.

Grade 3 is acceptable for Grades 1 and 2 applications, and also for assessing safety significance of equipment and operator actions. This assessment can be used in licensing submittals to the NRC to support positions regarding absolute levels of safety significance if supported by deterministic evaluations. Examples may include the following:

- Graded QA
- Inservice Testing (IST)
- Inservice Inspection (ISI)
- Backfit Calculations (See also Grade 4)
- Reduce or eliminate licensing commitments
- On-line maintenance evaluations
- Single TS changes

Grade 4

This review grade requires a comprehensive, intensively reviewed study that has the scope, level of detail, and documentation to ensure the highest quality of results. Routine reliance on the PRA as the basis for certain changes is expected as a result of this grade. It is expected that few PRAs would currently have many elements eligible for this grade.

Grade 4 is acceptable for Grades 1, 2, and 3 applications, and also usable as a primary basis for developing licensing positions that may change hardware, procedures, requirements, or methods (inside or outside the licensing basis). Examples may include the following:

- Reduce or eliminate licensing commitments (sole basis)
- Modify Technical Specifications (sole basis)
- Replace Technical Specifications with an On-Line Risk Monitor
- Backfit calculations
- Reclassification of the quality category of some equipment

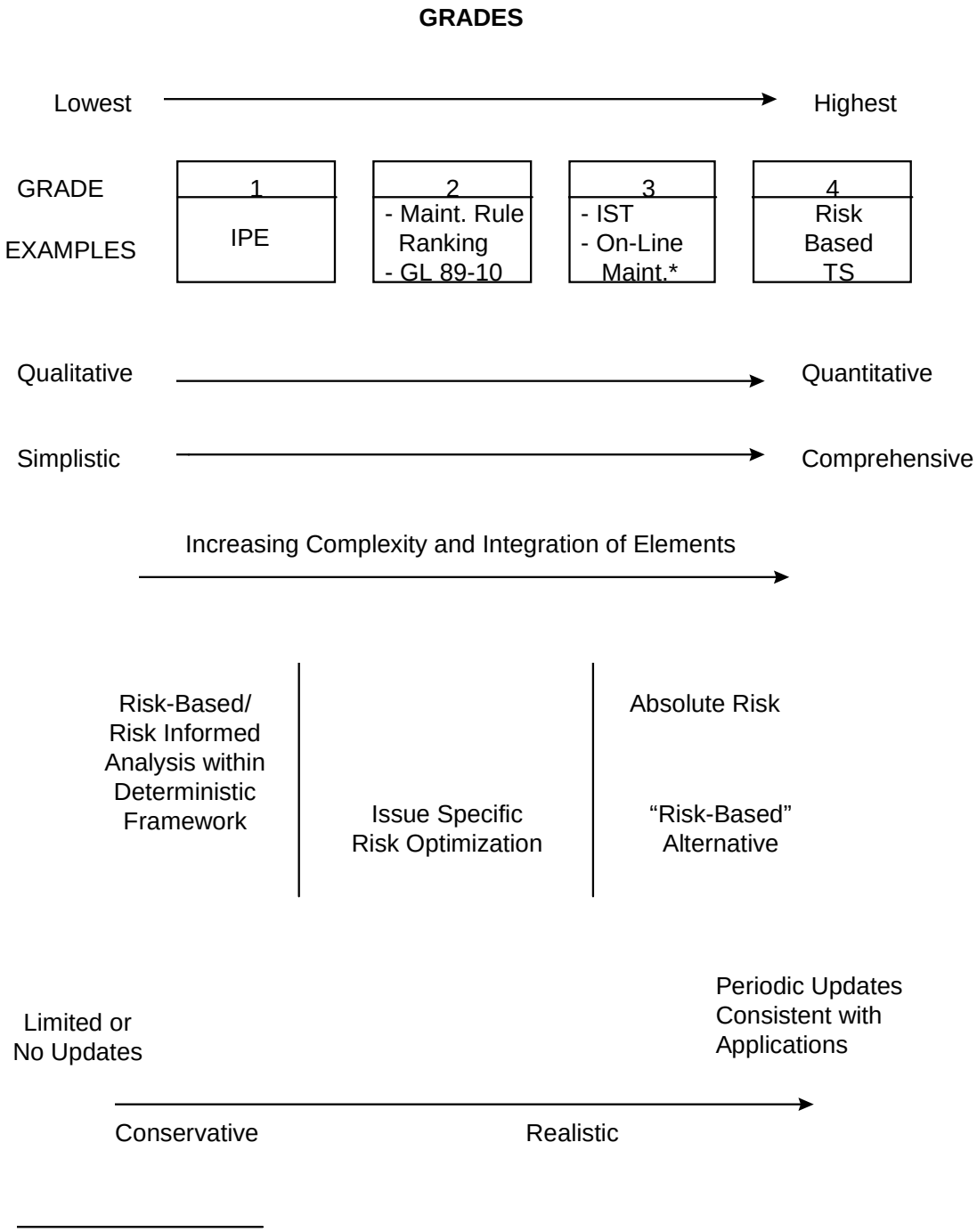
Additional grading information is provided in Figures 3-1 and 3-2. Figure 3-1 shows some of the attributes of the PRA grade levels and how the attributes vary with grade. Figure 3-2 presents a graphical representation of the expected spectrum of applications that can be performed effectively using a PRA with elements certified to each grade level.

Note: A PRA would not require all subelements to receive a grade 3 in order to be used for a grade 3 application. Rather, subelements grades less than 3 would require an assessment to determine the impact.

Grade Assignment

The Fact and Observation sheets are keys to supporting the technical information. Therefore, the fact and observation sheets are cross-referenced to the elements and sub-elements on the checklists. The grades developed as part of the criteria review are used to focus the review and to provide directed input to the host utility on the items that can be considered for future PRA updates or for compensatory measures for applications. Additional reviewer guidance is provided in Appendix C.

Table 3-2 summarizes some examples of how grades may be assigned for varying levels of PRA documentation, analysis depth, or data usage. It provides several examples where differentiation among PRA element grade levels can be assigned based upon varying degrees of quality.



* On-Line Maintenance Safety evaluation is specified as part of the Maintenance Rule

Figure 3-1
ATTRIBUTES OF THE PSA GRADES

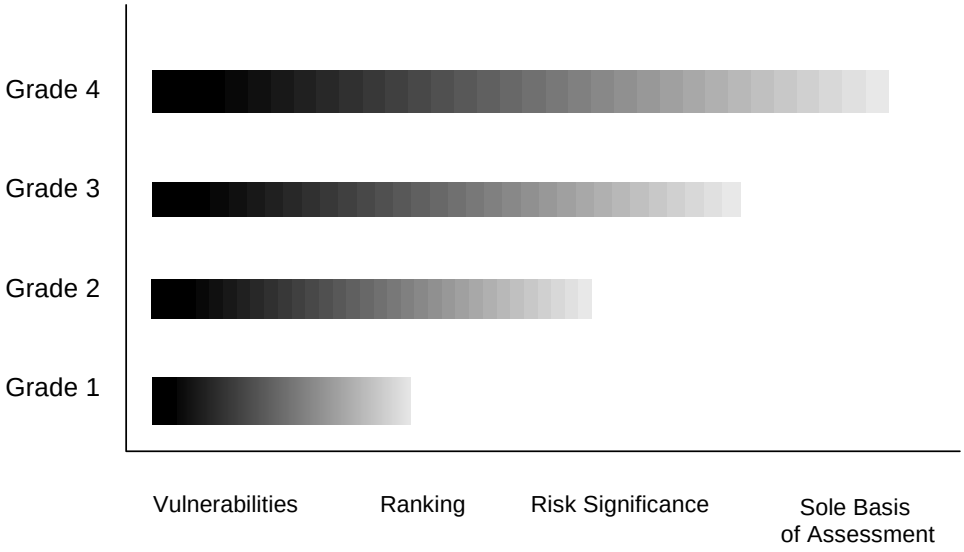


Figure 3-2

Spectrum of Applications Effectively Supported by the PSA

PPC209

Table 3-2

POSSIBLE DIFFERENTIATION AMONG PRA GRADE LEVELS
(Selected Issues)

PRA Element	Attributes	Grades			
		Grade 1	Grade 2	Grade 3	Grade 4
Initiating Events	Completeness IE-4: Groupings typically include but are not limited to: - Transient (including loss of offsite power/ SBO) - LOCA (including RCP seal LOCA) - Support System/ Special - ATWS - ISLOCA - SGTR (for PWRs) - Internal Floods - Steamline break	Subsumed IEs Are acceptable	Non-risk significant subsumed IEs are acceptable	Non-risk significant subsumed IEs are acceptable	Complete list of IEs within state-of-technology (Detailed development)
	IE-17: Systematic process more important for some initiators than for others.			The systematic process is applied to plant systems (e.g. support systems) with potential significant impact on CDF/LERF	The systematic process is applied to consistently across all plant systems

Table 3-2

POSSIBLE DIFFERENTIATION AMONG PRA GRADE LEVELS
(Selected Issues)

PRA Element	Attributes	Grades			
		Grade 1	Grade 2	Grade 3	Grade 4
	Frequencies	Generic or Conservative	Combination of Generic and Realistic in dominant contributors	Realistic and use of Plant Specific Data	Realistic and use of Plant Specific Data
Accident Sequence	Completeness AS-4: Groupings should include but need not be limited to: - Transient (including loss of offsite power/ SBO) - LOCA (including RCP seal LOCA) - Support System/ Special - ATWS - ISLOCA - SGTR (for PWRs) - Internal Floods - Steamline break AS-8: Branching structure level of detail	Acceptable to truncate development/transfer of paths/sequences based on low frequency	…	…	Branching structure and transfers among event trees consistently maintained and resolved

Table 3-2

POSSIBLE DIFFERENTIATION AMONG PRA GRADE LEVELS
(Selected Issues)

PRA Element	Attributes	Grades			
		Grade 1	Grade 2	Grade 3	Grade 4
Thermal Hydraulic Analysis	Success Criteria: Level of plant specificity	Conservative or Generic	Combination of Generic and Realistic	Plant Specific and Realistic	Plant Specific and Realistic
System Analysis	Systems with detailed models	Safety Systems	Safety Systems & Selected BOP	All Key Systems	All Systems that could potentially play a role in applications
Data	Data characterization	Generic or conservative	Combination of Generic and Realistic in dominant contributors	Realistic and use of Plant Specific Data	Realistic and use of Plant Specific Data
	Review of operating experience	No operating experience review	Dominant Contributors reviewed vs. operating experience	Operating Experience Review of LERs and system performance	Operating Experience Review of LERs and system performance
Dependencies	Common Cause Failure (CCF)	Generic CCF values	Use of NUREG/CR-4780 to develop CCF groups Generic CCF values	Use of NUREG/CR- 4780 to develop CCF groups Use of plant specific operating experience to confirm or modify CCF values and groups	Full NUREG/CR-4780 evaluation of CCF
Human Reliability Analysis	Level of detail	Screening or detailed	Detailed for dominant contributors	Detailed for dominant contributors and actions known to be important in other PRAs	Exceptional level of detail

Table 3-2

POSSIBLE DIFFERENTIATION AMONG PRA GRADE LEVELS
(Selected Issues)

PRA Element	Attributes	Grades			
		Grade 1	Grade 2	Grade 3	Grade 4
	Post-Initiator human interactions reviewed by operating staff	Minimal required	Dominant contributors reviewed by operating staff	HRA reviewed by the operating staff and their input included in the process	HRA reviewed by the operating staff and their input included in the process
	Recovery	May or may not be included selectively	Recovery may be included selectively	Systematic application of recovery actions	Systematic application of recovery actions
Model Quantification	Scope	Limited	Within the scope definition, a detailed treatment of the dominant contributors	Within the scope definition, a detailed treatment of identified issues including both dominant and non-dominant sequences	Includes full scope Level 1 and 2 with both internal and external initiators
	Screening Truncation (CDF) (i.e., elimination from the model, not elimination from the reported cutsets)	Screening < .01 * CDF Base	< 1E-4 * CDF Base	< 1E-4 * CDF Base	< 1E-5 * CDF Base
Containment Performance	Scope	Screening	Level 2: Dominant failure mode contributors (for LERF)	Level 2: Dominant and Less Significant Contributors (for LERF)	Level 2: All postulated failure modes encompassed

Table 3-2

POSSIBLE DIFFERENTIATION AMONG PRA GRADE LEVELS
(Selected Issues)

PRA Element	Attributes	Grades			
		Grade 1	Grade 2	Grade 3	Grade 4
	Phenomena	Screening Approach	Screening Approach (for LERF)	Screening Approach (for LERF)	All postulated phenomena considered and modeled to recognize state of technology
Structural Response	Containment	Conservative	Combination of Generic and Realistic	Plant Specific and Realistic	Plant Specific and Realistic
Maintenance & Update	Process	Not Required	Required	Required	Required
Guidance	Describe the Process	Minimal definition of the process used to develop and create results for the PRA element	Sufficient guidance for a highly knowledgeable analyst to understand and recreate the analysis	Sufficient Guidance for an analyst unfamiliar with the specific model and assumptions to reproduce the model and results	Sufficient Guidance for an analyst unfamiliar with the specific model and assumptions to reproduce the model and results
	Consistent with Industry Practices	Unusual approach to current industry practices which is judged to produce a below standard result	Consistent with industry practice but with some aspects that are not well defined.	Consistent with industry practices	Superior to normal industry practices
	Sufficient Detail provided to Reproduce the evaluation	Minimal number of quantified examples or models to provide a template for reproducing	Essentially all types of models available and quantified in documented form to allow highly knowledgeable analysts to recreate the model	All types of models quantified with assumptions highlighted to ensure quantification can be reproduced by an analyst unfamiliar with the models.	All types of models quantified with assumptions highlighted to ensure quantification can be reproduced by an analyst unfamiliar with the models.

Table 3-2

POSSIBLE DIFFERENTIATION AMONG PRA GRADE LEVELS
(Selected Issues)

PRA Element	Attributes	Grades			
		Grade 1	Grade 2	Grade 3	Grade 4
Documentation	Traceable	The link between models and references to support the models is obscure or non-existent	Limited amount of documentation to support model understanding and assumptions	Adequate documentation to support model understanding and thorough discussion of key assumptions	Superior documentation including all assumptions.
	Reflects the Process	Process description is minimal and provides only a superficial understanding of the PRA	The process is described in limited terms or is inconsistent in some respects.	The process is well described and reflects the model implementation. This may include documentation of software used.	The process is well described and reflects the model implementation, including documentation of software used.
	Independent Review	No documented independent review	Documentation that independent review is included	Identification of the principal independent review comments and their resolution.	Expert and in-depth independent review in the PRA element with resolution of comments included.
General	Level of documentation	Meets NUREG-1335 requirement	Meets Grade 1, plus ranking and update process	Meets Grade 2, plus risk determination process description	Meets Grade 3, plus additional detail
	Latent conservatisms	Present in model	Limited to non-dominant contributors	Limited to non-dominant contributors minimized for saved results	Limited to contributors below truncation
	Absolute risk measures characterization	May be conservative	May retain conservatism in non-risk significant portions	Realistic	Realistic

3.4 ADDITIONAL GUIDANCE ON THE TECHNICAL ELEMENTS REVIEW

The following general information applies to the use and interpretation of the checklists in Appendix B. These are provided as additional input in 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 PRA element. This "independent review" may have been performed as part of the IPE process. The Peer Review Team will review the results of that independent review process.

- The checklists 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 PRA should make an effort to provide a generally accepted reference to support the comment where appropriate.

- Footnotes have been added to the checklists in specific cases to clarify potential ambiguities regarding the criteria. These footnotes should be reviewed along with the checklists.

- For each element, assumptions and uncertainties associated with the element are to be factored into the criteria of that element.

- PRA Maintenance and PRA Updates: 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.

  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. PRA Maintenance should serve to keep the PRA reasonably current between PRA Updates. It is judged that the frequency should be no greater than once per year and no less than once per every three years (or every other fuel cycle).

Section 4

PEER REVIEW PROCESS RESULTS AND DOCUMENTATION

4.1 PEER REVIEW REPORT

The output of the peer review is a written report documenting both the details and the summary findings of the review. A suggested outline of the report is shown in Table C.6-1 in Appendix C. (This can be modified as needed to meet specific review requirements.) The checklists, Facts and Observation, and other forms prepared during the onsite 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 onsite 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 grade level achieved for each PRA element;
- the findings of the review team; and
- any recommendations to achieve the next higher grade level (if applicable).

The peer review report should be made part of the host utility's PRA documentation file for future internal and external reference.

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 in order to help make effective use of the limited time available, and to document the results of the PRA Peer Review. These forms are included and further described in Appendix C.

It is not the intent of this process to assign an overall grade to the PRA. The strength of the process is in the derivation and development of the grades by sub-element, and the identification of the subelement grades to the host utility as a means of focusing future PRA update activities or for use in strengthening specific applications with additional deterministic assessments.

This PRA Peer Review process 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 PRA by the review team is included in the report, using the form shown in Table C.7-6. This overall evaluation indicates the per-element basis for the evaluation, to allow focusing resources on those items that can be modified to achieve the next highest grade level for each element. An additional perspective on the grade assignments is provided in the summary provided using Table C.7-5, which shows a more in-depth breakdown of the grades assigned to the PRA elements. This summary table includes a method for ranking the PRA element overall grade.

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. Table C.7-10 is a process feedback form to be used in the reporting of 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.

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 peer review process.
- An example letter to be sent to the host utility for initiating the 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" week review.
- The agenda for the "on-site" week.

A.1 ESTIMATED HOST UTILITY RESOURCES

The PRA Peer Review process includes a detailed review of the PRA. This detailed review is not only of the PRA results but also of the basis for decisions made in the development of PRA. Of particular interest are assumptions regarding the development of data, initiating events, human error probabilities, plant model (including event trees, quantification, recovery and sequences/cutsets), endstate assignment, success criteria, independent review, Level 2, and uncertainty. Given the depth and breadth of the review, it is important that all documentation of the PRA development process be available and in a review-friendly format. As a result, the Peer Review Team may require access to any and all PRA documentation and supporting plant information, and also access to members of the host utility PRA group. This, in turn, requires a significant 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 PRA Peer Review Committee Chairman 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 Review Team;
- material to be available during the on-site review period; and
- the proposed agenda for the week.

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 significant amount of host utility involvement is critical to ensure that the process can be accomplished successfully. In its guidance, the BWROG suggested that the host utility should plan to spend a minimum of one person-week preparing documentation for the 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 Tier 2 and Tier 3 documents. 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/pre-peer-review process, 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 onsite review (Section A.4)
- information for reviewers prior to the onsite review (Section A.5)
- interpretation of information and models during the review, and responses to reviewer questions (Section A.6)
- preparation of sensitivity studies to demonstrate the robustness of the PRA (Section A.7)
- presentations to explain details of the model that would otherwise require extended study by the reviewers for full understanding (Section A.8)

A.4 INFORMATION AVAILABILITY AND PREPARATION VIA THE SELF-ASSESSMENT

A list of information that should typically be available or readily accessible during the onsite 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. Extraneous information and documents such as draft copies, editorial comments and outdated information or information no longer pertinent is not of primary interest to the Peer Review Team and should not be presented to the Team. Such information could be removed and placed in an archive file. In this way, the PRA peer reviewers can concentrate on the available and pertinent documentation. It is important to note that, although the PRA Peer Review following this process is not a certification of the documentation, inadequate documentation is a factor in PRA quality, and inadequate or inscrutable documentation affects the ability of the reviewers to determine PRA quality and can affect the grades received.

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 PRA Peer Review.

In addition, as part of the recommended preparatory review/self-assessment process, the host utility may be requested to fill out the checklists of the 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 sub-element grade?"* The host utility should prepare a list or a collection of documents which 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 utility in a better position to appropriately respond to preliminary findings of the reviewers.

A.5 INFORMATION FOR REVIEWERS PRIOR TO THE REVIEW

A specific list of information to be sent by the host utility to the review team in preparation for the onsite 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 onsite review. The listed information should be provided to each reviewer at least one week before the review, to allow sufficient preparation time. There are some items that should be provided to each reviewer, while other items may only need to be provided to those specific reviewers who will be responsible for their review. Examples of the more limited distribution documents might include HRA example calculations, data analysis and common cause methodology, containment performance information, and selected sensitivity cases. The distribution requirements should be discussed with the Owners Group review coordinator.

A.6 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 PRA (i.e., the staff member(s) most aware of the details of the development and current implementation of the PRA) during the site-visit review. 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.7 PREPARATION OF SENSITIVITY CALCULATIONS

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

- the "new" cutsets that may appear do not represent significant dependencies that have not been properly accounted for in the model and quantification process;
- the "new" cutsets that may appear can be explained relative to their low frequency in the baseline model, and there is a basis identified for their not being dominant contributors;
- sequences or cut sets are not omitted as a result of combining multiple HEPs in a single cutset or using common cause terms that may be too low;
- a method is provided to exercise the model and provide a new perspective on the results.

Note that the actual CDF numerical results of the sensitivity cases are not the objective of these sensitivities, and are not considered meaningful for the peer review.

The sensitivity studies may be chosen from the following list and should include a printout of the top 200 cutsets or sequences plus importance reports for:

- Sensitivity of results to post-initiator HEPs.
- Sensitivity of results to pre-initiator HEPs.
- Sensitivity of results to the common cause quantification.
- The risk significant system list in support of the maintenance rule (if available)
- Train importance measures, if available, or Component importance measures
- Zero maintenance model CDF and importance
- Zero HEP Model

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

A.8 PRESENTATIONS

Several presentations by the host utility to the peer review team are required during the onsite 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 PRA.

Initial Presentation

The initial presentation is intended to provide the reviewers with an overview of the important plant features that influence the PRA results, and also to help focus the peer review team resources by highlighting specific areas of the PRA for which the host utility desires review emphasis. 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 (including dominant sequences and cutsets) of the PRA;

- a brief summary of any unique design features of the plant;
- a brief summary of the PRA maintenance and update process, including examples of current uses of the 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 PRA;
- a summary of the types of risk-informed applications for which the PRA has been used or is planning to be used;
- the location of the 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; and
- a description of any elements of the PRA that would benefit from other PRA practitioners' insights.

Subsequent Presentations

The host utility is also expected to provide focused presentations on technical topics pertinent to the PRA. These may vary from review to review, but will typically include one-hour discussions of the station blackout model and loss of RCP seal cooling (seal LOCA) model, the interfacing system LOCA modeling, and the containment performance evaluation and large early release frequency model.

A.9 ADMINISTRATIVE DETAILS

Prior to the inception of the review at the plant site, there is a need for extensive planning and scheduling off-site to assure 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 2 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 members of the team during the entire week. It is also useful to have quiet areas where review team members can collect thoughts and prepare or summarize findings. The 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.

A.10 HOST UTILITY PREPARATION SUMMARY

In summary, the host utility desiring a peer review needs to accomplish the following tasks:

- perform a self assessment or other preparatory activities sufficiently in advance of the peer review that there is time to address missing or inaccurate information;
- ensure that all necessary information for the review is available onsite in reviewer-friendly format;
- provide initial information to be reviewed prior to the peer review team visit, including sensitivity studies (at least 1 week in advance of the visit); and
- prepare for and host the peer review team during the 1 week visit:
  - Provide facilities for the use of the review team while onsite
  - Provide an overview presentation and presentations on selected topics, and responses to reviewer questions
  - Provide a proof test run of the model and sensitivity runs as needed
  - Provide access to the management chain to discuss the PRA process
  - Provide selected focused walkdown(s) of the plant to augment the spatial interaction assessments.

Table A-1

Host Utility Involvement and Resource Estimates

Item	Resource Estimate
Support an optional Pre-Review visit by a representative of the Owners Group Peer Review Committee to identify the level of documentation that should be made available to the reviewers, and to help in coordinating the review logistics	0.2 Person Week

Table A-1

Host Utility Involvement and Resource Estimates

Item	Resource Estimate
Supply initial information, to include the following: • PRA Summary document • Example detailed PRA documentation, such as: – example analysis guidance documents – event tree notebooks for • general transients • small LOCA • station blackout – example system notebooks, preferably • one fluid system, and • one electrical system – HRA methodology and example calculations – data analysis and common cause methodologies – accident sequence quantification notebook (or method-ology), with summary of dominant core damage frequency (CDF) and large early release frequency (LERF) contributors – containment performance notebook /LERF methodology – Sensitivity and uncertainty methodology and results • Other material at the discretion of the Host Utility • Requested sensitivity cases, if any have been requested by the Peer Review Team leader prior to the review • NRC Staff Evaluation Report for the IPE	1 Person Week
Conduct PRA Self-Assessment/PRAPreparatory Activities	2 Person Weeks
Host the peer review team during the 1 week visit (Including focused Plant walkdowns)	1 Person Week
Prepare Initial Presentation Information • Initial expectations regarding peer review grades,	0.5 Person Week

Table A-1

Host Utility Involvement and Resource Estimates

Item	Resource Estimate
and basis for the expectations • Summary of Plant and principal design features • Summary of the Maintenance and Update process • Application examples • PRA Group Management Role in Use of PRA	
Assemble all Supporting Documentation	1 Person Week
Provide responses to questions as part of the Review Process	1 Person Week
Provide presentations on selected topics	0.4 Person Week
Provide a proof test run of the model	0.1 Person Week
Provide access to the management chain to discuss the PRA process	0.1 Person Week
Resolution of Comments/Findings	1.5 Person Weeks
Closeout Meeting	~ 1 Person Week
Total Host Utility Resource Requirement for Peer Review Process	~ 10 Person – Weeks(6)

(6) This estimate is associated with a PRA 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 Representative to Host Utility

Peer Review Planning Letter

Manager PRA

Host Utility

SUBJECT: PRA Peer Review

Dear Manager:

Thank you for your participation in the PRA Peer Review program. In addition to the direct benefits of this peer review to your organization's applications of the PRA, his program will provide benefits to the _____ (Fill in) Owners Group and its individual member utilities. The PRA Peer Review process should provide valuable insights for your use in gauging the overall quality of your PRA for future use in risk-informed applications and in planning for 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; and
- Key dates

A significant amount of 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 PRA peer review team for *Plant X* are:

	Reviewer	Affiliation
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____
6.	_____	_____

{For this review, we would also like to include participation by several observers who will not be official reviewers, 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 2 separate meeting rooms (one large enough for meetings with all of the team members plus several members of your staff) and individual work areas (if possible) available for use by the members of the team during the entire week. Also please note that the review team will require extended hours onsite during the review.

The pre-visit information for the review should be sent so that it is received by the reviewers 1 week prior to the on-site review, i.e., by _____. This is important so that the members of the review team have adequate preparation time. Also note that the review team would like to discuss with you the anticipated types of planned risk-informed applications and any expectations for the PRA.

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 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 PRA Peer Review Program

cc: _____ (Review Team Member)
_____ (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 Site Visit includes the following:

- PRA Summary document
- Example detailed PRA documentation, such as:
  - example analysis guidance documents
  - event tree notebooks for
    - general transients
    - small LOCA
    - station blackout
  - example system notebooks, preferably
    - one fluid system, and
    - one electrical system
  - HRA methodology and example calculations
  - data analysis methodology and common cause methodology
  - accident sequence quantification notebook (or methodology), with summary of dominant core damage frequency (CDF) and large early release frequency (LERF) contributors
  - containment performance notebook and LERF methodology
  - Sensitivity and uncertainty methodology and results
- Other material at the discretion of the Host Utility, e.g., results of previous peer reviews
- NRC requests for additional information on the PRA as received in conjunction with risk-informed licensing submittals or maintenance rule audit
- NRC Staff Evaluation Report for the IPE
- Requested sensitivity cases, if any have been requested by the Peer Review Team leader prior to the review

Attachment 1 to Peer Review Planning Letter

Information To Be Available For
Review By The Peer Review Team
(continued)

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
- Operating Procedures
- Abnormal Operating Procedures
- Emergency Operating Procedures
- Surveillance Procedures
- Technical Specifications
- Updated Final Safety Analysis Report
- P&IDs and General Arrangement Drawings
- Electrical Schematics

GENERAL PRA INFORMATION

- PRA
- Guidance Documents
- Staff Evaluation Report for the IPE
- Responses to the IPE Request for Additional Information
- Documentation of Independent Review
- Documentation of Plant Walkdowns (signoff/checkoff sheets or comment forms)

INITIATING EVENTS

- Initiating Event Development Guidance
- Generic Data Used
- Plant Specific Data Used (if applicable)
- Initiating Event Groupings or Classification Basis
- Special Initiating Event Analysis (ISLOCA, System Level Initiating Events)

Attachment 1 to Peer Review Planning Letter

Information To Be Available For
Review By The Peer Review Team
(continued)

DATA ANALYSIS

- Data Analysis Development Guidance
- Generic Data Used
- Plant Specific Data
- Common Cause Failure Development Guidance
- Common Cause Generic Data
- Common Cause Plant Specific Events
- Maintenance Data (plant specific or generic)

SYSTEMS ANALYSIS

- System Notebooks
- Fault Trees
- Basic Event Descriptions and Values
- System Success Criteria Basis
- Room Heatup Calculation
- Battery Calculations (Load Sizing)
- System Descriptions
- P&IDs and Layout Drawings
- Electrical Schematics
- Walkdown Summaries

ACCIDENT SEQUENCE QUANTIFICATION

- Event Trees - Quantified
- Event Tree Notebook or Description Material
- Success Criteria and References
- SBO Report
- Operating Instructions
- Updated Final Safety Analysis Report
- Abnormal Operating Procedures
- Emergency Operating Procedures & Bases
- Surveillance Procedures
- Technical Specifications

Attachment 1 to Peer Review Planning Letter

Information To Be Available For
Review By The Peer Review Team
(continued)

THERMAL HYDRAULIC ANALYSIS

- Thermal Hydraulic Analysis
- Success Criteria

HUMAN RELIABILITY ANALYSIS

- HRA Guidance Documents
- Description of HRA Methodology and Human Actions Evaluated
- Final HRA Values Used

DEPENDENCY ANALYSIS

- Dependency Matrices (Initiating Event, Support to Support, Support to Frontline and Frontline to Frontline)
- Any Spatial Dependencies Modeled
- ISLOCA/Break Outside Containment Reports
- Impacts or Evaluation of Unisolated LOCA Events (if applicable)
- RCP Seal Cooling Dependencies
- Internal Flooding Study

STRUCTURAL RESPONSE

- Containment Ultimate Capacity Evaluation
- Blowout Panels Design Basis (if applicable)
- Other Pertinent Structural Calculations

QUANTIFICATION AND RESULTS INTERPRETATION

- Results Summaries/Executive Summaries
- Maintenance Rule Ranking of SSCs
- Uncertainty Calculations
- Sensitivity Calculations and Reports
- Importance Lists
- Other Ranking or Importance Applications or Reports

Attachment 1 to Peer Review Planning Letter

Information To Be Available For
Review By The Peer Review Team
(continued)

Attachment 1 to Peer Review Planning Letter

Information To Be Available For
Review By The Peer Review Team
(continued)

CONTAINMENT PERFORMANCE ANALYSIS

- Level 2 and Containment Performance Analysis
- Definition of End-states (Large Early Release Frequency (LERF))
- MAAP Evaluations/Calculations

MAINTENANCE AND UPDATE PROCESS

- PRA Update Guideline or Procedure
- Other Procedures or Guidelines which reference PRA
- Other Documentation of Involvement in Plant Processes

Attachment 2 to Peer Review Planning Letter

Reviewer Addresses and Contact Information

NAME:		*Reviewer #1*
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

AGENDA ITEM	REVIEWER	TIME
SUNDAY		
Recommended Pre-Review Meeting of Peer Reviewers to Review the Process/Schedule, and for Calibration	(All)	(Evening)
MONDAY		
Overview Meeting of Team • Initial Observations and Changes in Focus	(All)	8 - 9 a.m.
Overview Presentation by Host Utility • Unique Plant Capabilities • Location of Reference Material (use Information Request as checklist) • Overview of Dominant Sequences/ Cutsets • Model Treatment - Dependencies - Data - Quantification	(All)	9 - 10 a.m.
General Review of Documents	(All)	10 a.m. - 12 p.m.
Demonstration of Model	(All)	10 a.m. - 12 p.m.
LUNCH		

Attachment 3 to Peer Review Planning Letter

Review Schedule And Agenda

AGENDA ITEM	REVIEWER	TIME
MONDAY (continued)		
Accident Sequence Models (AS) • Model Basis • Success Criteria • EOP Interface • Description • Dominant Sequences • Dominant Cutsets (if applicable) • Importance Rankings • Review Utility Sensitivity Cases Performed for the review	(Reviewers 1 & 2)	1 - 5 p.m.
Initiating Events (IE)	(Reviewer 3 & 6)	1 - 3 p.m.
Maintenance Unavailabilities, Common Cause Failure, and Plant Specific Data Sources (DA)	(Reviewer 3 & 6)	3 - 5 p.m.
System Analysis (SY) • Documentation • Dependency Matrix • Success Criteria Bases	(Reviewers 4 & 5)	1 - 5 p.m.
Consensus Sessions of All Team Elements	(All)	5 - 6 p.m.

Attachment 3 to Peer Review Planning Letter

Review Schedule And Agenda

AGENDA ITEM	REVIEWER	TIME
Summary of Days Findings • Written Items - Strengths - Assessment of Improvement • Open Questions	(All)	6 - 7 p.m.
Debrief Host Utility	(All)	7-7:30 p.m.

Attachment 3 to Peer Review Planning Letter

Review Schedule And Agenda

AGENDA ITEM	REVIEWER	TIME
TUESDAY		
Data Analysis (DA) • Components • Common Cause Failure Treatment	(Reviewer 6 Reviewer 3)	8 - 11 a.m. 8 - 10 a.m.
Thermal Hydraulic Analysis (TH)	(Reviewer 2 Reviewer 1)	8 - 11 a.m. 8 - 10 a.m.
System Analysis (SY) • RPS / ESF Actuation • Reactivity Control • High Pressure Injection/Recirculation • Low Pressure Injection/Recirculation • Auxiliary/Emergency Feedwater • Depressurization • CS • RHR • Containment Cooling	(Reviewer 4 Reviewer 5)	8 - 11 a.m. 8 - 10 a.m.
Structural Analysis (ST)	(Reviewers 1, 3, 5)	10 - 11 a.m.
Consensus Sessions • Data (DA) • T & H (TH) • Systems (SY) • Structural Analysis (ST)	(All)	11 a.m. – 12 p.m.
LUNCH		

Attachment 3 to Peer Review Planning Letter

Review Schedule And Agenda

AGENDA ITEM	REVIEWER	TIME
TUESDAY (continued)		
Host Utility Presentation on Station Blackout and Loss of RCP Seal Cooling Accident Sequences	(All)	1 - 2 p.m.
System Analysis (SY) • AC Power • DC Power • Room Cooling • HVAC - Control Building • Service Water • Component Cooling Water	(Reviewer 2 & 6)	2 - 5 p.m.
HRA (HR)	(Reviewer 1 & 5)	2 - 5 p.m.
Plant Specific Issues (DE)		
• Dependency Matrix	(Reviewers 3 & 4)	2 - 3 p.m.
• Spatial Dependencies	(Reviewers 3 & 4)	3 - 5 p.m.
• Internal Flood Evaluation	(Reviewers 3 & 4)	3 - 5 p.m
Consensus Sessions • Systems (SY) • HRA (HR) • Dependencies (DE)	(All)	5 - 6 p.m.
Summary of Days Findings • Written Items - Strengths - Areas of Improvement • Open Questions • Identification of Additional Sensitivity Calculations	(All)	6 - 7 p.m.
Debrief Host Utility	(All)	7 - 7:30 p.m.

Attachment 3 to Peer Review Planning Letter

Review Schedule And Agenda

AGENDA ITEM	REVIEWER	TIME
WEDNESDAY		
Host Utility Presentation on ISLOCA Accident Sequence	(All)	8 - 9 a.m.
Data - CCF (DA)	(Reviewer 5 & 6)	9 - 11 a.m.
Quantification Process (QU)	(Reviewers 1, 3)	9 - 11 a.m.
Re-evaluation of Accident Sequence Models (AS)	(Reviewers 2 & 4)	9 - 11 a.m.
Consensus Sessions • Data (DA) • Quantification (QU) • Accident Sequence (AS)	(All)	11 a.m. - noon
LUNCH		

Attachment 3 to Peer Review Planning Letter

Review Schedule And Agenda

AGENDA ITEM	REVIEWER	TIME
WEDNESDAY (continued)	(Reviewer 2 & 4)	1 - 3 p.m.
Focused Walkdown of Plant • Internal Flood Issues • Spatial Issues • Room Cooling		
Accident Sequence End States (AS)	(Reviewer 1 & 5)	1 - 3 p.m.
Data (DA) - Unique Unavailabilities	(Reviewer 3 & 6)	1 - 3 p.m.
Accident Sequence Overview and Quantification (Including HRA, Dependencies) (QU)	(Reviewer 2, 4 & 6)	3 - 5 p.m.
Evaluation of Sensitivity Calculations (QU)	(Reviewer 1, 3 & 5)	3 - 5 p.m.
Evaluation of the Treatment of Uncertainties (QU) • Qualitative • Quantitative	(Reviewer 1, 3 & 5)	3 - 5 p.m.
Consensus Sessions • Accident Sequences (AS) • Data (DA) • Sensitivities and Uncertainties (QU)	(All)	5 - 6 p.m.
Summary of Days Findings	(All)	6 - 7 p.m.
Debrief Host Utility	(All)	7 - 7:30 p.m.

Attachment 3 to Peer Review Planning Letter

Review Schedule And Agenda

AGENDA ITEM	REVIEWER	TIME
THURSDAY		
Level 2 (LERF) (L2)	(Reviewer 1, 3, & 4)	8 a.m. - noon
Maintenance and Update Process	(Reviewers 2, 5 & 6)	8 a.m. - noon
Consensus Sessions • Level 2 (L2) • Maintenance and Update (MU)	(All)	11 a.m. - noon
LUNCH		
Review Host Utility Sensitivity Runs	(All)	1 - 2 p.m.
Write-up the Summary Sheets on PRA Elements/Sub-Elements	(All)	2 - 3 p.m.
Identify Findings	(All)	1 - 3 p.m.
Review Open Questions with PRA Group	(All)	3 - 5 p.m.
Finalize Findings	(All)	5 - 7 p.m.
Debrief Host Utility	(All)	7 - 7:30 p.m.

Attachment 3 to Peer Review Planning Letter

Review Schedule And Agenda

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