PSA Peer Review
Enclosures

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PSA Peer Review
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Enclosure 1

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Probabilistic Risk Assessment (PRA) Peer Review Process Guidance

Rev. A3

Prepared for

Nuclear Energy Institute
Risk-Based Applications Task Force

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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.

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 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.

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[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.

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

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).

[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.

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.

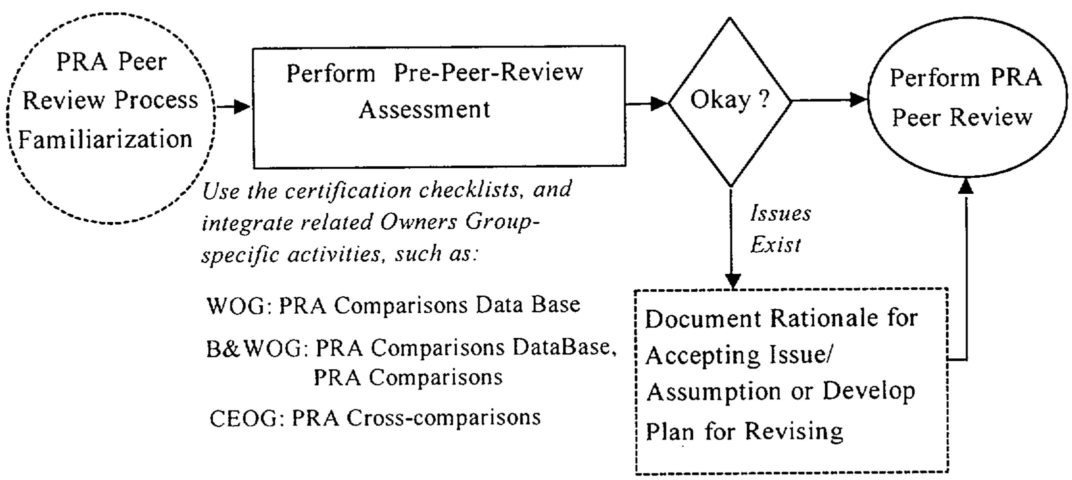


Figure 1-1. Overall PRA Peer Review Process

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;

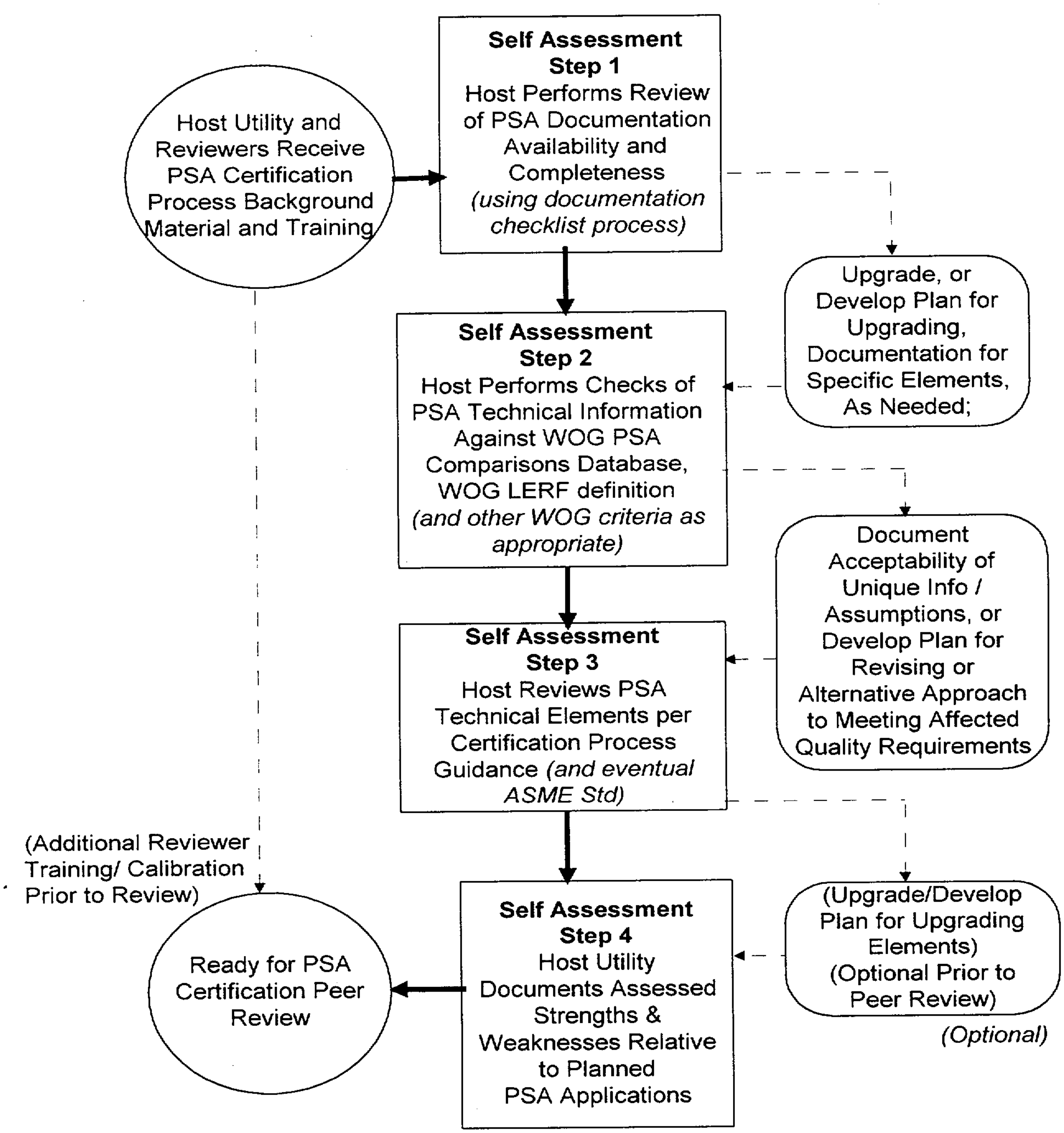
and

- 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.

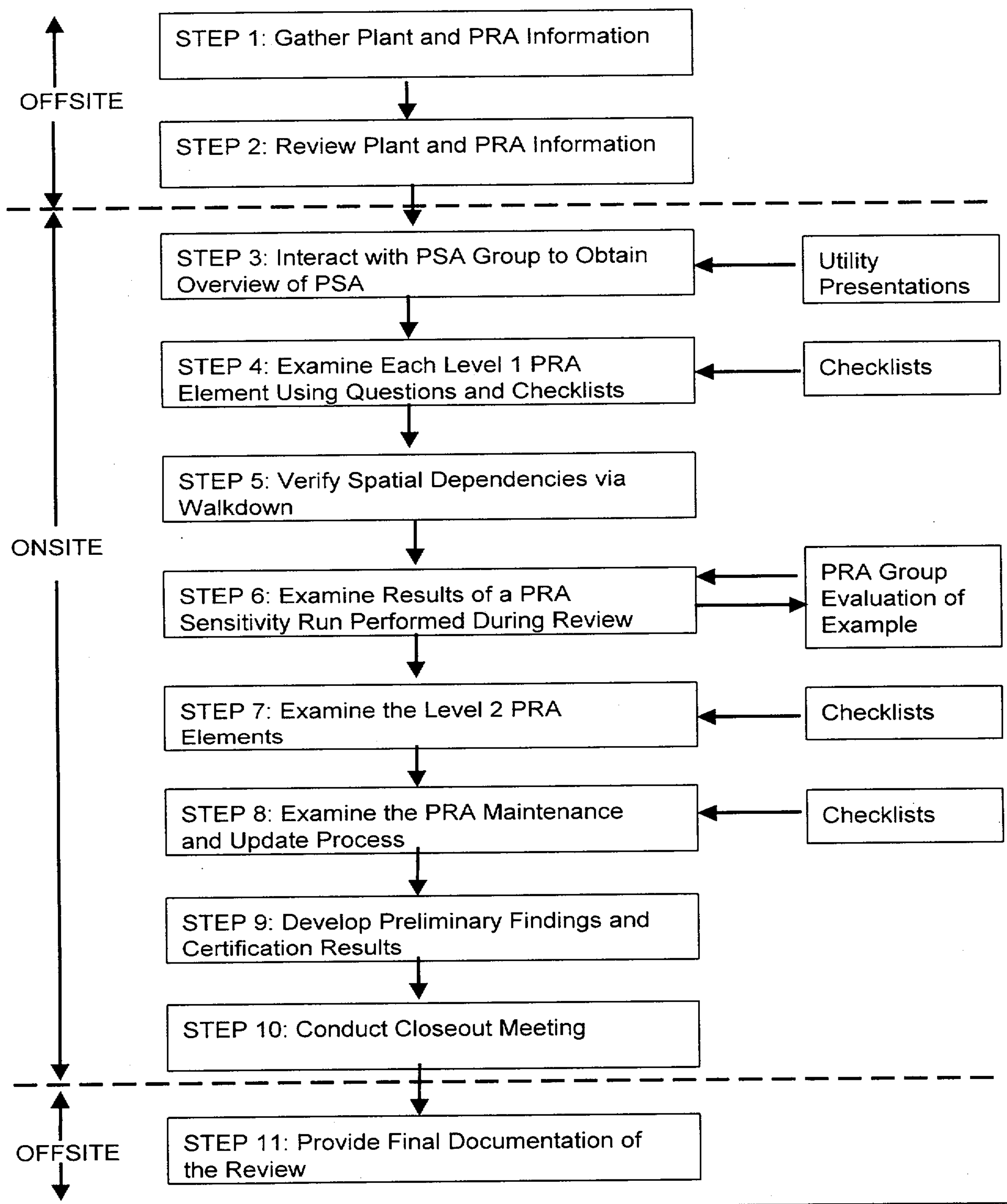
The PRA Peer Review Process is developed as a rational approach to assessing PRA quality and allowing the necessary focused feedback for PRA improvement. The process does not require a 10CFR50 Appendix B program for the review or for the PRA. However, the review process includes the principal elements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

<u>Step 1: Gather Plant and PRA Information</u>

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.

<u>Step 2: Review Plant and PRA Information</u>

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.)

<u>Step 3: Interact with the Host Utility PRA Group to Obtain Overview of the PRA</u>

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.*

<u>Step 4: Examine Each Level 1 PRA Element Using Questions and Checklists</u>

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

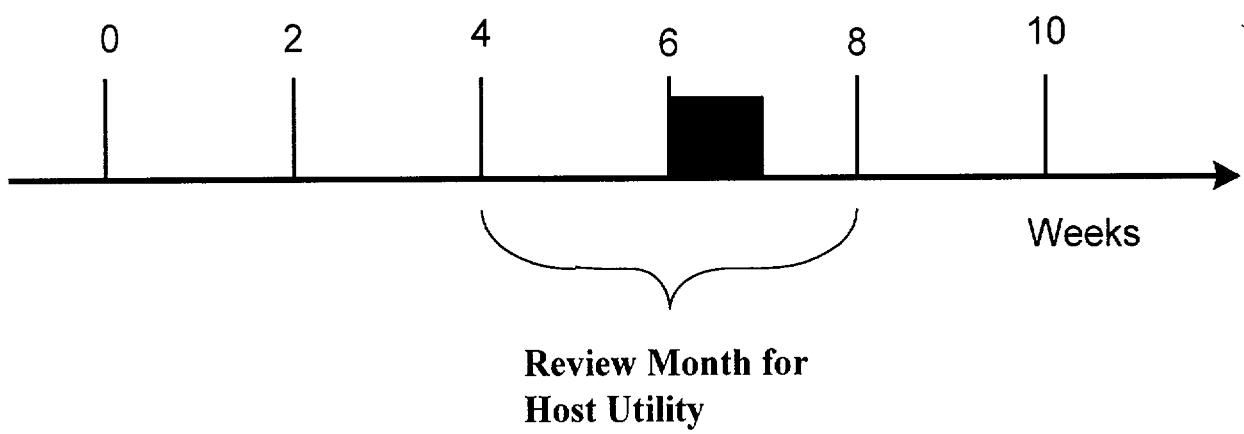
This is the presentation of the results of the preliminary findings and Review Team Report to the host utility PRA group and management, held on the last day of the onsite review.

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



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:

- <u>Independence</u>: 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.

- <u>Expert in All Phases of PRA</u>: 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.

- 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

[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.

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

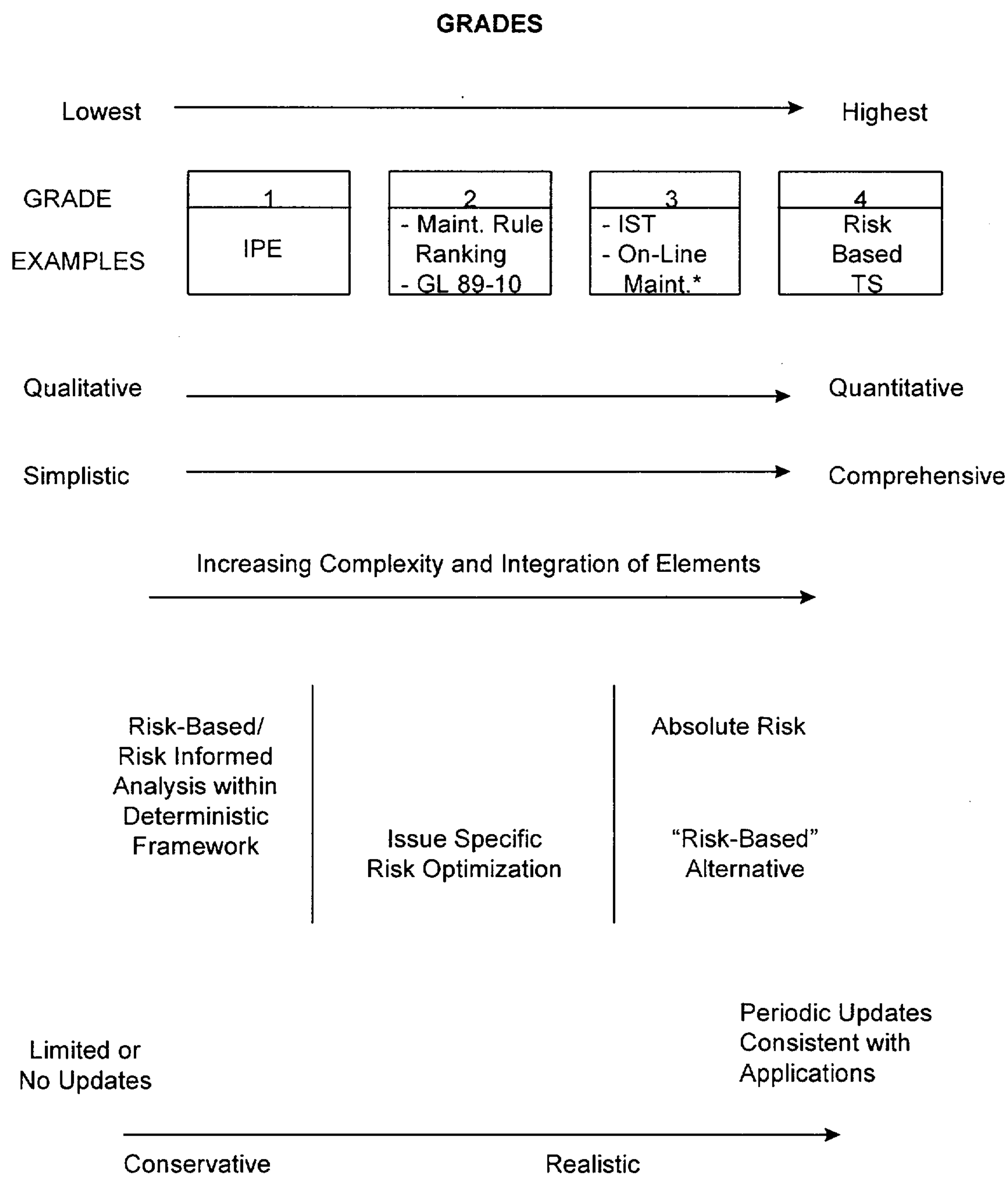
Additional grading information is provided in Figures 3-1 and 3-2. Figure 3-1 shows some of the attributes of the PRA grade levels and how the attributes vary with grade. Figure 3-2 presents a graphical representation of the expected spectrum of applications that can be performed effectively using a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

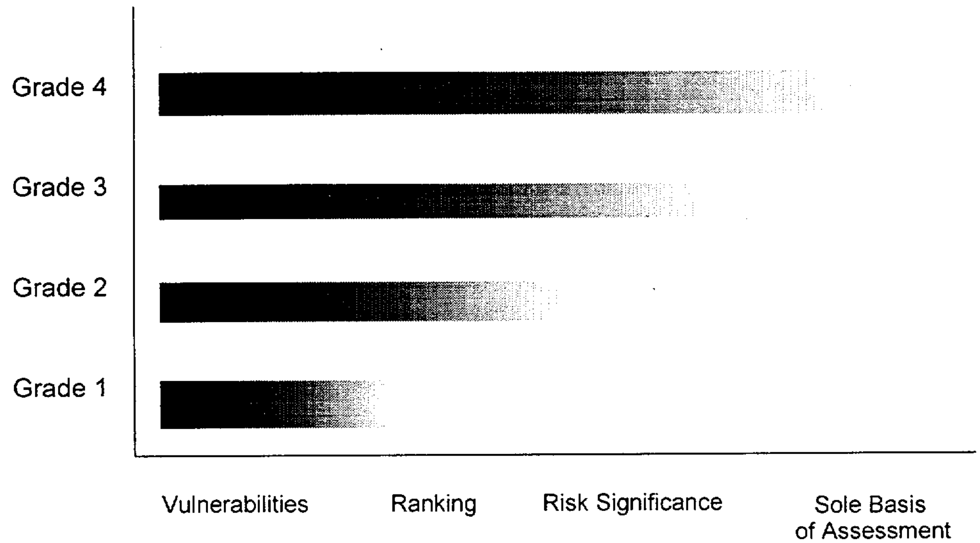


Figure 3-2

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 onehour 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
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 methodology), 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

Table A-1

Host Utility Involvement and Resource Estimates

Item	Resource Estimate
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, 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	0.5 Person Week
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)

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
<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	(All)	8 - 9 a.m.
• Initial Observations and Changes in Focus		
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)	(Reviewer 6	8 - 11 a.m.
	Reviewer 3)	8 - 10 a.m.
• Components • Common Cause Failure Treatment		
Thermal Hydraulic Analysis (TH)	(Reviewer 2	8 - 11 a.m.
	Reviewer 1)	8 - 10 a.m.
System Analysis (SY)	(Reviewer 4	8 - 11 a.m.
	Reviewer 5)	8 - 10 a.m.
• RPS / ESF Actuation • Reactivity Control • High Pressure Injection/Recirculation • Low Pressure Injection/Recirculation • Auxiliary/Emergency Feedwater • Depressurization • CS • RHR • Containment Cooling		
Structural Analysis (ST)	(Reviewers 1, 3, 5)	10 - 11 a.m.
Consensus Sessions	(All)	11 a.m. – 12 p.m.
• Data (DA) • T & H (TH) • Systems (SY) • Structural Analysis (ST)		
LUNCH		

Attachment 3 to Peer Review Planning Letter

Review Schedule And Agenda

AGENDA ITEM	REVIEWER	TIME
<u>TUESDAY (continued)</u>		
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
<u>WEDNESDAY (continued)</u>	(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.

Appendix B

TECHNICAL ELEMENT CHECKLISTS

This appendix provides the checklists to be used in reviewing the technical elements of the PRA. Table B-1 lists the technical elements and the corresponding checklist table identifier.

Table B-1

LISTING OF CHECKLIST FORMS FOR USE IN THE PRA PEER REVIEW

PRA Element	Element Designator	Checklist Table Designator
Initiating Events	IE	Table IE
Accident Sequences Evaluation	AS	Table AS
Thermal Hydraulic Analysis	TH	Table TH
Systems Analysis	SY	Table SY
Data Analysis	DA	Table DA
Human Reliability Analysis	HR	Table HR
Dependency Analysis	DE	Table DE
Structural Response	ST	Table ST
Quantification and Results Interpretation	QU	Table QU
Containment Performance Analysis	L2	Table L2
Maintenance and Update Process	MU	Table MU

Table IE

INITIATING EVENT RELATED GRADES – ELEMENT IE

Designator	CRITERIA	PSA GRADE 1	2	3	4	Plant Review Check	Grade
IE-1	GUIDANCE • Describes the process used		✓	✓	✓		
IE-2	• Consistent with industry practices		✓	✓	✓		
IE-3	• Sufficient detail provided for reproducing the evaluation		✓	✓	✓		
IE-4	IDENTIFICATION AND GROUPING • Grouped initiators by plant response consistent with event tree structure and success criteria.		✓	✓	✓		
IE-5	• The class of initiating events that is caused by failure of part or all of a system that supports the front-line safety function are addressed: - Cooling water systems (e.g., service water, component cooling water, etc.) - AC Power - DC Power - HVAC - Instrument/Station Air		✓	✓	✓		
IE-6	• For multi-unit sites with shared systems, the impact of initiators requiring simultaneous response (e.g., LOOP, loss of cooling source due to ice, loss of an AC or DC bus, etc.) are included	✓	✓	✓	✓		
IE-7	• Initiators considered cover the spectrum of internal event challenges	(1)	✓	✓	✓		
IE-8	• All experienced initiators are accounted for in the model	✓	✓	✓	✓		
IE-9	• If typical initiators cited in NUREG-1150 or industry PSAs have been excluded, the basis is documented	✓	✓	✓	✓		
IE-10	• A structured approach for plant support systems is performed to determine if a loss of support system initiator presents a unique challenge to the plant	✓	✓	✓	✓		
IE-11	Subsumed Initiating Events • Treatment of subsumed initiating events is traceable	✓	✓	✓	✓		

Table IE

INITIATING EVENT RELATED GRADES – ELEMENT IE

Designator	CRITERIA	PSA GRADE 1	PSA GRADE 2	PSA GRADE 3	PSA GRADE 4	Plant Review Check	Plant Review Grade
IE-12	• Subsumed initiating events are included OR • Subsumed initiating events are included, in non-risk significant sequences or non-risk significant initiators OR • Complete list of initiating events within the state of the technology. Detailed plant specific development.	✓ (first item)	✓ (second item)	✓ (second item)	✓ (third item)		
IE-13	DATA • Initiating event frequencies and recovery are consistent with industry experience or analysis	✓	✓	✓	✓		
IE-14	• The features that lead to the frequency of interfacing system LOCA (e.g., surveillance test practices, start up procedures, etc.) are modeled explicitly or identified in the PSA documentation.		✓	✓	✓		
IE-15	• Plant specific features are reflected in the initiating event frequency and recovery inputs where appropriate	✓	(2) ✓	(2) ✓	(2) ✓		
IE-16	• Plant specific experience is reflected in the initiating event definitions and frequency plus recovery inputs where appropriate		✓	✓	✓		
IE-17	•A systematic process is used to identify the need for and application of techniques such as plant specific models or FMEAs, to quantify initiating event frequencies and recovery. (See also SY-21)			✓	✓		
IE-18	DOCUMENTATION • Documentation provides the basis of the quantified values and is traceable	✓	✓	✓	✓		
IE-19	• Documentation reflects the process used	✓	✓	✓	✓		
IE-20	• Documentation provides the basis for the initiating event frequency groupings	✓	✓	✓	✓		
IE-21	• Independent review provided for the documented results	✓	✓	✓	✓		

NOTES TO TABLE IE:

(1) Conservatively treat the spectrum with at least bounding analysis. This could include the use of generalized groups and the "conservative" treatment of the plant response.

(2) LOOP frequency based on NUREG-1032 or equivalent; ISLOCA frequency based on plant specific features and NSAC-154 or equivalent.

Table IE (Report)

PRA PEER REVIEW REPORT
ELEMENT: INITIATING EVENTS (IE)
Guidance:
Grouping:
Treatment of Support System/Special Initiators:
Data:
Documentation:
Recommended Enhancements:
Overall Process Assessment:
Recommended Element Grade: ☐ Grade 1 - Supports Assessment of Plant Vulnerabilities ☐ Grade 2 - Supports Risk Ranking Applications ☐ Grade 3 - Supports Risk Significance Evaluations w/Deterministic Input ☐ Grade 4 - Provides Primary Basis For Application

Table AS

ACCIDENT SEQUENCE EVALUATION RELATED GRADES – ELEMENT AS

Designator	CRITERIA	PSA GRADES 1	2	3	4	Plant Review Check	Grade
AS-1	<u>GUIDANCE</u> • Describes the process used		✓	✓	✓		
AS-2	• Consistent with industry practices		✓	✓	✓		
AS-3	• Sufficient detail provided for reproducing the evaluation		✓	✓	✓		
AS-4	<u>ACCIDENT SCENARIO EVALUATION</u> • The event trees reflect the initiating event groupings	(1)	✓	✓	✓		
AS-5	• The models and analysis are consistent with the as-built plant (as could be confirmed during the Peer Review process)[6]	✓	✓	✓	✓		
AS-6	• The necessary critical safety functions are modeled in each sequence	✓	✓	✓	✓		
AS-7	• All relevant systems are credited for each function			✓	✓		
AS-8	• The branching structure and transfers among event trees maintain and resolve the failure paths	✓	✓	✓	✓		
AS-9	• Success paths are defined correctly	✓	✓	✓	✓		
AS-10	• Dependencies among top events are identified and addressed	✓	✓	✓	✓		
AS-11	• The method of treating dependencies is documented and consistently applied to capture the dependencies among top events.	✓	✓	✓	✓		
AS-12	• PWRs: An appropriate model for the reactor coolant pump seal LOCA, which may result from a loss of seal cooling due to various causes, is used and documented. Appropriate seal cooling dependencies are considered. <u>OR</u> • BWRs: The recirculation pump seal LOCA which may result after a loss of offsite power, or a loss of seal cooling is addressed for the isolation condenser plants		✓ ✓	✓ ✓	✓ ✓		

Table AS

ACCIDENT SEQUENCE EVAULATION RELATED GRADES – ELEMENT AS

Designator	CRITERIA	PSA GRADES 1	2	3	4	Plant Review Check	Grade
AS-13	• Time phased evaluation is included for sequences with significant time dependent failure modes (e.g., batteries for SBO, PWR RCP seal LOCA) and significant recoveries (e.g., AC recovery for SBO)			✓	✓		
AS-14	• Functions and structure are adequate to discriminate among plant conditions necessary for Level 2 analysis	✓	✓	✓	✓		
AS-15	• Transfers among event trees are performed correctly to avoid loss of information in the transfer	✓	✓	✓	✓		
AS-16	• System/component repair and recovery, if included in the accident sequences, are correctly modeled	✓	✓	✓	✓		
AS-17	<u>SUCCESS CRITERIA</u> • Functional success criteria are identified	✓	✓	✓	✓		
AS-18	<u>SUCCESS CRITERIA BASES</u> • Success criteria are consistent with generic and realistic analyses but may be conservative	(2)	✓				
	<u>OR</u> • Success criteria are based on realistic thermal hydraulic analyses			✓	✓		
	<u>OR</u> • Success criteria reflect plant specific thermal hydraulic analysis				✓		
AS-19	<u>INTERFACE WITH EOPs/AOPs</u> • Reflects the EOPs and AOPs. (The functions and structure of the event trees are consistent with the EOPs and abnormal procedures). (See also SY-5)	✓	✓	✓	✓		
AS-20	<u>ACCIDENT SEQUENCE END-STATES (PLANT DAMAGE STATES)</u> [5] • The development of plant damage states, their relationship to functional failures, and their relationship to Level 1 event tree end states or linked fault tree cut sets is documented.	✓	✓	✓	✓		
AS-21	• Plant damage states are sufficient to support the transfer of information to Level 2	✓	✓	✓	✓		

Table AS

ACCIDENT SEQUENCE EVAULATION RELATED GRADES – ELEMENT AS

Designator	CRITERIA	PSA GRADES				Plant Review	
		1	2	3	4	Check	Grade
AS-22	• Plant damage states are based on a clear, consistent definition of CDF that is consistent with industry usage	(2)	(4)	(4)	(4)		
AS-23	• Plant damage states are based on mission time of 24 hours or separately justified	(3)	✓	✓	✓		
AS-24	DOCUMENTATION • Documentation provides the basis of event tree structure and is traceable to plant specific or generic analysis	✓	✓	✓	✓		
AS-25	• Documentation reflects the process used	✓	✓	✓	✓		
AS-26	• Documentation includes an independent review for the documented results	✓	✓	✓	✓		

Notes to Table AS:

(1) Not all event trees are required to be quantified. There may be initiating events and event trees that are screened from consideration.

(2) Vulnerabilities may be identified even with extreme definitions of what constitutes a core damage event, e.g.,

Water Level Below Top of Active Fuel

OR

Large core melt event

(3) Mission times other than 24 hours can be effectively used to identify vulnerabilities.

(4) The PSA Applications Guide has identified definitions of core damage that would meet the intent of a core damage to be used for PRA applications as follows:

- Collapsed liquid level less than 1/3 core height (BWR)
- Collapsed liquid level below top of active fuel (PWR)
- Core peak nodal temperature > 1800°F
- Core exit thermocouple reading > 1200°F (PWR)
- Core maximum fuel temperature approaching 2200°F

These definitions are provided as general guidelines. In some cases, alternative definitions can be justified.

(5) Plant damage states are collections of accident sequence end states according to plant conditions at the onset of severe core damage. The plant conditions considered are those that determine the capability of the containment to cope with a severe core damage accident. The plant damage states represent the interface between the Level 1 and Level 2 analyses. (Also refer to Element L2).

(6) The peer review process does not have as a primary objective to confirm that the model corresponds to the as-built plant. The "as-built" review is one that examines the model applicability as information is presented to the peer review group. The peer review does not provide an independent review of the as-built features of the plant to ensure that they are included except as it may result from the PRA peer review process. This may occur if information becomes available as a result of the review that indicates the model is different than the as-built plant and there is limited or no basis to support the differences; in such a case, substantially lower grades can be assigned. The Maintenance and Update of the PRA is the element that ensures that a process is in place to capture changes in plant configuration practices, or procedures.

Table AS (Report)

PRA PEER REVIEW REPORT
ELEMENT: ACCIDENT SEQUENCE EVALUATION (Event Trees) (AS)
Guidance:
Success Criteria and Bases:
Accident Scenario Evaluation (Event Tree Structure):
Interface with EOPs/AOPs:
Accident Sequence Endstate Definition/Treatment:
Documentation:
Recommended Enhancements:
Overall Process Assessment:
Recommended Element Grade: ☐ Grade 1 - Supports Assessment of Plant Vulnerabilities ☐ Grade 2 - Supports Risk Ranking Applications ☐ Grade 3 - Supports Risk Significance Evaluations w/Deterministic Input ☐ Grade 4 - Provides Primary Basis For Application

Table TH

THERMAL HYDRAULIC ANALYSES GRADES – ELEMENT TH

Designator	CRITERIA	PSA GRADES				Plant Review	
		1	2	3	4	Check	Grade
TH-1	<u>GUIDANCE</u> • Describes the process used		✓	✓	✓		
TH-2	• Consistent with industry practices		✓	✓	✓		
TH-3	• Sufficient detail provided for reproducing the evaluation		✓	✓	✓		
TH-4	<u>T&H ANALYSES</u> • FSAR analyses are used exclusively as basis for Thermal Hydraulic analysis	✓					
	<u>OR</u> • Generic assessments are used as sole basis for Thermal Hydraulic analysis		✓	✓			
	<u>OR</u> • Plant specific best-estimate (e.g., MAAP, RETRAN, etc.) models or equivalent are used for support of Thermal Hydraulic analysis (supported by FSAR or generic analysis)			✓	✓		
TH-5	<u>MULTIPLE T&H INPUTS</u> • A combination of plant specific, generic and FSAR calculations are used to support success criteria and HRA timing.		✓	✓	✓		
TH-6	<u>GENERIC ASSESSMENTS</u> • Application of the generic assessments account for limitations of the generic analysis when applied to the specific plant	✓	✓	✓	✓		
TH-7	<u>BEST ESTIMATE CALCULATIONS (e.g., MAAP, RETRAN, SAFER-GESTER)</u> • Application of the T & H codes account for the limitations of each of the codes	✓	✓	✓	✓		
TH-8	<u>ROOM HEATUP CALCULATIONS</u> • Documented evaluation available to support the modeling decisions,		✓	✓			
	<u>OR</u> • Plant specific realistic calculations or tests are available to support the modeling decisions regarding room heatup.				✓		

Table TH

THERMAL HYDRAULIC ANALYSES GRADES – ELEMENT TH

Designator	CRITERIA	PSA GRADES				Plant Review	
		1	2	3	4	Check	Grade
TH-9	DOCUMENTATION • Documentation provides the basis of the Thermal Hydraulic Analysis, is traceable to plant specific or generic analysis, and demonstrates the reasonableness of the success criteria.	✓	✓	✓	✓		
TH-10	• Documentation reflects the process used	✓	✓	✓	✓		
TH-11	• Documentation includes an independent review for the documented results	✓	✓	✓	✓		

Table TH (Report)

PRA PEER REVIEW REPORT
ELEMENT: THERMAL HYDRAULIC ANALYSIS (TH)
Guidance:
Best Estimate Calculations:
Room Heat Up Calculation:
Documentation:
Recommended Enhancements:
Overall Process Assessment:
Recommended Element Grade: ☐ Grade 1 - Supports Assessment of Plant Vulnerabilities ☐ Grade 2 - Supports Risk Ranking Applications ☐ Grade 3 - Supports Risk Significance Evaluations w/Deterministic Input ☐ Grade 4 - Provides Primary Basis For Application

Table SY

SYSTEM ANALYSIS (FAULT TREES) RELATED GRADES – ELEMENT SY

Designator	CRITERIA	PSA GRADES				Plant Review	
		1	2	3	4	Check	Grade
SY-1	GUIDANCE • Describes the process used		✓	✓	✓		
SY-2	• Consistent with industry practices		✓	✓	✓		
SY-3	• Sufficient detail provided for reproducing the evaluation		✓	✓	✓		
SY-4	SYSTEM MODELS (e.g., Fault Trees) • The system models are available for review		✓	✓	✓		
SY-5	• The models and analyses are consistent with the as-built, as-operated plant including EOPs and AOPs (See also AS-19)	✓	✓	✓	✓		
SY-6	• The structure of the system model provides detail down to at least the major active component level (e.g., pumps and valves)	(1)	✓	✓	✓		
SY-7	• The level of detail of the system models reflects certain passive components that may impact CDF.[6]	(2)	(2)	✓	✓		
SY-8	• The system models contain at a minimum the following (if applicable): - Common cause failure contributors - Test and maintenance unavailabilities - Operator errors that can influence system operability (where appropriate) - False instrument signals that can cause failures of the system[8] - Operator interface dependencies across systems or trains	(2)	✓	✓	✓		
SY-9	• Modules used in the system models are well correlated to their constituent components and capable of providing importance and parametric effects on a component level.		✓	✓	✓		
SY-10	• Spatial or environmental dependencies (e.g., internal floods, room cooling, etc.) are addressed for each system within the system model or in the accident sequence evaluation.[5]		✓	✓	✓		

Table SY

SYSTEM ANALYSIS (FAULT TREES) RELATED GRADES – ELEMENT SY

Designator	CRITERIA	PSA GRADES 1	2	3	4	Plant Review Check	Grade
SY-11	• In some accident sequences, systems are expected to perform in degraded environments (e.g., inside containment after a LOCA). While equipment is generally qualified for such an environment, there should be some evidence that a search has been made for equipment that is not so qualified (e.g., statements that necessary equipment is qualified.) Other examples of degraded environments include: - SRV Operability (small LOCA, drywell spray, severe accident) (for BWRs) - Steamline breaks outside containment - Debris that could plug screens/filters (both internal and external to the plant), and - heating of the water supply (e.g., BWR suppression pool, PWR containment sump) that could affect pump operability		✓	✓	✓		
SY-12	• Support system requirements are accounted for	✓	✓	✓	✓		
SY-13	• The inventories of air, power, and cooling sufficient to support the mission time (or potential deficiencies) are identified and included in the model as appropriate. (Also refer to Elements TH and DE regarding definition of success criteria)	✓	✓	✓	✓		
SY-14	• The system boundary included in the system model is clearly discerned from a simplified schematic of system	✓	✓	✓	✓		
SY-15	• The system model analysis considered generic system failure modes observed in industry(9)		✓	✓	✓		
SY-16	• The system model analysis included plant specific failure modes(7), (9)			✓	✓		
SY-17	• The success criteria for the system are based on: - Generic thermal hydraulic analysis		✓				
	OR - Realistic thermal hydraulic analysis			✓			
	OR - Plant specific thermal hydraulic analysis				✓		

Table SY

SYSTEM ANALYSIS (FAULT TREES) RELATED GRADES – ELEMENT SY

Designator	CRITERIA	PSA GRADES				Plant Review	
		1	2	3	4	Check	Grade
SY-18	• The system model nomenclature is developed in a consistent manner to allow model manipulation and to represent the same designator when a component failure mode is used in multiple systems or trains.		(10)	(10)	(10)		
SY-19	• The systems used in the event trees have detailed system model development to support them unless they are generally treated with point estimate values, e.g.: - SRVs (for BWRs) - RPS - Diesel Generators - Switchyard The following impact on Grades is suggested for the above sample items: - Point Estimates - Conditional Probabilities (Split Fractions) - Linked Fault Trees or Cutsets	(4) ✓	(4) ✓ ✓ ✓	(4) ✓ ✓	(4) ✓ ✓		
SY-20	• The system models are used to quantify the accident sequences by: - Point Estimates Only - Conditional Probabilities (Split Fractions) - Linked Fault Trees or Cut Sets	(4) ✓	(4) ✓ ✓	(4) ✓ ✓	(4) ✓ ✓		
SY-21	• The impact of the system model on initiating events has been examined (see also IE-10, IE-17)	(3)	(3)	✓	✓		
SY-22	• The assumptions for the system model logic model are identified		✓	✓	✓		
SY-23	• The system operation under accident conditions is identified in the system notebook		✓	✓	✓		
SY-24	• System/component repair and recovery actions and modeling, if used, are identified and documented (see also QU-18)	✓	✓	✓	✓		
SY-25	<u>DOCUMENTATION</u> • Reflects the process used	✓	✓	✓	✓		
SY-26	• Includes an independent review for the documented results	✓	✓	✓	✓		
SY-27	• Provides the basis of the system model and is traceable to plant specific or generic analysis		✓	✓	✓		

NOTES FOR TABLE SY:

(1) System models can be performed at a super component level and still identify vulnerabilities.

(2) Not required for successful ranking or dominant contributor determination.

(3) It is noted that to attain the highest Grade assignments it is judged necessary to account for support or front line system failures that can cause initiating events and/or multiple system failures.

(4) PRA that relies heavily on point estimates would generally be rated lower while PRA that uses detailed fault tree modeling would generally be rated higher.

(5) The spatial or environmental dependencies included within each individual system include the following examples:

- Room cooling
- False trip signals caused before or during accident progression
- NPSH dependencies
- Accident progression impacts of temperature, pressure
- Rupture disk failures
- Sufficient water or air capacity
- Real trip signals caused by accident progression
- Internal flooding

(6) Passive failures that do not impact CDF are not required to be modeled in fault trees for a Grade 3.

(7) Observed plant specific failure modes should be represented in the models and rectification included if appropriate. Such failure modes may include: ice frazil; leaf clogging; covering BWR SRV solenoids with insulation; hard seat check valves in air system; explosive valve firing circuits; bio-fouling.

(8) The criterion is to investigate whether false isolation and trip signals are present in the models (e.g., high pressure injection, recirculation cooling) to account for latent failure modes that may exist and persist to defeat safety system success. Spurious actuation evaluation is not examined in this criterion.

(9) The generic or plant-specific failure data used for quantification (see Element DA) and the modeled failure modes must be consistent.

(10) There is no reasonable gradation in this sub-element, because inconsistencies in nomenclature can affect the results.

Table SY (Report)

PRA PEER REVIEW REPORT
ELEMENT: SYSTEMS ANALYSIS (e.g., Fault Trees) (SY)
Guidance:
Systems Modeled:
System Model Structure (Fault Tree):
Success Criteria:
Recommended Enhancements:
Overall Process Assessment:
Recommended Element Grade: ☐ Grade 1 - Supports Assessment of Plant Vulnerabilities ☐ Grade 2 - Supports Risk Ranking Applications ☐ Grade 3 - Supports Risk Significance Evaluations w/Deterministic Input ☐ Grade 4 - Provides Primary Basis For Application

Table DA
DATA ANALYSIS RELATED GRADES – ELEMENT DA

Designator	CRITERIA	PSA GRADES				Plant Review	
		1	2	3	4	Check	Grade
DA-1	GUIDANCE • Describes the process used		✓	✓	✓		
DA-2	• Consistent with industry practices		✓	✓	✓		
DA-3	• Sufficient detail provided for reproducing the evaluation		✓	✓	✓		
DA-4	FAILURE PROBABILITIES • The random independent component failure probability data used in the evaluation are based on generic data sources that may be conservative.	✓	✓	✓			
	OR • The random independent component failure probabilities are realistic compared with past generic data evaluations at least for dominant contributors.		✓	✓	✓		
	OR • The random independent component failure probability data used in the evaluation and where it can be justified is based on accumulated plant specific experience; otherwise, realistic generic data is used.			✓	✓		
DA-5	• For plant specific data development, similar components have been grouped together in a reasonable manner and the grouping is supported by the documentation.			✓	✓		
DA-6	• For basic events derived using standby failure rate data, the plant specific surveillance test intervals have been identified and used in the analysis.			✓	✓		
DA-7	SYSTEM/TRAIN MAINTENANCE UNAVAILABILITIES (1) • The system/train maintenance unavailabilities are derived based on generic data sources.	✓					
	OR • The maintenance unavailabilities reflect plant specific practices and are reasonable or are higher than the projected maintenance goals used by the utility.		✓				
	OR • The system/train maintenance unavailabilities are derived based on plant specific data.			✓	✓		

Table DA
DATA ANALYSIS RELATED GRADES – ELEMENT DA

Designator	CRITERIA	PSA GRADES 1	2	3	4	Plant Review Check	Grade
DA-8	COMMON CAUSE FAILURE PROBABILITIES • The common cause failure probabilities are referenced to acceptable data sources.(2)	✓	✓	✓	✓		
DA-9	• The common cause failure probabilities are realistic based on generic data source comparisons.			✓	✓		
DA-10	• Common cause groups to which the common cause failure probability applies have been derived based on sound judgment and are documented.	✓	✓	✓	✓		
DA-11	• Justification is provided for treatment of common cause failure of on-site AC sources that include consideration of: - Design diversity - Common maintenance crews - Common I&C technicians - Similarity of procedures - Common fuel oil - Common lube oil - Common heating/cooling designs	✓	✓	✓	✓		
DA-12	• NUREG/CR-4780 (EPRI NP-5613 or equivalent) systematic approach used to provide plant specific grouping of similar system components for CCF treatment			✓	✓		
DA-13	• Dominant contributors for sequences include MGL for more than 2 redundant trains				✓		
DA-14	• Full intent of NUREG/CR-4780 (EPRI NP-5613 or equivalent) included: - Plant specific screening of common cause data				✓		

Table DA
DATA ANALYSIS RELATED GRADES – ELEMENT DA

Designator	CRITERIA	PSA GRADES 1	2	3	4	Plant Review Check	Grade
DA-15	UNIQUE UNAVAILABILITIES OR MODELING ITEMS • Documentation of the failure probabilities from plant specific or generic sources that do not fit into the basic event database, e.g.: - AC Power Recovery - EDG Mission Time - Repair and Recovery Model - LOOP Given Transient - BOP Unavailability - Pipe/tank Rupture Failure Probability - ATWS-related RPS Failures - RCP Seal Failure (for PWRs) - % of time Pressurizer PORVs blocked during operation (PWRs) - PORV demand probability given an initiating event - % of time SG PORVs or atmospheric dump valves blocked during operation - ARI (for BWRs) - RPT (for BWRs) - PCS Recovery (for BWRs) - SORV (for BWRs)		✓	✓	✓		
DA-16	• Conservatively biased values	✓					
	OR • The values are judged conservative only for those contributors of non-dominant sequences	✓	✓				
	OR • These failure probabilities are justified to the current state of the technology	✓	✓	✓	✓		
DA-17	DOCUMENTATION • Reflects the process used	✓	✓	✓	✓		
DA-18	• Includes an independent review for the documented results	✓	✓	✓	✓		
DA-19	• Provides the basis of the data treatment and is traceable to plant specific or generic analysis.		✓	✓	✓		

Table DA
DATA ANALYSIS RELATED GRADES – ELEMENT DA

Designator	CRITERIA	PSA GRADES				Plant Review	
		1	2	3	4	Check	Grade
DA-20	• The generic and plant specific data bases are available for inspection and use.		✓	✓	✓		

Notes to Table DA:

(1) The data evaluation grade varies with how the train unavailabilities are set.

- The highest grades or pedigree is assigned to use of plant specific train unavailability data. This may result in unavailabilities which are best estimates and below the Performance Criteria selected for the Maintenance Rule.
- An alternative to use the PC from the Maintenance Rule is given nearly equivalent grades.
- A third alternative which uses very conservative unavailabilities, larger than the Performance Criteria, is considered to represent a conservative assessment that could be classified as a Grade 2.
- A fourth alternative of using generic sources is assumed to have a marginal pedigree and is given the lowest grade.

(2) The quantification of common cause effects has been a continuing area of uncertainty in PSA development and application. The NRC (AEOD in INEL 94/0064) has sponsored research on the collection and analysis of data to support common cause model quantification. It is judged that one "preferable" source of common cause data in the future may be the NRC sponsored data base for common cause failures.

Table DA (Report)

PRA PEER REVIEW REPORT
ELEMENT: DATA ANALYSIS (DA)
Guidance/Documentation:
Plant Specific Component Data:
System/Train Unavailabilities:
Common Cause Failure Quantification:
(Unique Unavailabilities or Data Modeling Issues, e.g., Offsite Power Recovery Quantification):
Recommended Enhancements:
Overall Process Assessment:
Recommended Element Grade: ☐ Grade 1 – Supports Assessment of Plant Vulnerabilities ☐ Grade 2 – Supports Risk Ranking Applications ☐ Grade 3 – Supports Risk Significance Evaluations w/Deterministic Input ☐ Grade 4 – Provides Primary Basis For Application

Table HR

HUMAN RELIABILITY ANALYSIS (HRA) MODELING RELATED GRADES – ELEMENT HR

Designator	CRITERIA	PSA GRADES				Plant Review	
		1	2	3	4	Check	Grade
HR-1	GUIDANCE • Describes the process used		✓	✓	✓		
HR-2	• Consistent with industry practices		✓	✓	✓		
HR-3	• Sufficient detail provided for reproducing the evaluation		✓	✓	✓		
HR-4	PRE-INITIATOR HUMAN ACTIONS • Pre-initiator Human Interactions (HIs) were considered in the PRA	✓	✓	✓	✓		
HR-5	• A systematic process is used to identify the Pre-Initiator Human Errors to be included in the PRA (e.g., miscalibration of instruments)		✓	✓	✓		
HR-6	• Screening HEPs are used in the quantification of the pre-initiator HEPs	✓					
	OR						
	• Best estimate HEPs are used in the quantification of pre-initiator HEPs for dominant contributors		✓	✓			
	OR						
	• Assessment of plant procedures and plant specific operating experience are explicitly included in the identification and quantification process for the HIs.				✓		
HR-7	• Those pre-initiator actions with the possibility of adversely impacting baseline CDF or LERF are included in the quantification.	✓	✓	✓	✓		
HR-8	POST-INITIATOR HUMAN ACTIONS • Post-Initiator HIs were considered in the PRA	✓	✓	✓	✓		
HR-9	• A systematic process is used to identify the Post-Initiator Human Errors to be included in the PRA.		✓	✓	✓		
HR-10	• Assessment of plant procedures plant specific operating experience are explicitly included in the identification and quantification process for the HIs.	✓	✓	✓	✓		
HR-11	• The symptoms available during the postulated accident sequence are evaluated and input into the HRA process.		✓	✓	✓		

Table HR

HUMAN RELIABILITY ANALYSIS (HRA) MODELING RELATED GRADES – ELEMENT HR

Designator	CRITERIA	PSA GRADES				Plant Review	
		1	2	3	4	Check	Grade
HR-12	• HEP values are internally consistent within the PRA.	✓	✓	✓	✓		
HR-13 (1)	• Screening HEPs are used in the quantification of dominant contributors.	✓					
HR-14	• Operator actions have been reviewed by the operating staff and their impact is included in the HRA evaluation;			✓	✓		
	OR						
	• Dominant operator actions have been reviewed by the operating staff and their input has been included in the HRA evaluation.	✓	✓				
HR-15 (1)	• Best estimate HEPs are used in the quantification of dominant contributors.		✓	✓	✓		
HR-16	• Emphasis of the Human Reliability Analysis is to identify that the HI is folded correctly into the model and that the HI:						
	- Reflects the procedures (EOPs & AOPs)	✓	✓	✓	✓		
	- Reflects training	✓	✓	✓	✓		
	- Reflects simulator results (if applicable)				✓		
HR-17	• The performance shaping factors such as time available, time to perform, stress, complexity, etc. are included in the quantification.	✓	✓	✓	✓		
HR-18	• The performance shaping factor for time available for an action and the time required to take an action are developed on a plant specific basis.			✓	✓		
HR-19	• The time available for action is based on:						
	- generic T & H analysis	✓	✓				
	OR						
	- plant specific T & H analysis			✓	✓		
HR-20	• The time required to complete the actions is based on observation or operations staff input.		✓	✓	✓		
HR-21	• The recovery actions are included systematically in the model;			✓	✓		
	OR						
	• The recovery actions are included selectively in the model for dominant cut sets.	✓	✓				

Table HR

HUMAN RELIABILITY ANALYSIS (HRA) MODELING RELATED GRADES – ELEMENT HR

Designator	CRITERIA	PSA GRADES				Plant Review	
		1	2	3	4	Check	Grade
HR-22	• The models and analysis are consistent with the operating procedures and training.	✓	✓	✓	✓		
HR-23	• Operator actions including recovery are not credited unless a procedure is available or operator training has included the action as part of crew's training.	✓	✓	✓	✓		
HR-24	• Inter-unit cross ties are only credited if procedures <u>and</u> training are available.	✓	✓	✓	✓		
HR-25	• Inter-unit cross ties are accurately accounted for under conditions of outage for the other unit and special initiating events.	✓	✓	✓	✓		
HR-26	<u>DEPENDENCE AMONG ACTIONS</u> • The dependence among human actions is evaluated in the PSA process.	✓	✓	✓	✓		
HR-27	• Identification of sequences that, but for low human error rates in recovery actions, would have been dominant contributors to core damage frequency is included as a test of modeling adequacy. Equivalent techniques may also be used.	✓	✓	✓	✓		
HR-28	<u>DOCUMENTATION</u> • Reflects the process used	✓	✓	✓	✓		
HR-29	• Includes an independent review for the documented results	✓	✓	✓	✓		
HR-30	• Provides the basis of the HRA and is traceable to plant specific or generic analysis.			✓	✓		

<u>Notes to Table HR:</u>

(1) Sub-elements 13 and 15 are complementary and should be evaluated together. If a grade is assigned for one, then no grade is needed for the other.

Table HR (Report)

PRA PEER REVIEW REPORT
ELEMENT: HUMAN RELIABILITY ANALYSIS (HR)
Guidance:
Pre-Initiator Human Actions:
Post-Initiator Human Actions:
Treatment of Dependencies:
Documentation:
Recommended Enhancements:
Overall Process Assessment:
Recommended Element Grade: ☐ Grade 1 - Supports Assessment of Plant Vulnerabilities ☐ Grade 2 - Supports Risk Ranking Applications ☐ Grade 3 - Supports Risk Significance Evaluations w/Deterministic Input ☐ Grade 4 - Provides Primary Basis For Application

Table DE

DEPENDENCY RELATED GRADES – ELEMENT DE

Designator	CRITERIA	PSA GRADES				Plant Review	
		1	2	3	4	Check	Grade
DE-1	<u>GUIDANCE</u> • Describes the process used		✓	✓	✓		
DE-2	• Consistent with industry practices		✓	✓	✓		
DE-3	• Sufficient detail provided for reproducing the evaluation		✓	✓	✓		
DE-4	<u>INTER SYSTEM DEPENDENCIES</u> • The dependencies of the front-line system to support systems and support systems to support systems are identified. This is typically done by a dependency matrix. Dependency matrices are useful tools but are not considered necessary if sufficient documentation is available to assure quality of dependency assessments.	✓	✓	✓	✓		
DE-5	<u>SYSTEM / INITIATOR DEPENDENCIES</u> • The dependencies of the support systems and front-line systems to the initiating events are identified	✓	✓	✓	✓		
DE-6	<u>METHODOLOGY</u> • Support system and system to system interactions are treated in the event trees or linked fault trees. (See Element AS-6)	✓	✓	✓	✓		
DE-7	<u>HUMAN INTERACTIONS</u> • The human interactions that can cut across system trains and can cause failure of multiple trains due to pre-initiator and post initiator human interactions (HIs) are identified and documented. (See Element HR-26) Examples include: - Common cause miscalibration of similar sensors - Operator procedure-based actions to terminate injection - RPV external injection termination above MPCWLL (for BWRs)	✓	✓	✓	✓		
DE-8	<u>COMMON CAUSE</u> • Similar components within a system are included in a common cause group. (See Element DA-10)	✓	✓	✓	✓		

Table DE
DEPENDENCY RELATED GRADES – ELEMENT DE

Designator	CRITERIA	PSA GRADES 1	2	3	4	Plant Review Check	Grade
DE-9	• NUREG/CR-4780 methodology or equivalent is used to develop the component groups,		✓				
	OR						
	• NUREG/CR-4780 methodology or equivalent supported by plant specific operating experience is used to ensure grouping is adequate,			✓			
	OR						
	• Full NUREG/CR-4780 Application or its equivalent				✓		
	(See Elements DA-12 and DA-14)						
DE-10	SPATIAL DEPENDENCIES • Spatial challenges that can result in dependencies among components are included in the model for: - Flooding - High temperature - Inadvertent sprinkler operation - Missiles (HPCI/RCIC turbines for BWRs, turbine-driven EFW/AFW pumps for PWRs) - Intake anomalies (e.g., ice frazil, bio-fouling)	✓	✓	✓	✓		
DE-11	WALKDOWN • Specifically examines the spatial dependencies that could affect the system or intersystem reliabilities or initiating events.	✓	✓	✓	✓		
DE-12	DOCUMENTATION • Reflects the process used	✓	✓	✓	✓		
DE-13	• Includes an independent review for the documented results	✓	✓	✓	✓		
DE-14	• Provides the basis of the dependency treatment and is traceable to plant specific or generic analysis.		✓	✓	✓		

Table DE (Report)

PRA PEER REVIEW REPORT
ELEMENT: DEPENDENCY ANALYSIS (DE)
Guidance/Documentation:
Dependency Matrices:
Common Cause Treatment:
Spatial Dependencies:
HI Dependencies:
Recommended Enhancements:
Overall Process Assessment:
Recommended Element Grade: ☐ Grade 1 - Supports Assessment of Plant Vulnerabilities ☐ Grade 2 - Supports Risk Ranking Applications ☐ Grade 3 - Supports Risk Significance Evaluations w/Deterministic Input ☐ Grade 4 - Provides Primary Basis For Application

Table ST

STRUCTURAL RESPONSE RELATED GRADES – ELEMENT ST

Designator	CRITERIA	PSA GRADES 1	2	3	4	Plant Review Check	Grade
ST-1	GUIDANCE • Describes the process used		✓	✓	✓		
ST-2	• Consistent with industry practices		✓	✓	✓		
ST-3	• Sufficient detail provided for reproducing the evaluation		✓	✓	✓		
ST-4	RPV CAPABILITY (ATWS) • Failure Limit considered, OR • Best estimate failure condition considered (ASME Service Level C used)	✓	✓	✓	✓		
ST-5	CONTAINMENT • Conservative estimate of failure probability is used OR • Realistic estimate of failure probability is used based on detailed plant specific structural examination	✓	✓	✓	✓		
ST-6	• Level 2 analysis considers multiple pathways from the containment			✓	✓		
ST-7	REACTOR BUILDING (for BWRs) • Blowout panels considered		✓	✓	✓		
ST-8	• Level 2 analysis considers multiple pathways from the reactor building			✓	✓		
ST-9	PIPE OVERPRESSURE (ISLOCA) • Conservative estimate is used OR • Generic realistic estimate is used OR • Plant specific realistic estimate is used	✓	✓	✓	✓		
ST-10	FLOOD BARRIER INTEGRITY • Internal flooding analysis considers flood barrier (e.g., doors) structural capability and features when these barriers are credited for limiting flood propagation		✓	✓	✓		

Table ST

STRUCTURAL RESPONSE RELATED GRADES – ELEMENT ST

Designator	CRITERIA	PSA GRADES				Plant Review	
		1	2	3	4	Check	Grade
ST-11	DOCUMENTATION • Reflects the process used	✓	✓	✓	✓		
ST-12	• Includes an independent review for the documented results	✓	✓	✓	✓		
ST-13	• Provides the basis of the treatment and is traceable to plant specific or generic analysis.		✓	✓	✓		

Table ST (Report)

PRA PEER REVIEW REPORT
ELEMENT: STRUCTURAL RESPONSE (ST)
Guidance/Documentation:
RPV Capability:
Containment Capability:
Pipe Overpressurization:
Recommended Enhancements:
Overall Process Assessment:
Recommended Element Grade: ☐ Grade 1 - Supports Assessment of Plant Vulnerabilities ☐ Grade 2 - Supports Risk Ranking Applications ☐ Grade 3 - Supports Risk Significance Evaluations w/Deterministic Input ☐ Grade 4 - Provides Primary Basis For Application

Table QU
QUANTIFICATION RELATED GRADES – ELEMENT QU

Designator	CRITERIA	PSA GRADES				Plant Review	
		1	2	3	4	Check	Grade
QU-1	GUIDANCE • Describes the process used		✓	✓	✓		
QU-2	• Consistent with industry practices		✓	✓	✓		
QU-3	• Sufficient detail provided for reproducing the evaluation		✓	✓	✓		
QU-4	CODE • The base computer code and its inputs have been tested and demonstrated to produce reasonable answers.[(3), (4)]	✓	✓	✓	✓		
QU-5	• The simplified model (cutset model) is demonstrated to produce reasonable results for typical applications.[(2)]		✓	✓	✓		
QU-6	• Applications are not limited by the capabilities of the computer code.		✓	✓	✓		
QU-7	SIMPLIFIED MODEL • The simplified model (e.g., solved cutset) limitations are clearly identified.	✓	✓	✓	✓		
QU-8	DOMINANT SEQUENCES/CUTSETS • The dominant cut sets or sequences[(1)] -Make physical sense	✓	✓	✓	✓		
QU-9	- Include common cause potential where appropriate	✓	✓	✓	✓		
QU-10	- Include dependency among human actions when multiple HEPs are in the same cutset or sequence		✓	✓	✓		
QU-11	- Are not missing potentially dominant cut sets or sequences for similar plants. Possible reasons for differences include: (a) physical plant or procedural differences among plants; (b) documented assumptions; (c) detailed modeling or data to supplant assumptions.		✓	✓	✓		
QU-12	• Asymmetry: The model asymmetry is well described in terms of: - modeling - plant support systems - normally running equipment - cross-ties to an adjacent unit		✓	✓	✓		

Table QU
QUANTIFICATION RELATED GRADES – ELEMENT QU

Designator	CRITERIA	PSA GRADES 1	2	3	4	Plant Review Check	Grade
QU-13	• Asymmetry: Any modeling quantitative asymmetry (e.g., one train of dual-train system modeled as in-service, other in standby) is documented and is well understood so that applications affected by asymmetry can be determined.		✓	✓	✓		
QU-14	• Circular logic can sometimes occur when using linked fault trees. The PSA process appropriately accounts for support system dependencies in a consistent fashion that avoids so-called circular logic.	✓	✓	✓	✓		
QU-15	<u>NON-DOMINANT SEQUENCES/CUTSETS</u>(1) • The non-dominant cut sets or sequences - Make physical sense		✓	✓	✓		
QU-16	- Include common cause potential or there are equivalent cutsets that do include the common cause potential	✓	✓	✓	✓		
QU-17	- Include dependency among human actions when multiple HEPs are in the same cutset or sequence	✓	✓	✓	✓		
QU-18	<u>RECOVERY ANALYSIS</u> • Recovery actions credited in the evaluation are either proceduralized or have reasonable likelihood of success when the TSC/EOF are manned.	✓	✓	✓	✓		
QU-19	• Recovery actions that are included in the quantification process are included on selected dominant accident sequences; <u>OR</u> • Recovery actions that are included in the quantification process are included in all applicable sequences and cut sets		✓	✓	✓		
QU-20	• Transfers of sequences among event trees are treated explicitly.	✓	✓	✓	✓		
QU-21	<u>TRUNCATION</u> • The truncation of accident sequences based on frequency is a key decision made by PSA analysts that may affect the future PRA applications. The PSA Applications Guide implies that truncation limits be low enough to support the evaluation of dependencies among systems, structures, and components.	✓	✓	✓	✓		

Table QU
QUANTIFICATION RELATED GRADES – ELEMENT QU

Designator	CRITERIA	PSA GRADES 1	2	3	4	Plant Review Check	Grade
QU-22	• Example truncation values used in a base PSA are given. These should be treated as examples only. The screening truncation of events or failure modes retained in the model are as follows for screened out events: Level 1 / LERF (per yr) < 0.01 * CDF Base / < 0.01 * LERF Base	✓					
	OR < 0.0001 * CDF Base / < 0.0001 * LERF Base		✓	✓			
	OR < 0.00001 * CDF Base / < 0.00001 * LERF Base				✓		
QU-23	• The truncation values used in the system fault trees and accident sequences are sufficiently low to support their use in representative applications.		✓	✓	✓		
QU-24	• There is evidence of convergence towards a stable result		✓	✓	✓		
QU-25	• If the fault tree linking approach is used, "delete" terms (cutset complements) are used to account for the successes in event sequences as appropriate to assure that the correct cut sets are generated.			✓	✓		
QU-26	• The quantification process identifies and deletes mutually exclusive cutsets.		✓	✓	✓		
QU-27	UNCERTAINTY • A search is performed for unique or unusual sources of uncertainty not present in the typical or generic plant analysis.		✓	✓	✓		
QU-28	• If there are unusual sources of uncertainty, special sensitivity evaluations or quantitative uncertainty assessments are performed to support the base conclusion and future applications.		✓	✓	✓		
QU-29	• The capability to perform focused sensitivities to support the PSA applications is available.		✓	✓	✓		

Table QU
QUANTIFICATION RELATED GRADES – ELEMENT QU

Designator	CRITERIA	PSA GRADES				Plant Review	
		1	2	3	4	Check	Grade
QU-30	• A parametric uncertainty evaluation is performed that propagates the uncertainty distribution through the model sufficient to produce a valid mean value of CDF.		✓				
	OR						
	• A quantification of selected uncertainties is performed, or the impact of the selected uncertainties on the final risk measures is estimated.			✓			
	OR						
	• A quantitative uncertainty evaluation is performed using selected sensitivities to establish the approximate uncertainty bands.			✓			
	OR						
	• A comparison is made between the plant specific PSA and a similar generic study with "full" uncertainty evaluation. The differences in the plant, model, or data are used to identify whether there are any differences that would impact the calculated uncertainty band or obviate the ability to use the uncertainty band.		✓	✓			
	OR						
	• A complete quantification of all sources of uncertainty is performed and the final estimates for risk measures is presented along with the uncertainty distribution.				✓		
QU-31	RESULTS SUMMARY • The PSA results summary identifies the dominant contributors.	✓	✓	✓	✓		
QU-32	• Reflects the process used.	✓	✓	✓	✓		
QU-33	• Includes an independent review for the documented results.	✓	✓	✓	✓		
QU-34	• Provides the basis and is traceable to plant specific or generic analysis.		✓	✓	✓		

Notes to Table QU:

(1) A model of Grade 3 Level should be capable of generating sequences (at all reliability levels) which are reasonable. That is, the sequences which are dominant and those which are of very low frequency should all be equally correct logically. It is important to view the checklist on results as integral to and a part of the process of confirming accurate sequence delineation. A review which evaluates 20 or 30 sequences and determines that they are generally logically correct would probably be sufficient to draw a conclusion that the logical depiction in the model is correct. Such a review should consider both dominant and low frequency cases. There may be thousands of sequences generated by the model. It is not necessary to evaluate even a large fraction of these many sequences as part of the peer review process. This same level of judgment is appropriate when dealing with the completeness of the consideration of systems, recovery actions, and timing.

(2) The cutset model is part of the PRSA model assessment because the cutset model may be used in future applications and its viability as a PRA tool for applications is considered to be part of the PSA Peer Review of the base PRA. The limitations of the simplified pre-generated cutsets (or equivalent) are clearly identified.

(3) It is recognized that various computer codes used in the probabilistic assessment of accident sequences may treat the success branches differently. However, in the probabilistic evaluation it is necessary for a Grade 3 and 4 to ensure that when success probabilities deviate from approximately 1.0 that this numerical effect be accounted for. Evidence of this is necessary to ensure that Grade 3 and 4 applications are appropriately evaluated and not biased.

(4) The success branches account for the calculated success states in the cutsets that result on success branches.

Table QU

PRA PEER REVIEW REPORT
ELEMENT: QUANTIFICATION (QU)
Guidance/Documentation:
Dominant Sequences:
Truncation/Recovery Analysis:
Uncertainty:
Results Summary:
Recommended Enhancements:
Overall Process Assessment:
Recommended Element Grade: ☐ Grade 1 - Supports Assessment of Plant Vulnerabilities ☐ Grade 2 - Supports Risk Ranking Applications ☐ Grade 3 - Supports Risk Significance Evaluations w/Deterministic Input ☐ Grade 4 - Provides Primary Basis For Application

Table L2

CONTAINMENT PERFORMANCE ANALYSIS - ELEMENT: L2

Designator	CRITERIA	PSA GRADES				Plant Review	
		1	2	3	4	Check	Grade
L2-1	<u>GUIDANCE</u> • Describes the process used	✓	✓	✓	✓		
L2-2	• Consistent with industry practices		✓	✓	✓		
L2-3	• Sufficient detail provided for reproducing the evaluation		✓	✓	✓		
L2-4	<u>SUCCESS CRITERIA</u> • The success criteria are identified	✓	✓	✓	✓		
L2-5	• The success criteria are supported by thermal hydraulic analysis, system capability evaluations, or industry studies		✓	✓	✓		
L2-6	• The success criteria are judged realistic			✓	✓		
L2-7	<u>L1/L2 INTERFACE</u> • The link between the Level 1 and Level 2 is sufficient and adequately documented to provide the transfer of information from the Level 1 analysis to the Level 2 containment evaluation.	✓	✓	✓	✓		
L2-8	<u>PHENOMENA CONSIDERED</u> (1),(3) • The phenomena that may control the LERF radionuclide release characterization are included.	✓	✓	✓	✓		
L2-9 (4)	• (BWRs): The phenomena that may affect accident management actions and planning are included. <u>OR</u> • (PWRs): If plant specific features are not consistent with those assumed in Owners Group SAMG analyses, the L2 model addresses any plant-specific phenomena that may affect accident management actions and planning.	✓	✓	✓ ✓	✓ ✓		
L2-10	• The phenomena that may influence applications are included.		✓	✓	✓		

Table L2
CONTAINMENT PERFORMANCE ANALYSIS - ELEMENT: L2

Designator	CRITERIA	PSA GRADES				Plant Review	
		1	2	3	4	Check	Grade
L2-11	HEPs AND SYSTEM PERFORMANCE • System performance has been evaluated to account for the adverse conditions that may be present during the core melt progression response.	✓	✓	✓	✓		
L2-12	• Success of human actions has been evaluated to account for the adverse conditions that may be present during the core melt progression response.			✓	✓		
L2-13	• Containment and system functional failures are conservatively treated OR	✓					
	• Containment and system functional failures are treated realistically for dominant contributors		✓	✓	✓		
L2-14	CONTAINMENT CAPABILITY ASSESSMENT • Containment capability is analyzed under severe accident conditions for its survivability	✓	✓	✓	✓		
L2-15	• Both static and dynamic effects are included (2), (3)		✓	✓	✓		
L2-16	• All postulated failure modes identified by IDCOR or NRC Staff in NUREG-1150 are considered (2), (3)			✓	✓		
L2-17	• For Ice Condenser and BWR Mark III containments only: Geometric details impacting the hydrogen related phenomena (i.e., heat sink distribution, circulation paths, ignition sources, water availability, and gravity drain paths) should be documented in a readily comprehensible form, together with representative combustible transients.	✓	✓	✓	✓		
L2-18	• Both leakage and large failures are included in the analysis			✓	✓		
L2-19	• Containment failure modes are treated realistically in the analysis		✓	✓	✓		

Table L2
CONTAINMENT PERFORMANCE ANALYSIS - ELEMENT: L2

Designator	CRITERIA	PSA GRADES				Plant Review	
		1	2	3	4	Check	Grade
L2-20	• The containment analysis is: - Conservative OR - Realistic	✓ 	✓ 	 ✓	 ✓		
L2-21	ENDSTATE DEFINITION • The Level 2 end states support the applications currently envisioned.		✓	✓	✓		
L2-22	LERF DEFINITION • The LERF definition is consistent with the following guidance, and is documented: - Regulatory Guide 1.174 OR - PSA Applications Guide or other Owners Group-specific definitions (5)	✓	✓ ✓	 ✓	 ✓		
L2-23	• The LERF definitions use Emergency Action Levels (EAL) bases if required; and the EAL bases are documented.		✓	✓	✓		
L2-24	CONTAINMENT EVENT TREES (CETs) • The CETs: - Include all the functional events required to meet a safe stable condition - Include the phenomena cited under phenomena	✓	✓	✓	✓		
L2-25	• The CETs: - Include the systems and HEPs necessary - Are consistent with the EOPs - Include reasonable recovery actions			✓	✓		
L2-26	DOCUMENTATION • Documentation reflects the process used	✓	✓	✓	✓		
L2-27	• Includes an independent review for the documented results	✓	✓	✓	✓		
L2-28	• Provides the basis of the containment performance analysis and the analysis is traceable to plant specific or generic analysis.		✓	✓	✓		

Notes to Table L2:

(1) The consideration of the severe accident phenomena that may influence core melt progression or containment integrity should be quantified as part of the Level 2 evaluation. This quantification should also recognize the uncertainty in the phenomena. For PWRs, accident management actions need only be considered for grades 3 and 4.

(2) The assessment of containment failure modes should be included quantitatively in the PSA. It may be possible to treat certain failure modes in a conservative fashion for some applications.

(3) Position papers that justify eliminating phenomena or modes should be used with care. Quantification is the preferred method of evaluation in the PSA process. Assignment of higher grades would in general be based on a quantified model of LERF that recognizes phenomena uncertainties.

(4) BWR EOPs have strategies to prevent containment failure, whereas PWR EOPs stop at the onset of core damage and no instruction / guidance is available to model in the Level 2 PSA. Thus, accident management has traditionally been modeled in BWR PSA Level 2 studies, while for PWRs, the level 2 analyses generally assume little or no response to the severe accident by control room operators. Thus, PWR PSAs do not generally model phenomena that impact accident management, and to do so would require a major upgrade to most PWR PSA Level 2 studies. Consideration of applications suggested for PSA Grades 3 and 4 implies a need to start considering severe accident management guidance (SAMG). Thus, the criteria for phenomena that imply or require accident management are only applicable to PSA Grades 3 and 4. The L2-9 criterion for PWRs are considered to be met (grades 3 or 4) if the plant features are consistent with those modeled in the Owners Group SAMG analyses, or if the level 2 analysis addresses accident management actions related to plant-specific phenomena not covered by the SAMG analyses.

(5) For example, the WOG has adopted its own definition of LERF. Other owners groups ...

Table L2 (Report)

PRA PEER REVIEW REPORT
ELEMENT: CONTAINMENT PERFORMANCE ANALYSIS (L2)
Guidance/Documentation:
Level 1/Level 2 Interface:
Phenomena CETs/HEPs/System Considered/Success Criteria:
Containment Capability Assessment:
End-state Definitions:
LERF Definition:
Recommended Enhancements:
Overall Process Assessment:
Recommended Element Grade: ☐ Grade 1 - Supports Assessment of Plant Vulnerabilities ☐ Grade 2 - Supports Risk Ranking Applications ☐ Grade 3 - Supports Risk Significance Evaluations w/Deterministic Input ☐ Grade 4 - Provides Primary Basis For Application

Table MU

MAINTENANCE AND UPDATE PROCESS -- ELEMENT MU [(1)]

Designator	CRITERIA	PSA GRADE 1	2	3	4	Plant Review Check	Grade
MU-1	<u>GUIDANCE</u> • Describes the process used		✓	✓	✓		
MU-2	• Consistent with industry practices		✓	✓	✓		
MU-3	• Sufficient detail provided to update the evaluation		✓	✓	✓		
MU-4	<u>INPUT -- MONITORING AND COLLECTING NEW INFORMATION</u> [(2)] • Each of the following information sources is part of the PSA update process for monitoring new information associated with the following: - Operational Experience - Plant Design - New Maintenance Policies - Operator Training Program - Technical Specification - Revised Engineering Calculations - Emergency and Abnormal Operating Procedures - Operating Procedures - Emergency Plan - Accident Management Programs - Industry Studies		✓	✓	✓		
MU-5	• Plant specific data is included for quantitative reevaluation.			✓	✓		
MU-6	<u>MODEL CONTROL</u> • The computer models of the PRA are stored in a controlled manner. This also applies to sensitivity cases that may be performed to support a specific application.		✓	✓	✓		

Table MU

MAINTENANCE AND UPDATE PROCESS -- ELEMENT MU [1]

Designator	CRITERIA	PSA GRADE 1	2	3	4	Plant Review Check	Grade
MU-7	COMPUTER CODE CONTROL • Computer code controls are formalized to ensure that the effect on the PRA of changes to these codes are understood and addressed if appropriate		✓	✓	✓		
MU-8	PRA UPDATE • A process is in place to maintain the PRA. The PRA update model process consists of the elements identified and the steps in the process. The model update process consists of the following: - Identification of Affected Model Elements - Modification of PRA Models - Requantification of PRA Models - Evaluation of Results - Re-Evaluation of Past PRA Applications		✓	✓	✓		
MU-9	• The plant has defined a fixed update schedule or a reasonable criteria upon which to base the need for an update.		✓	✓	✓		
MU-10	EVALUATION OF RESULTS • The PRA results are evaluated by knowledgeable personnel before the results are used.		✓	✓	✓		
MU-11	RE-EVALUATION OF PAST PRA APPLICATIONS [3] • Past PRA Applications are evaluated qualitatively to assure that the conclusions remain valid.		✓	✓	✓		
MU-12	• Past PRA Applications that may be affected by the latest information and update are re-performed.		✓	✓	✓		
MU-13	DOCUMENTATION • Documentation reflects the process used		✓	✓	✓		

Table MU

MAINTENANCE AND UPDATE PROCESS -- ELEMENT MU [(1)]

Designator	CRITERIA	PSA GRADE				Plant Review	
		1	2	3	4	Check	Grade
MU-14	• Includes an independent review for the documented results		✓	✓	✓		
MU-15	• Provides the basis of the update process and the results are traceable to specific changes in design, procedures, training, or operating experience.		✓	✓	✓		

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 which 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. 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.

Table MU (Report)

PRA PEER REVIEW REPORT
ELEMENT: MAINTENANCE AND UPDATE PROCESS (MU)
Guidance:
Input:
Model Control:
Update/Maintenance:
Application Re-evaluation:
Documentation:
Recommended Enhancements:
Overall Process Assessment: •
Recommended Element Grade: ☐ Grade 1 - Supports Assessment of Plant Vulnerabilities ☐ Grade 2 - Supports Risk Ranking Applications ☐ Grade 3 - Supports Risk Significance Evaluations w/Deterministic Input ☐ Grade 4 - Provides Primary Basis For Application

Appendix C
GUIDANCE FOR THE PEER REVIEW TEAM

C.1 PURPOSE

The purpose of this appendix is to: (a) provide helpful information to the Peer Review Team in preparation for and during the site visit; and, (b) identify a recommended approach to completing the PRA Peer Review Process in a manner that provides the maximum benefit of the host utility.

C.2 PEER REVIEW TEAM MODE OF OPERATION

There are two distinct modes of operation of the peer review team members during the Peer Review as defined in this process. These are:

- Independent investigation and issue identification. This mode of operation is expected to occupy approximately 50% of each reviewer's time. It also includes summarizing the results of the investigation in the Fact and Observation sheets, the Checklists, and the Qualitative summaries.

- Consensus Evaluation. This is the consensus/reviewer interaction process in which the team or portions of the team meet to reach agreement on the relative quality of the PRA elements under review and the information that should be provided on each of the assessment forms. This mode of operation is expected to occupy the remainder of the time spent by each reviewer.

C.3 RECOMMENDED APPROACH TO COMPLETING THE REVIEW

Based on their experience in their pilot and subsequent reviews, the BWROG has recommended the following approach, as a means of providing beneficial technical feedback to the host utility:

1. First, review the criteria in the technical element checklist tables to establish the general areas of interest.

2. Then focus on the Observations and Facts that will eventually support the conclusions regarding the criteria and the associated grades. These Observations and Facts are taken from written or oral information about the PRA and are focused on assessing the technical capability of the model. Cross referencing of the Observation and Fact sheets to the PRA element, subelement, and criteria are a valuable and recommended technique for the Team and the host utility. Both strengths and weaknesses of the PRA elements should be documented.

3. Assign grades to the criteria using the observations to support these grade assignments.

4. Use "Footnotes" to justify a Grade based on contingent action, when that grade is not justified by the existing state of the PRA – i.e., the element (or subelement) obtains the given grade only after the host utility completes some recommended action or an equivalent.

5. Summarize the qualitative evaluation using the observations and checklists as inputs

The following process mechanics and facilitator notes regarding interactions with the host utility are provided to help with the conduct of the review.

- Any additional documentation and supporting information should be provided in a list presented to the host utility at the end of each day.

- The areas of strength and potential improvement should be identified and discussed with the host utility at the end of each day.

- A summary of the Peer Review Team observations and conclusions, at the end of the week, should be short and to the point.

- The host utility should be kept informed of the team's schedule and any administrative needs.

C.4 GRADING

The definitions of the grades to be assigned to the PRA elements were discussed in Section 3. A quick summary of these general grade definitions is provided in Table C.4-1 for reviewer convenience.

C.5 PEER REVIEW TEAM GOOD PRACTICE LIST

The success of the Peer Review Team has been determined (Ref. *BWROG Certification Guidelines*) to be tied to a number of items including the following:

- One member of the Peer Review Team must serve as a facilitator to ensure that: (1) reviews are completed in a timely fashion; (2) consensus meetings occur and that a consensus process is carried out by the Team; (3) evening meetings occur to discuss strengths and areas of improvement, and to identify needs for the following days; and (4) information and feedback is provided to the utility on a daily basis. The facilitator also serves as the central spokesman for the exit meeting with the host utility PRA group and management.

- The checklists, qualitative summaries and the Fact and Observation forms should be provided to the reviewers in electronic format, so that they can be completed by the designated reviewers during the week. (Ideally, each reviewer should bring a portable computer to faciliatate the completion and compilation of forms.) ~~[Question: does this imply that reviewers should be a portable computer? If so, should it be included in this list?]~~

- The review tasks associated with assigned PRA elements must be completed in a timely fashion. This includes the following:

  - preparation of written observations to support the findings on the PSA subelements

  - meetings within the group of reviewers assigned to an element to form a consensus

  - summary of the consensus presented to the Peer Review Team for discussion and concurrence

- The time spent in a plant walkdown is considered to be a valuable addition to the team's knowledge of the plant and the PSA model interface.

- The team should consist of at least two utility representatives to obtain the maximum benefit for the host utility and the owners group. This allows for multiple inputs, for more complete coverage of the PSA subelements, and affords greater levels of feedback on alternative approaches, comparisons of results and practices, and so forth, to the participating utilities.

- It is useful to utility PRA analysts and utility management to hear from the reviewers about other methods that may be used within the industry to address various issues. These other methods may be typical approaches from which the host utility may choose or they may be recommended approaches by the peer review team based on their experience. This particularly applies to the following categories:
  - where inconsistent or non-standard methods are used that would make it difficult for regulators to review or sanction.
  - where there are recognized industry "accepted" or standardized approaches.

C.6 OUTPUT

The output of the peer review is a written report documenting both the details and the summary findings of the review. The outline of the report is shown in Table C.6-1. The checklists, Facts and Observation, and other forms prepared during the onsite review constitute the largest portion of the report, and the principal results, conclusions, and recommendations of the Peer Review Team are communicated to the host utility at the completion of the onsite review.

C.7 FORMS

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. Some of these forms are provided here for use during the specific utility application. The blank checklists for individual subelement grades and the qualitative summary forms are provided in Appendix B.

The review process is captured on the following forms:

- Reviewer Element Responsibilities. Table C.7-1 lists the reviewers (and the lead reviewer) for each PRA element.

- Peer Review Findings. These qualitative results are process oriented and address the major process issues related to the PRA and its maintenance and update process. Table C.7-2 provides a typical blank form for one of the PRA elements, Initiating Events. The blank forms to be used in an individual review are provided along with the Grading Checklists in Appendix B.

- Grading Checklists. These are used to focus the peer review process on key PRA issues. A complete set of blank checklists is included in Appendix B.

- Fact and Observation Sheets. The third type of results are detailed technical observations that highlight specific aspects of the PRA or the maintenance and update process that should or could be changed. Table C.7-3 is the standard form for reporting these Fact and Observation findings to the host utility. The importance of these findings are rated from A to D, with A being the most important. A fifth level of significiance has been added, S, which recognizes superior treatment in the PRA. Accordingly, Facts and Observations should not necessarily focus solely on PRA weaknessess, but also on its strengths. Table C.7-4 summarizes the rating scheme. Note that the definitions from this table have been added to the bottom of Table C.7-3 for reviewer convenience.

- Summary of Technical Element Grades. Table C.7-5 is the summary sheet of grades that can be used to display the results of the PRA element grades. [Question: is this form necessary? Wasn't there some discussed about eliminating so as to not focus too much on the grades? Are both this form and the next form necessary ... does it promote too much emphasis on grades?]

- Overall Assessment Summary. Table C.7-6 provides an overall summary of the review conclusions, and also provides the element grades in another format.

- Reviewer Actions Form. Table C.7-7 shows an example summary sheet of required actions by individual reviewers.

- Review Team Member Experience. Table C.7-8 lists the pertinent experience of each member of the review team.

- Reviewer Statement of Independence. Table C.7-9 provides documentation that each of the reviewers had no prior association with the preparation or maintenance of the PRA being reviewed. [Question: Can some of the individuals that have already filled this out provide an example of the text that might be used?]

- Process Feedback Form. This form provides an opportunity for both the host utility and the PRA Peer Review Team to provide feedback for the purpose of improving the review process. Table C.7-10 is an example form.

Table C.4-1

SUMMARY OF GRADE DEFINITIONS

Grade 1

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

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.

Grade 3

This 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.

Grade 4

This 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. 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). It is expected that few PRAs would currently have many elements eligible for this grade.

Table C.6-1 PRA PEER REVIEW PROCESS REPORT OUTLINE

Table C.7-1

LISTING OF REVIEWERS ASSIGNED TO PRA TECHNICAL ELEMENTS FOR THE PEER REVIEW

(SAMPLE)

PRA Element	Applicable Checklist	Reviewer	Lead Responsibility
Initiating Events	Table IE	3, 6	3
Accident Sequences Evaluation	Table AS	1,2,5,4	2
Thermal Hydraulic Analysis	Table TH	1,2	2
Systems Analysis	Table SY	2,3,4,5,6	5
Data Analysis	Table DA	3,5,6	6
Human Reliability Analysis	Table HR	1,5,4	5
Dependency Analysis	Table DE	3,4,5	5
Structural Response	Table ST	1,3,4	4
Quantification and Results Interpretation	Table QU	1,2,3,4,5,6	2
Containment Performance Analysis	Table L2	1,3,4	1
Maintenance and Update Process	Table MU	2,5,6	2

Table C.7-2

PRA PEER REVIEW PROCESS ELEMENT REPORT
ELEMENT: INITIATING EVENTS (IE)
Guidance:
Grouping:
Treatment of Support System/Special Initiators:
Data:
Documentation:
Recommended Enhancements:
Overall Process Assessment:
Recommended Element Grade: ☐ Grade 1 - Supports Assessment of Plant Vulnerabilities ☐ Grade 2 - Supports Risk Ranking Applications ☐ Grade 3 - Supports Risk Significance Evaluations w/Deterministic Input

☐ Grade 4 - Provides Primary Basis For Application

Table C.7-3

FACT/OBSERVATION REGARDING PRA TECHNICAL ELEMENTS
OBSERVATION (ID:) / **Element ______** / **Subelement ______**
LEVEL OF SIGNIFICANCE
POSSIBLE RESOLUTION
PLANT RESPONSE OR RESOLUTION

LEVELS OF SIGNIFICANCE FOR FACTS AND OBSERVATIONS

A.	Extremely important and necessary to address to ensure the technical adequacy of the PRA, the quality of the PRA, or the quality of the PRA update process. (Contingent Item for Grade Assignment.)
B.	Important and necessary to address, but may be deferred until the next PRA update (Contingent Item for Grade Assignment.)
C.	Considered desirable to maintain maximum flexibility in PRA Applications and consistency in the Industry, but not likely to significantly affect results or conclusions.
D.	Editorial or Minor Technical Item, left to the discretion of the host utility.
S.	Superior treatment, exceeding requirements for anticipated applications and exceeding what would be found in most PRAs.

Table C.7-4

LEVELS OF SIGNIFICANCE FOR FACTS AND OBSERVATIONS

Significance Level	Definition
A.	Extremely important and necessary to address to assure the technical adequacy of the PSA, the quality of the PRA, or the quality of the PRA update process. (Contingent Item for Grade Assignment.)
B.	Important and necessary to address, but may be deferred until the next PRA update (Contingent Item for Grade Assignment.)
C.	Considered desirable to maintain maximum flexibility in PRA Applications and consistency in the Industry, but not likely to significantly affect results or conclusions.
D.	Editorial or Minor Technical Item, left to the discretion of the host utility.
S.	Superior treatment, exceeding requirements for anticipated applications and exceeding what would be found in most PRAs.

Table C.7-5

SUMMARY OF GRADE ASSIGNMENTS BY PRA ELEMENT: DISTRIBUTION BY GRADE FOR SUBELEMENTS

PRA PEER REVIEW Areas Reviewed	Total Reviewed	Average Score	# of Individual Scores by Grade			
			1	2	3	4
Initiating Events						
Accident Sequences Evaluation						
Thermal Hydraulic Analysis						
Systems Analysis						
Data Analysis						
Human Reliability Analysis						
Dependency Analysis						
Structural Response						
Quantification and Results Interpretation						
Containment Performance Analysis						
Maintenance and Update Process						
	TOTAL					
	PERCENT					

Table C.7-6

PRA PEER REVIEW SUMMARY REPORT			
OVERALL ASSESSMENT			
PRA ELEMENT	GRADE BASED ON SUB-ELEMENTS		
	Minimum [1]	Average	Assigned [2]
Initiating Events			
Accident Sequence Evaluation			
Thermal Hydraulic Analysis			
System Analysis			
Data Analysis			
Human Reliability Analysis			
Dependencies			
Structural Response			
Quantification			
Containment Performance			
Maintenance & Update			
Overall Assessment:			
Areas Recommended for Enhancement:			

[1] Minimum grade assigned, regardless of whether or not a "note" was associated with the grade, making it a contingent grade.

[2] These are the grades as recommended by consensus of the reviewers. A "(C)" designation indicates that the grade is contingent upon implementation of recommended improvements or equivalent actions.

Table C.7-7

PRA PEER REVIEW - STATUS OF REPORT INPUTS

(Sample)

PRA PEER REVIEW				Process Feedback Forms	Résumé	Checklist, Qualitative Summary, and Fact Observation Forms[3]				
						Initiating Events	Accident Sequence Evaluation	Thermal Hydraulic Analysis	Systems Analysis	Data Analysis
No.	Reviewer	Phone	FAX			IE	AS	TH	SY	DA
1				(4)	(5)		✶	✶		
2				(4)	(5)		✶ (1), (2)	✶ (1), (2)	✶	
3				(4)	(5)	✶ (1), (2)				✶ (1), (2)
4				(4)	(5)				✶	
5				(4)	(5)		✶		✶	✶
6				(4)	(5)	✶	✶		✶ (1), (2)	✶

Forms to be Submitted:

(1) Checklist Form (to be submitted by person who presented results at exit meeting)

~~(3)~~ (2) Qualitative Summary Form (to be submitted by person who presented results)

~~(5)~~ (3) Fact/Observation Form (to be submitted by each reviewer for area reviewed)

~~(7)~~ (4) Process Feedback Form (to be submitted by each reviewer who has a feedback on the process)

~~(9)~~ (5) Résumé (to be submitted by each reviewer).

* Reviewers

Table C.7-7

PRA PEER REVIEW - STATUS OF REPORT INPUTS

Sample (cont'd)

PRA PEER REVIEW				Checklist, Qualitative Summary, and Fact Observation Forms					
				Human Reliability Analysis	Dependency Analysis	Structural Analysis	Quantification and Results Interpretation	Containment Performance Analysis	Maintenance & Update Process
No.	Reviewer	Phone	FAX	HR	DE	ST	QU	L2	MU
1				✶		✶	✶ (1), (2)	✶ (1), (2)	
2									✶
3					✶	✶	✶	✶	
4					✶	✶ (1), (2)		✶	
5				✶ (1), (2)	✶		✶		✶ (1), (2)
6					✶ (1), (2)				✶

Forms to be Submitted:

(1) Checklist Form (to be submitted by person who presented results at exit meeting)

~~(3)~~ (2) Qualitative Summary Form (to be submitted by person who presented results)

~~(5)~~ (3) Fact/Observation Form (to be submitted by each reviewer for area reviewed)

~~(7)~~ (4) Process Feedback Form (to be submitted by each reviewer who has a feedback on the process)

~~(9)~~ (5) Résumé (to be submitted by each reviewer).

* Reviewers

Table C.7-8

PRA PEER REVIEW TEAM EXPERIENCE

TEAM MEMBER	EXPERIENCE SUMMARY			
	Degree	Years Experience	Years PRA Experience	Selected PRA Projects

Table C.7-9

STATEMENT OF REVIEWER INDEPENDENCE

REVIEWER	INDEPENDENT STATUS

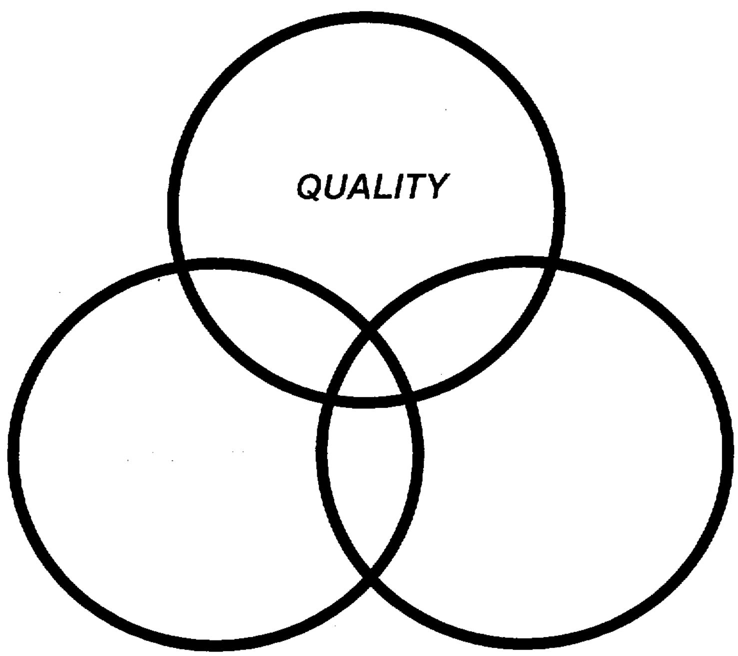
Table C.7-10

PRA PEER REVIEW PROCESS FEEDBACK FORM	
ISSUE	
RECOMMENDED RESOLUTION	
PRIORITY	
PERSONS RECOMMENDING	
Person:	***Organization:***

Enclosure 2

PSA Peer Review

Subtier Criteria



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Section 1
INTRODUCTION

The BWROG has implemented a PSA Peer Review process to provide feedback to individual utilities regarding the key elements of their PSAs and the overall PSA quality. [1, 2, 3, 4]. NEI has subsequently sponsored an industry document that draws on the BWROG product and then addresses all LWR product lines for PSA Peer Reviews.

As a supplement to the PSA Peer Review process, a documented set of subtier criteria was published in June 1999 under the sponsorship of EPRI. This supplement served to formally document the subtier criteria that had been used in the early implementation of the BWROG PSA Peer Review Process. The PSA Peer Review Teams are trained in the use of the following:

- 11 PSA Elements
- 209 PSA Criteria
- Subtier for each of the 209 PSA Criteria (except dependencies and PSA Maintenance and Update)

These subtier criteria were developed to document the interpretations of the 209 PSA Criteria as they are applied in the PSA Peer Reviews. The subtier criteria document can be used to ensure consistency in the application of the peer review process. This means the following are part of the consistency process:

- Provide specific criteria for 209 of the PSA subelements.
- Incorporate veteran members of previous BWROG PSA Peer Reviews on each Peer Review Team.
- Provide training on the process and the PSA criteria to be used.

- Supplement the above with written subtier criteria that document the distinctions among grades for the 209 criteria.

Section 2

PURPOSE

The purpose of the subtier criteria is to establish a documented basis for distinctions among the PSA Grades to be assigned for each PSA Element Criteria.

Section 3
SCOPE

The scope of the subtier development process includes the following:

- document the distinctions among the Grades for the PSA criteria consistent with that implemented in the early PSA Peer Reviews.
- distinguish among the top 3 grade categories:

Category	Qualitative Characterization
2	Risk Ranking Prioritization
3	Risk-Informed Decisions
4	Risk-Based Decisions

The lowest grade category (Grade 1) has not been explicitly broken out with separate subtier criteria. By process of elimination, it can be assumed that if the PSA being reviewed is inadequate to meet Grade 2, then it would be placed in Grade 1 or possibly be identified as "Not Applicable", if the particular criteria does not apply".

The scope of the subtier criteria document is to provide additional information for the PSA Peer Review Team. While, no formal review of the subtier criteria was performed as part of issuing these subtier criteria, the subtier criteria were developed and reviewed by veteran members of previous PSA Peer Review Teams. Therefore, the technical content and consistency of the subtier criteria with previous reviews is assured. Use of the documented subtier criteria has subsequently been confirmed by the Certification Teams during the application of these subtier criteria to be beneficial when veteran Certification Team members are not available.

Section 4
FORMAT

The format selected for the subtier criteria incorporates the following:

- The subtier criteria are provided in tabular format.
- Each PSA element[1] and its criteria are expressed in terms of the subtier criteria.
- Three grade levels are distinguished.

The subtier criteria format (e.g., numbering scheme) is developed to coincide with the NEI PRA Peer Review Process elements. Because there are slight differences in the subelement numbering between the BWROG and the NEI Peer Review criteria, the user needs to be aware that the subtier criteria will need to be matched to the correct subelement. This has not presented any problems in the application of this criteria to either implementation of the BWROG criteria tables or the NEI PRA Peer Review criteria tables, both of which have been used by the BWROG in Peer Reviews of BWRs.

The wording of the subtier criteria are meant to be similar to their usage in ASME Standards as follows:

- Shall -- means that the subtier criteria must be included in the PSA to satisfy the Grade Level.
- Should -- means that the subtier criteria is expected to be in place and would be in place unless there are compensating actions or documentation to support deviations from the subtier criteria.

(1) The subtier criteria for Dependencies were not developed separately. This is principally because the Dependency criteria are addressed in other criteria.

- May -- means that the subtier criteria could be part of the PSA; however, it is not required and could be absent without a documentation basis.

As in all peer review processes, the expertise of the Peer Review Team is an essential element of the process. Not all aspects of a PSA can be written down in a concise manner that would allow the process to be implemented within a short time frame. Therefore, the criteria and subtier criteria have been implemented in a manner that allows the Team to provide a thorough review of the critical criteria within a one week review process. A more extended review could be performed at increasing costs.

Section 5
SUBTIER CRITERIA

This section includes the tabular information on the PRA Peer Review Process subtier criteria for the following:

Table	Element
5-1	Initiating Event Assessment
5-2	Accident Sequence Evaluation
5-3	Success Criteria and Thermal Hydraulic Analysis
5-4	Systems Analysis
5-5	Data Analysis
5-6	Human Reliability Analysis
5-7	Structural Response
5-8	Quantification & Results Interpretation
5-9	Level 2/LERF Evaluation

REFERENCES

[1] BWROG PSA Peer Review Certification Implementation Guidelines, BWROG, January 1997.

[2] NEI PSA Certification Workshop, April 7-8, 1998, Renaissance Harborplace, Baltimore, Maryland.

[3] Gregory A. Krueger, Edward T. Burns, Richard A. Hill, Results of Applying the BWROG PSA Peer Review Certification Guidelines, PSA 99, Washington D.C.

[4] Transmittal of BWR Owners' Group Document, "PSA Peer Review Certification Implementation Guidelines", Letter from Kevin P. Donovan, Chairman BWR Owner's Group, to U.S. Nuclear Regulatory Commission Document Control Desk, J.H. Wilson, dated January 31, 1997.

Table 5-1

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: INITIATING EVENT

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk-Informed Decisions	Risk-Based Decisions
IE-1	GUIDANCE • Describes the process used	General description of the initiating event process is provided.	The documentation of the initiating events and its quantification should be sufficiently well described in the documented results to act as guidance for future updates and revisions.	A specific guidance document should be available that specifies the process for initiating event development and quantification including the updating process.
IE-2	• Consistent with industry practices	General adherence to accepted industry approaches is included	The guidance should provide a reasonable basis for performing the initiating event analysis and should maintain consistency with proven approaches.	The guidance for initiating event analyses should be complete and detailed and should maintain consistency with proven approaches.
IE-3	• Sufficient detail provided for reproducing the evaluation	Guidance may be available to supply general approaches used.	The guidance should be sufficient to provide a means to obtain equivalent results.	The guidance shall be sufficiently detailed to reproduce the results.
IE-4	IDENTIFICATION AND GROUPING • Grouped initiators by plant response consistent with event tree structure and success criteria.	Grouping criteria from Risk Significance apply except there may be a relatively high level of conservatism encountered by subsuming initiating events into broad categories.	Grouping of initiating events should be performed only when the following can be assured: • Events can be considered similar in terms of: - Plant response - success criteria - timing - recovery probability OR • Events can be subsumed into a group and bounded by the worst case impacts within the "new" group, however, to avoid excess conservatism the event frequency for subsumed events should not be negligible within a group AND its consequences far worse than other group contributors	Criteria from Risk Significance apply except grouping of initiating events should be minimized to the maximum practical extent to limit conservatisms in the best estimate model.

Table 5-1

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: INITIATING EVENT

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk-Informed Decisions	Risk-Based Decisions
			Initiating events with significantly different plant response impacts or which may have more severe radionuclide release potential (e.g., LERF) should be treated separately from other initiating event groups. This includes such initiators as: • excessive LOCA • ISLOCA • Unisolated breaks outside containment Non-conservative grouping (subsuming of initiators into broader categories not bounded by the worst case accident) shall not be performed.	
IE-5	• The class of initiating events that is caused by failure of part or all of a system that supports the front-line safety function are addressed: - Cooling water systems (e.g., service water, component cooling water, etc.) - AC Power - DC Power - HVAC - Instrument/Station Air	Addressing support system failures may include truncation or subsuming within broader groups if it can be shown that the quantitative contribution is expected to be small.	Support system failures should be quantitatively included in the PSA in a realistic fashion. This means that the individual support systems (or trains) that can cause a scram should be treated explicitly in the initiating event quantification.	In addition to the risk significance requirements, detailed fault tree quantifications should be included in the model for quantification. This quantification should be checked against plant specific and generic data and any significant discrepancies identified including a technical bases for resolution identified. Model initiating events (especially those that result from the loss of support systems) using a fault tree (or equivalent) approach so that system dependencies are fully understood and accounted for.

Table 5-1

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: INITIATING EVENT

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk-Informed Decisions	Risk-Based Decisions
IE-6	• For multi-unit sites with shared systems, the impact of initiators requiring simultaneous response (e.g., LOOP, loss of cooling source due to ice, loss of an AC or DC bus, etc.) are included.	Multi-unit sites with shared systems should acknowledge that dual unit initiators may impact the model. A qualitative evaluation should be performed.	Multi-unit site initiators such as dual unit LOOP events or total loss of service water should be treated and quantified explicitly.	Multi-unit site initiators such as dual unit LOOP events or total loss of service water should be treated and quantified explicitly
IE-7	• Initiators considered cover the spectrum of internal event challenges	A structured process for identifying initiating event groups may be used. The spectrum of internal event challenges may include the following general categories and within each category should be quantitatively incorporated in the model: • Transients - Separate events with different impacts on PCS and PCS recovery - LOOP/SBO - Manual Shutdowns • LOCAs - Small - Medium -- Include stuck open safeties (to the drywell) - Large -- Include inadvertant ADS -- Include component ruptures	A structured process for identifying initiating event groups should be used. The spectrum of internal event challenges should include the following general categories and within each category should be quantitatively incorporated in the model: • Transients - Separate events with different impacts on PCS and PCS recovery - LOOP/SBO - Manual Shutdowns • LOCAs - Small - Medium -- Include stuck open safeties (to the drywell) - Large -- Include inadvertant ADS -- Include component ruptures	A structured process for identifying initiating event groups shall be used. The spectrum of internal event challenges shall include at least the following general categories and within each category should be quantitatively incorporated in the model: • Transients - Separate events with different impacts on PCS and PCS recovery - LOOP/SBO - Manual Shutdowns • LOCAs - Small - Medium -- Include stuck open safeties (to the drywell) - Large -- Include inadvertant ADS -- Include component ruptures

Table 5-1

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: INITIATING EVENT

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk-Informed Decisions	Risk-Based Decisions
IE-7 (cont'd)		- Excessive LOCA -- Include RPV Rupture - LOCAs Outside Containment -- BOC -- ISLOCA • Special Initiators - Support system failures - Instrument line breaks Internal Flood contributors may be quantified for all non-screened compartments	- Excessive LOCA -- Include RPV Rupture - LOCAs Outside Containment -- BOC -- ISLOCA • Special Initiators - Support system failures - Instrument line breaks Internal Flood contributors should be quantified for all non-screened compartments	- Excessive LOCA -- Include RPV Rupture - LOCAs Outside Containment -- BOC -- ISLOCA • Special Initiators - Support system failures - Instrument line breaks Internal Flood contributors should be quantified for all non-screened compartments
IE-8	• All experienced initiators are accounted for in the model	Qualitatively assess the operating experience reviews cited in the Risk Significance requirements. Incorporate those events that are considered important. Document the dismissal of any observed events, including any credit for rectification.	Qualitatively reflect in the model the results of the following: • A review of plant specific operating experience of all initiators should be performed qualitatively to assess whether the list of challenges accounts for plant experience • A review of similar plants should be performed to assess whether the list of challenges included in the model accounts for industry experience.	Qualitatively reflect in the model the results of the following: • A review of plant specific operating experience of all initiators should be performed qualitatively to assess whether the list of challenges accounts for plant experience • A review of similar plants should be performed to assess whether the list of challenges included in the model accounts for industry experience.
IE-9	• If typical initiators cited in NUREG-1150 or industry PSAs have been excluded, the basis is documented	Exclusion of initiators previously identified in the industry PSAs or NUREG-1150 are justified qualitatively.	Initiators previously identified in industry PSAs NUREG-1150 should be included.	Initiators previously identified in industry PSAs NUREG-1150 shall be included if applicable.

Table 5-1

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: INITIATING EVENT

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk-Informed Decisions	Risk-Based Decisions
IE-10	• A structured approach for plant support systems is performed to determine if a loss of support system initiator presents a unique challenge to the plant	At least a qualitative review of system impacts should be performed	A Structured Approach (such as a system by system review of initiating event potential, or an FMEA or fault tree) should be used to assess and document the possibility of an initiating event resulting from support system failures. The search for initiating events should consider initiating event precursors and should consider each system alignment and alignments of supporting systems.	A detailed model of system interfaces including fault tree development should be performed. An FMEA shall be performed to assess and document the possibility of an initiating event resulting from individual systems or train failures.
IE-11	<u>Subsumed Initiating Events</u> • Treatment of subsumed initiating events is traceable		The documentation should provide a detailed accounting of discrete plant upsets and how they transfer into the final initiating event categories, including a focus on numerical details.	The documentation should provide a detailed accounting of discrete plant upsets and how they transfer into the final initiating event categories, including a focus on numerical details.
IE-12	• Subsumed initiating events are included <u>OR</u> • Subsumed initiating events are included, in non-risk significant sequences or non-risk significant initiators <u>OR</u> • Complete list of initiating events within the state of the technology. Detailed plant specific development.	Subsumed initiating events are included	Subsumed initiating events are included, in non-risk significant sequences or non-risk significant initiators	Complete list of initiating events within the state of the technology. Detailed plant specific development.

Table 5-1

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: INITIATING EVENT

Designator	CRITERIA	SUBTIER CRITERIA: Risk Ranking Prioritization	SUBTIER CRITERIA: Risk-Informed Decisions	SUBTIER CRITERIA: Risk-Based Decisions
IE-13	DATA • Initiating event frequencies and recovery are consistent with industry experience or analysis	The process for comparing initiating events and recovery probabilities may be formalized and documented. The results of the initiating event analysis may be compared with generic data sources to provide a reasonableness check of the quantitative and qualitative results.	The process for comparing initiating events and recovery probabilities should be formalized and documented. The calculated frequencies and any associated recovery should be consistent with industry experience unless a design or procedural difference exists that would provide the basis for a difference. The results of the initiating event analysis should be compared with generic data sources to provide a reasonableness check of the quantitative and qualitative results. A documented review/comparison with industry generic data should be performed.	The process for comparing initiating events and recovery probabilities shall be formalized and the results documented for review by the peer review process. The calculated frequencies and any associated recovery should be consistent with industry experience unless a design or procedural difference exists that would provide the basis for a difference. The results of the initiating event analysis shall be compared with generic data sources to provide a reasonableness check of the quantitative and qualitative results. A documented review/comparison with industry generic data should be performed.
IE-14	• The features that lead to the frequency of interfacing system LOCA (e.g., surveillance test practices, start up procedures, etc.) are modeled explicitly or identified in the PSA documentation.	Interfacing system LOCA analysis may address the most dominant features of plant and procedures that may influence the ISLOCA frequency.	Interfacing system LOCA analysis should address the most dominant features of plant and procedures that may influence the ISLOCA frequency.	The ISLOCA frequency should explicitly address the plant and procedural features that influence the calculation: • Surveillance procedure steps should be evaluated • Surveillance test intervals should be explicitly included • One-line surveillance testing should be quantitatively assessed • Pipe rupture probability should be quantified • Valve design (e.g., air operated testable check valves) are explicitly addressed • Valve isolation capability given the high to low pressure differential should be quantitatively included

Table 5-1

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: INITIATING EVENT

Designator	CRITERIA	SUBTIER CRITERIA: Risk Ranking Prioritization	SUBTIER CRITERIA: Risk-Informed Decisions	SUBTIER CRITERIA: Risk-Based Decisions
IE-15	• Plant specific features are reflected in the initiating event frequency and recovery inputs where appropriate	For rare events, industry generic data may be used or augmented with a plant specific fault tree evaluation which accounts for plant specific features. For extremely rare events, engineering judgement may be used augmented by applicable generic data sources.	The plant specific features that may influence initiating events and recovery probabilities should be included in the quantification. Examples of plant specific features which should be included are the following: • Plant geography for LOOP and LOOP recovery • Service water intake characteristics and plant experience • LOCA frequency calculation For rare events, industry generic data should be used or augmented with a plant specific fault tree evaluation which accounts for plant specific features. For extremely rare events, engineering judgement may be used and should be augmented by applicable generic data sources.	The plant specific features that may influence initiating events and recovery probabilities should be included in the quantification. Examples of plant specific features which should be included: • Plant location for LOOP and LOOP recovery • Service water intake characteristics and plant experience • LOCA frequency calculation For rare events, industry generic data shall be investigated and its appropriateness evaluated. In addition, a plant specific fault tree evaluation which accounts for plant specific features shall be developed. The use of the generic data or the fault tree shall be documented and the comparison provided. For extremely rare events, engineering judgement may be used and should be augmented by applicable generic data sources.

Table 5-1

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: INITIATING EVENT

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk-Informed Decisions	Risk-Based Decisions
IE-16	• Plant specific experience is reflected in the initiating event definitions and frequency plus recovery inputs where appropriate	Plant specific data may be used to characterize the initiating event frequency. Recovery probabilities may reflect plant specific features of procedures.	The initiating event frequency should be calculated directly from plant specific data, if sufficient data is available. The initiating event frequency should use the most recent available data to quantitatively characterize the initiating event frequencies. Rectification actions that are credited should be documented. The initiating event frequency should use a Bayesian update process of generic industry data if only limited data is available. The initiating event frequency should not use data from the initial year of commercial operation. Recovery data may be even more difficult to justify. However, plant specific information should be used in the assessment where available.	Plant specific data shall be used for all initiating events that have occurred. The initiating event frequency should use the most recent available data to quantitatively characterize the initiating event frequencies. Rectification actions that are credited should be documented. The initiating event frequency should use a Bayesian update process of generic industry data if only limited data is available. The initiating event frequency should not use data from the initial year of commercial operation. Recovery data may be even more difficult to justify. However, plant specific information should be used in the assessment where available.
IE-17	• A systematic process is used to identify the need for and application of techniques such as plant specific models or FMEAs, to quantify initiating event frequencies and recovery. (See also SY-21)	A systematic qualitative evaluation of each system should be performed to assess the possibility of an initiating event occurring due to the system.	A systematic evaluation should be performed to ascertain whether a technique such as an FMEA or fault tree should be developed for a given system with the intent of identifying whether an initiating event should be included for the given system or train.	A systematic evaluation should be performed using a defined process (FMEA or Fault tree analysis) to assess the possibility of an initiating event due to each plant system and train.
IE-18	DOCUMENTATION • Documentation provides the basis of the quantified values and is traceable	The initiating event frequencies shall be documented.	Documentation should provide the derivation of the initiating event frequencies and the recoveries used in conjunction with the initiating event.	Documentation should provide the derivation of the initiating event frequencies and the recoveries used in conjunction with the initiating event.

Table 5-1

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: INITIATING EVENT

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk-Informed Decisions	Risk-Based Decisions
IE-19	• Documentation reflects the process used	Documentation may reflect process features.	Documentation should provide the basis for meeting each of the criteria IE-4 through IE-17. The documentation shall describe the results consistent with the process.	Documentation shall provide the basis for meeting each of the criteria IE-4 through IE-17. The documentation shall describe the results consistent with the process.
IE-20	• Documentation provides the basis for the initiating event frequency groupings	The initiating event analysis should be reviewed.	Documentation should provide the basis for grouping of initiating events.	Documentation shall provide the basis for grouping of initiating events.
IE-21	• Independent review provided for the documented results	The initiating event analysis should be reviewed.	Independent review should be performed and documented by knowledgeable personnel.	Independent review should be performed and documented by knowledgeable personnel. Independent review of the initiating event interpretation and categorization process should be performed by operations personnel or equivalent.

Table 5-2

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: ACCIDENT SEQUENCE EVALUATION

Designator	CRITERIA	SUBTIER CRITERIA Risk Ranking	 Risk Significance	 Risk Input as Sole Basis
AS-1	GUIDANCE • Describes the process used	General description of the accident sequence analysis process is provided.	The documentation of the accident sequence analysis should be sufficiently well described in the documented results to act as guidance for future updates and revisions.	A specific guidance document should be available that specifies the process for accident sequence analysis including the updating process.
AS-2	• Consistent with industry practices	General adherence to accepted industry approaches is included.	The guidance should provide a reasonable basis for performing the accident sequence analysis and should maintain consistency with proven approaches.	The guidance for accident sequence analysis should be complete and detailed and should maintain consistency with proven approaches.
AS-3	• Sufficient detail provided for reproducing the evaluation	Guidance may be available to supply general approaches used.	The guidance should be sufficient to provide a means to obtain equivalent results.	The guidance shall be sufficiently detailed to reproduce the results.
AS-4	ACCIDENT SCENARIO EVALUATION • The event trees reflect the initiating event groupings	Event trees should reflect the initiating event groups. The plant response to the different initiating event groups shall be modeled. This includes: timing, system success criteria, operator actions. There should be a direct correlation between the initiating event groups and the event tree modeled response. Note: while event trees should be developed, other logic models may be justified to replace the event tree structure (e.g., single top fault tree).	Event trees shall reflect the initiating event groups. The plant response to the different initiating event groups shall be modeled. This includes: timing, system success criteria, operator actions. There should be a direct correlation between the initiating event groups and the event tree modeled response. The event trees should reflect the initiating events and their potential for impact on mitigation systems. Note, while event trees should be developed, other logic models may be justified to replace the event tree structure (e.g., single top fault tree).	Event trees shall reflect the initiating event groups. The plant response to the different initiating event groups shall be modeled. This includes: timing, system success criteria, operator actions. There should be a direct correlation between the initiating event groups and the event tree modeled response. The event trees should reflect the initiating events and their potential for impact on mitigation systems. Note: While event trees should be developed, other logic models may be justified to replace the event tree structure (e.g., single top fault tree).
AS-5	• The models and analysis are consistent with the as-built plant (as could be confirmed during the Peer Review process)[6]	The models and analysis should be consistent with the as-built plant. Conservative modeling of the as-built plant may result from lack of available information. System analysis and dependency evaluation tasks of the PRA shall provide input to the accident sequence model development.	The models and analysis shall be consistent with the as-built plant. Realistic modeling of the as-built plant should be performed as supported by available information. System analysis and dependency evaluation tasks of the PRA shall provide input to the accident sequence model development.	The models and analysis shall be consistent with the as-built plant. Realistic modeling of the as-built plant shall be performed as supported by available information. System analysis and dependency evaluation tasks of the PRA shall provide input to the accident sequence model development.

Table 5-2

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: ACCIDENT SEQUENCE EVALUATION

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking	Risk Significance	Risk Input as Sole Basis
AS-6	• The necessary critical safety functions are modeled in each sequence	The necessary critical safety functions to reach a safe stable state shall be included in the model. Critical safety functions may be addressed quantitatively or qualitatively in the PRA. Typical critical safety functions that may be left out of a risk ranking model may include: • Vapor Suppression • RPT • ARI • Containment heat removal following: - successful ATWS mitigation - successful AC power recovery	The necessary critical safety functions to reach a safe stable state shall be included in the model. Each necessary critical safety function should be explicitly included in the quantitative model. Exceptions to the critical safety functions should be clearly defined.	The necessary critical safety functions to reach a safe stable state shall be included in the model. Each necessary critical safety function shall be explicitly included in the quantitative model. Exceptions to the critical safety functions should be clearly defined.
AS-7	• All relevant systems are credited for each function	All relevant systems may be included quantitatively in the model.	All relevant systems should be credited in the quantified model.	All relevant systems to support the critical safety functions shall be included in the quantified model.

Table 5-2

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: ACCIDENT SEQUENCE EVALUATION

		SUBTIER CRITERIA		
Designator	CRITERIA	Risk Ranking	Risk Significance	Risk Input as Sole Basis
AS-8	• The branching structure and transfers among event trees maintain and resolve the failure paths	The branching structure and transfers among event trees should maintain and resolve the failure paths. A reasonably complete set of event sequences involving core damage that could result from each modeled initiating event should be developed. The level of discrimination in the event tree structure should be sufficient to represent the key procedurally directed operator actions and critical safety function challenges. The transfers among event trees should preserve the dependencies that are part of the transferred sequence. This includes functional, system, initiating event, operator, and spatial or environmental dependencies.	The branching structure and transfers among event trees shall maintain and resolve the failure paths. Transfers between event trees should be clearly defined and may be treated quantitatively or qualitatively. A reasonably complete set of event sequences involving core damage that could result from each modeled initiating event shall be developed. The level of discrimination in the event tree structure should be sufficient to represent the key procedurally directed operator actions and critical safety function challenges. The transfers among event trees should preserve the dependencies that are part of the transferred sequence. This includes functional, system, initiating event, operator, and spatial or environmental dependencies.	The branching structure and transfers among event trees shall maintain and resolve the failure paths. Transfers between event trees shall be clearly defined and treated quantitatively. A reasonably complete set of event sequences involving core damage that could result from each modeled initiating event shall be developed. The level of discrimination in the event tree structure should be sufficient to represent the key procedurally directed operator actions and critical safety function challenges. The transfers among event trees should preserve the dependencies that are part of the transferred sequence. This includes functional, system, initiating event, operator, and spatial or environmental dependencies.
AS-9	• Success paths are defined correctly	Success paths shall be defined correctly. Conservative bias to the treatment of success paths may be included.	Success paths shall be defined correctly. Realistic treatment of success paths should be implemented.	Success paths shall be defined correctly. Realistic treatment of success paths shall be implemented.

Table 5-2

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: ACCIDENT SEQUENCE EVALUATION

Designator	CRITERIA	SUBTIER CRITERIA: Risk Ranking	SUBTIER CRITERIA: Risk Significance	SUBTIER CRITERIA: Risk Input as Sole Basis
AS-10	• Dependencies among top events are identified and addressed	Dependencies among top events should be identified and may be treated quantitatively or qualitatively. Accident sequence dependencies may be accounted for: Functional: Functional failures due to the accident sequence may be addressed, e.g.: a) LOCA initiator causes debris clogging of ECCS Suction b) turbine driven system dependency on SORV, depressurization, and containment heat removal (suppression pool cooling). c) low pressure system injection success dependent on need for RPV depressurization. Intra and Intersystem: Common cause may be treated per dependency criteria. System dependencies can be assessed in system notebooks, dependency matrices, or linked fault trees. Human: Adverse environment or sequence timing influences on operator actions may be included in the HRA. Spatial/Environmental: Spatial/ Environmental dependencies that may result from initiating events and subsequent sequences may be included in the accident sequence evaluation.	Dependencies among top events shall be identified and should be included quantitatively in the model. Accident sequence dependencies should be accounted for: Functional: Functional failures due to the accident sequence should be addressed, e.g.: a) LOCA initiator causes debris clogging of ECCS Suction b) turbine driven system dependency on SORV, depressurization, and containment heat removal (suppression pool cooling). c) low pressure system injection success dependent on need for RPV depressurization. Intra and Intersystem: Common cause should be treated per dependency criteria. System dependencies should be assessed in system notebooks, dependency matrices, or linked fault trees. Human: Adverse environment or sequence timing influences on operator actions should be included in the HRA. Spatial/Environmental: Spatial/Environmental dependencies that may result from initiating events and subsequent sequences should be included in the accident sequence evaluation.	Dependencies among top events shall be identified and shall be quantitatively included in the model. Accident sequence dependencies shall be accounted for: Functional: Functional failures due to the accident sequence shall be addressed, e.g.: a) LOCA initiator causes debris clogging of ECCS Suction b) turbine driven system dependency on SORV, depressurization, and containment heat removal (suppression pool cooling). c) low pressure system injection success dependent on need for RPV depressurization. Intra and Intersystem: Common cause shall be treated per dependency criteria. System dependencies shall be assessed in system notebooks, dependency matrices, or linked fault trees. Human: Adverse environment or sequence timing influences on operator actions shall be included in the HRA. Spatial/Environmental: Spatial/ Environmental dependencies that may result from initiating events and subsequent sequences shall be included in the accident sequence evaluation.
AS-11	• The method of treating dependencies is documented and consistently applied to capture the dependencies among top events.	The method of treating dependencies should be documented and consistently applied to capture the dependencies among top events. Conservative bias to the treatment of dependencies may be incorporated into the model.	The method of treating dependencies should be documented and consistently applied to capture the dependencies among top events. A realistic treatment of the dependencies should be implemented.	The method of treating dependencies shall be documented and consistently applied to capture the dependencies among top events. A realistic treatment of the dependencies shall be implemented.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: ACCIDENT SEQUENCE EVALUATION

Designator	CRITERIA	SUBTIER CRITERIA Risk Ranking	 Risk Significance	 Risk Input as Sole Basis
AS-12	• PWRs: An appropriate model for the reactor coolant pump seal LOCA, which may result from a loss of seal cooling due to various causes, is used and documented. Appropriate seal cooling dependencies are considered. OR • BWRs: The recirculation pump seal LOCA which may result after a loss of offsite power, or a loss of seal cooling is addressed for the isolation condenser plants	Pump seal LOCA should be explicitly incorporated in the PSA model.	Pump seal LOCA should be explicitly incorporated in the PSA model.	Pump seal LOCA shall be explicitly incorporated in the model.
AS-13	• Time phased evaluation is included for sequences with significant time dependent failure modes (e.g., batteries for SBO, PWR RCP seal LOCA) and significant recoveries (e.g., AC recovery for SBO)	Time phased analysis for accident sequences with well defined potential for recovery may be included in the quantified model.	Time phased analysis for accident sequences with well defined potential for recovery should be included in the quantified model.	Time phased analysis for accident sequences with well defined potential for recovery shall be included in the quantified model.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: ACCIDENT SEQUENCE EVALUATION

Designator	CRITERIA	SUBTIER CRITERIA: Risk Ranking	SUBTIER CRITERIA: Risk Significance	SUBTIER CRITERIA: Risk Input as Sole Basis
AS-13 (cont'd)			The following time phased events may be included in a realistic assessment of the accident sequences and the procedurally directed operator actions resulting for LOOP/SBO; • AC power recovery • DC battery adequacy (time dependent discharge) • Environmental conditions (e.g., room cooling) for operating equipment and the control room • Suppression pool temperature (i.e., HCTL) • Containment pressure • CST inventory • Drywell temperature • Recirc Pump Seal Failure • RPV Pressure (as it is needed for turbine driven systems IC effectiveness, low pressure injection systems) • Isolation Condenser Makeup Similarly, for ATWS/failure to scram events, key time dependent actions which may be included: • SBLC initiation • RPV level control • ADS inhibit Other events that may be subject to strong time dependent characterization include: • CRD as an adequate RPV injection source As part of the time dependence assessment, the following should be addressed: • Mission time of diesel generators • Mission time of RPT, ARI, scram system	The following time phased events should be included in a realistic assessment of the accident sequences and the procedurally directed operator actions resulting for LOOP/SBO; • AC power recovery • DC battery adequacy (time dependent discharge) • Environmental conditions (e.g., room cooling) for operating equipment and the control room • Suppression pool temperature (i.e., HCTL) • Containment pressure • CST inventory • Drywell temperature • Recirc Pump Seal Failure • RPV Pressure (as it is needed for turbine driven systems IC effectiveness, low pressure injection systems) • Isolation Condenser Makeup Similarly, for ATWS/failure to scram events, key time dependent actions which should be included: • SBLC initiation • RPV level control • ADS inhibit Other events that may be subject to strong time dependent characterization include: • CRD as an adequate RPV injection source As part of the time dependence assessment, the following should be addressed: • Mission time of diesel generators • Mission time of RPT, ARI, scram system

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: ACCIDENT SEQUENCE EVALUATION

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking	Risk Significance	Risk Input as Sole Basis
AS-14	• Functions and structure are adequate to discriminate among plant conditions necessary for Level 2 analysis	LERF only should be able to be determined from the Level 1 end state results.	LERF shall be able to be determined from the Level 1 end state results. Accident sequences with significantly different plant response impacts or which may have more severe radionuclide release potential (e.g., LERF) should be treated explicitly. This includes: • excessive LOCA • ATWS • ISLOCA • Breaks in high energy lines outside containment These should be evaluated in a realistic manner and have the capability to be assessed in sensitivity studies. Non-conservative grouping (subsuming of sequences into broader categories not bounded by the worst case accident) shall not be performed.	LERF shall be able to be determined from the Level 1 end state results. Accident sequences with significantly different plant response impacts or which may have more severe radionuclide release potential (e.g., LERF) should be treated explicitly. This includes: • excessive LOCA • ATWS • ISLOCA • Breaks in high energy lines outside containment These shall be evaluated in a realistic manner and have the capability to be assessed in sensitivity studies. Non-conservative grouping (subsuming of sequences into broader categories not bounded by the worst case accident) shall not be performed.
AS-15	• Transfers among event trees are performed correctly to avoid loss of information in the transfer	Transfers among event trees should be explicitly treated in the quantification except for cases that are noted in the documented descriptions of the sequences. Treatment of single top fault tree as the base model shall conform to all applicable requirements. Requirements that cannot be met should be identified and justification provided.	Transfers among event trees should be explicitly treated in the quantification and shall be documented. Treatment of single top fault tree as the base model shall conform to all applicable requirements. Requirements that cannot be met should be identified and justification provided.	Transfers among event trees shall be explicitly treated in the quantification and documented. Treatment of single top fault tree as the base model shall conform to all applicable requirements. Requirements that cannot be met should be identified and justification provided.
AS-16	• System/component repair and recovery, if included in the accident sequences, are correctly modeled	Conservative evaluations of repair and recovery may be incorporated in the model.	Repair and recovery included in the PSA model should be based on data or accepted models applicable to the plant and should account for accident sequence dependencies such as time available, adverse environment, and lack of access, lighting, or room cooling.	Repair and recovery included in the PSA model shall be based on data or accepted models applicable to the plant and shall account for accident sequence dependencies such as time available, adverse environment, and lack of access, lighting, or room cooling.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: ACCIDENT SEQUENCE EVALUATION

		SUBTIER CRITERIA		
Designator	CRITERIA	Risk Ranking	Risk Significance	Risk Input as Sole Basis
AS-17	SUCCESS CRITERIA • Functional success criteria are identified	Functional success criteria should be identified and documented. The critical safety functions that should have technical bases developed to support the probabilistic analyses include the following: • Reactivity Control - Control Rods - Boron Injection - RPV Water Level Control • RPV Makeup Injection for Core Cooling - High Pressure Injection - Low Pressure Injection - Depressurization - Containment Flooding • RPV Pressure Control - SRVs/SVs/TBVs - Feedwater Trip - RPT - ARI - Control rods - IC • Containment Pressure Control - Vapor Suppression - Containment Heat Removal - Containment Venting	Functional success criteria should be identified and documented. The critical safety functions that should have technical bases developed to support the probabilistic analyses include the following: • Reactivity Control - Control Rods - Boron Injection - RPV Water Level Control • RPV Makeup Injection for Core Cooling - High Pressure Injection - Low Pressure Injection - Depressurization - Containment Flooding • RPV Pressure Control - SRVs/SVs/TBVs - Feedwater Trip - RPT - ARI - Control rods - IC • Containment Pressure Control - Vapor Suppression - Containment Heat Removal - Containment Venting	Functional success criteria shall be identified and documented. The critical safety functions that shall have technical bases developed to support the probabilistic analyses include the following: • Reactivity Control - Control Rods - Boron Injection - RPV Water Level Control • RPV Makeup Injection for Core Cooling - High Pressure Injection - Low Pressure Injection - Depressurization - Containment Flooding • RPV Pressure Control - SRVs/SVs/TBVs - Feedwater Trip - RPT - ARI - Control rods - IC • Containment Pressure Control - Vapor Suppression - Containment Heat Removal - Containment Venting

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: ACCIDENT SEQUENCE EVALUATION

		SUBTIER CRITERIA		
Designator	CRITERIA	Risk Ranking	Risk Significance	Risk Input as Sole Basis
AS-18	SUCCESS CRITERIA BASES • Success criteria are consistent with generic and realistic analyses but may be conservative OR • Success criteria are based on realistic thermal hydraulic analyses OR • Success criteria reflect plant specific thermal hydraulic analysis	Success criteria should be consistent with generic and realistic analyses but may be conservative. The success criteria used for the initiating event group and its associated event tree shall represent the most limiting of the initiating events and system failures encompassed by the initiating event group and accident sequence representation. The TH Element addresses the technical bases to support these success criteria.	Success criteria should be based on realistic thermal hydraulic analyses. The success criteria used for the initiating event group and its associated event tree shall represent the most limiting of the initiating events and system failures encompassed by the initiating event group and accident sequence representation. The TH Element addresses the technical bases to support these success criteria.	Success criteria should reflect realistic plant specific thermal hydraulic analysis. The success criteria used for the initiating event group and its associated event tree shall represent the most limiting of the initiating events and system failures encompassed by the initiating event group and accident sequence representation. The TH Element addresses the technical bases to support these success criteria.
AS-19	INTERFACE WITH EOPs/AOPs • Reflects the EOPs and AOPs. (The functions and structure of the event trees are consistent with the EOPs and abnormal procedures). (See also SY-5)	The functions and structure of the event trees should be consistent with the EOPs and abnormal procedures. Exceptions may be noted; or level of detail may be less deep.	The functions and structure of the event trees shall be consistent with the EOPs and abnormal procedures. Procedurally directed operator actions (both positive and negative impacts) that substantially influence the accident sequence progression or its probability should be accounted for in the accident sequence structure or the supporting fault tree analysis. This should include operator training input on the interpretation of proceduralized steps.	(The functions and structure of the event trees shall be consistent with the EOPs and abnormal procedures). Procedurally directed operator actions (both positive and negative impacts) that substantially influence the accident sequence progression or its probability shall be accounted for in the accident sequence structure or the supporting fault tree analysis. This shall include operator training input on the interpretation of proceduralized steps.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: ACCIDENT SEQUENCE EVALUATION

		SUBTIER CRITERIA		
Designator	CRITERIA	Risk Ranking	Risk Significance	Risk Input as Sole Basis
AS-20	ACCIDENT SEQUENCE END-STATES (PLANT DAMAGE STATES) [5] • The development of plant damage states, their relationship to functional failures, and their relationship to Level 1 event tree end states or linked fault tree cut sets is documented.	The Level 1 end state shall be clearly defined as core damage or a safe stable state. The core damage definition may be consistent with the PSA Applications Guide. The PSA Applications Guide has identified definitions of core damage that would meet the intent of a core damage to be used for PRA applications as follows: • Collapsed liquid level less than 1/3 core height (BWR) • Collapsed liquid level below top of active fuel (PWR) • Core peak nodal temperature > 1800°F • Core exit thermocouple reading > 1200°F (PWR) • Core maximum fuel temperature approaching 2200°F Other end states such as "core vulnerable" should be resolved into core damage or safe stable states. This resolution should clearly address the treatment of the impact of containment failure or vent on continued RPV makeup capability.	The Level 1 end state shall be clearly defined as core damage or a safe stable state. The core damage definition should be consistent with the PSA Applications Guide. The PSA Applications Guide has identified definitions of core damage that would meet the intent of a core damage to be used for PRA applications as follows: • Collapsed liquid level less than 1/3 core height (BWR) • Collapsed liquid level below top of active fuel (PWR) • Core peak nodal temperature > 1800°F • Core exit thermocouple reading > 1200°F (PWR) • Core maximum fuel temperature approaching 2200°F Other end states such as "core vulnerable" shall be resolved into core damage or safe stable states. This resolution shall clearly address the treatment of the impact of containment failure or vent on continued RPV makeup capability.	The Level 1 end state shall be clearly defined as core damage or a safe stable state. The core damage definition shall be consistent with the PSA Applications Guide. The PSA Applications Guide has identified definitions of core damage that would meet the intent of a core damage to be used for PRA applications as follows: • Collapsed liquid level less than 1/3 core height (BWR) • Collapsed liquid level below top of active fuel (PWR) • Core peak nodal temperature > 1800°F • Core exit thermocouple reading > 1200°F (PWR) • Core maximum fuel temperature approaching 2200°F Other end states such as "core vulnerable" shall be resolved into core damage or safe stable states. This resolution shall clearly address the treatment of the impact of containment failure or vent on continued RPV makeup capability.
AS-21	• Plant damage states are sufficient to support the transfer of information to Level 2	Level 1 plant damage states should provide adequate information to support Level 2 analysis with minimal loss of information. If individual sequence cut sets are assigned to Plant Damage States (PDS), sufficient information may be imbedded in the cutset basic events to unambiguously assign a unique PDS.	Level 1 plant damage states shall provide adequate information to support Level 2 analysis with minimal loss of information. If individual sequence cut sets are assigned to Plant Damage States (PDS), sufficient information should be imbedded in the cutset basic events to unambiguously assign a unique PDS.	All accident sequences are transferred directly to Level 2 for processing with no loss of information. If individual sequence cut sets are assigned to Plant Damage States (PDS), sufficient information shall be imbedded in the cutset basic events to unambiguously assign a unique PDS.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: ACCIDENT SEQUENCE EVALUATION

Designator	CRITERIA	SUBTIER CRITERIA: Risk Ranking	SUBTIER CRITERIA: Risk Significance	SUBTIER CRITERIA: Risk Input as Sole Basis
AS-22	• Plant damage states are based on a clear, consistent definition of CDF that is consistent with industry usage	The CDF definition is conservative and may bias the results of the quantified model.	The CDF definition should be realistic and avoid biasing the results of the Level 1 PRA.	The CDF definition shall be realistic and avoid biasing the results of the Level 1 PRA.
AS-23	• Plant damage states are based on mission time of 24 hours or separately justified	The mission time may be defined to be 24 hours or an appropriate representation for the accident sequence. Alternative mission times may be included if additional justification is provided.	The mission time should be defined to be 24 hours or an appropriate representation for the accident sequence. Alternative mission times may be included if additional justification is provided.	The mission time should be defined to be 24 hours or an appropriate representation for the accident sequence. Alternative mission times may be included if additional justification is provided.
AS-24	DOCUMENTATION • Documentation provides the basis of event tree structure and is traceable to plant specific or generic analysis	Examples of methods of documentation include: event sequence diagrams, text descriptions dependency matrices.	Examples of methods of documentation include: event sequence diagrams, text descriptions dependency matrices. Documentation should provide the basis for meeting each of the criteria AS-4 through AS-23. The documentation shall describe the results consistent with the process.	Examples of methods of documentation include: event sequence diagrams, text descriptions dependency matrices. Documentation shall provide the basis for meeting each of the criteria AS-4 through AS-23. The documentation shall describe the results consistent with the process.
AS-25	• Documentation reflects the process used	Documentation may reflect process features.	Documentation should provide the basis for accident sequence process.	Documentation shall provide the basis for accident sequence process.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: ACCIDENT SEQUENCE EVALUATION

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking	Risk Significance	Risk Input as Sole Basis
AS-26	• Documentation includes an independent review for the documented results	The accident sequence analysis should be reviewed.	Independent review of documented results is one of the pillars on which the integrity and quality of engineering work rests. Because of the complexity of the PSA model, it is desirable to have a thorough independent review of the accident sequence modeling. A documented summary of the treatment of each initiator and event tree would be useful to support applications. Independent review should be performed and documented by knowledgeable personnel.	Independent review of documented results is one of the pillars on which the integrity and quality of engineering work rests. Because of the complexity of the PSA model, it is desirable to have a thorough independent review of the accident sequence modeling. A documented summary of the treatment of each initiator and event tree would be useful to support applications. Independent review should be performed and documented by knowledgeable personnel. Independent review of the initiating event interpretation and categorization process should be performed by operations personnel or equivalent.

Table 5-3

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: SUCCESS CRITERIA AND THERMAL HYDRAULIC ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
TH-1	GUIDANCE • Describes the process used	General description of the derivation of success criteria and the use of thermal hydraulic calculations is provided.	The documentation of the derivation of success criteria and the use of thermal hydraulic calculations should be sufficiently well described in the documented results to act as guidance for future updates and revisions. A description of the approach to be used for determining the need for thermal hydraulic (T&H) calculations and the type of T&H calculation to perform along with the output needed should be provided.	A specific guidance document should be available that specifies the process for derivation of success criteria and the use of thermal hydraulic calculations including the updating process. A description of the approach to be used for determining the need for thermal hydraulic (T&H) calculations and the type of T&H calculation to perform along with the output needed should be provided. An overall guidance document on the construction and maintenance of the PRA should include a description of the types of thermal-hydraulic analyses needed and their applicability.
TH-2	• Consistent with industry practices	General adherence to accepted industry approaches is included.	The guidance should provide a reasonable basis for performing the derivation of success criteria and the use of thermal hydraulic calculations and should maintain consistency with proven approaches.	The guidance for derivation of success criteria and the use of thermal hydraulic calculations should be complete and detailed and should maintain consistency with proven approaches.
TH-3	• Sufficient detail provided for reproducing the evaluation	Guidance may be available to supply general approaches used.	The guidance should be sufficient to provide a means to obtain equivalent results.	The guidance should be sufficiently detailed to reproduce the results.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: SUCCESS CRITERIA AND THERMAL HYDRAULIC ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
TH-4	T&H ANALYSES • FSAR analyses are used exclusively as basis for Thermal Hydraulic analysis OR • Generic assessments are used as sole basis for Thermal Hydraulic analysis OR	AS-17 provides the criteria that functional success criteria should be established for all critical safety functions. AS-20 provides the criteria that core damage prevention should be the basis for assuring successful end states. This element and subtier criteria establish the technical analysis used to support these success criteria.	AS-17 provides the criteria that functional success criteria should be established for all critical safety functions. AS-20 provides the criteria that core damage prevention should be the basis for assuring successful end states. This element and subtier criteria establish the technical analysis used to support these success criteria.	AS-17 provides the criteria that functional success criteria shall be established for all critical safety functions. AS-20 provides the criteria that core damage prevention shall be the basis for assuring successful end states. This element and subtier criteria establish the technical analysis used to support these success criteria.
TH-4 (cont'd)	• Plant specific best-estimate (e.g., MAAP, RETRAN, etc.) models or equivalent are used for support of Thermal Hydraulic analysis (supported by FSAR or generic analysis)	The critical safety functions that should have technical bases developed to support the probabilistic analyses include the following: • Reactivity Control - Control Rods - Boron Injection - RPV Water Level Control • RPV Makeup Injection for Core Cooling - High Pressure Injection - Low Pressure Injection - Depressurization - Containment Flooding • RPV Pressure Control - SRVs/SVs/TBVs - Feedwater Trip - RPT - ARI - Control rods - IC	The critical safety functions that should have technical bases developed to support the probabilistic analyses include the following: • Reactivity Control - Control Rods - Boron Injection - RPV Water Level Control • RPV Makeup Injection for Core Cooling - High Pressure Injection - Low Pressure Injection - Depressurization - Containment Flooding • RPV Pressure Control - SRVs/SVs/TBVs - Feedwater Trip - RPT - ARI - Control rods - IC	The critical safety functions that should have technical bases developed to support the probabilistic analyses include the following: • Reactivity Control - Control Rods - Boron Injection - RPV Water Level Control • RPV Makeup Injection for Core Cooling - High Pressure Injection - Low Pressure Injection - Depressurization - Containment Flooding • RPV Pressure Control - SRVs/SVs/TBVs - Feedwater Trip - RPT - ARI - Control rods - IC

Table 5-3

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: SUCCESS CRITERIA AND THERMAL HYDRAULIC ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
		• Containment Pressure Control - Vapor Suppression - Containment Heat Removal - Containment Venting FSAR analyses may be used exclusively as basis for Thermal Hydraulic analysis	• Containment Pressure Control - Vapor Suppression - Containment Heat Removal - Containment Venting Generic assessments may be used as sole basis for Thermal Hydraulic analysis	• Containment Pressure Control - Vapor Suppression - Containment Heat Removal - Containment Venting Plant specific best-estimate (e.g., MAAP, RETRAN, etc.) models or equivalent should be used for support of Thermal Hydraulic analysis (supported by FSAR or generic analysis)
TH-5	<u>MULTIPLE T&H INPUTS</u> • A combination of plant specific, generic and FSAR calculations are used to support success criteria and HRA timing.	The review of the as-built, as operated plant performed as part of the AS, SY, and HRA elements may be used to confirm that the thermal hydraulic analyses are also current with the plant.	The review of the as-built, as operated plant performed as part of the AS, SY, and HRA elements should be used to confirm that the thermal hydraulic analyses are also current with the plant.	The review of the as-built, as operated plant performed as part of the AS, SY, and HRA elements shall be used to confirm that the thermal hydraulic analyses are also current with the plant.

Table 5-3

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: SUCCESS CRITERIA AND THERMAL HYDRAULIC ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
		Reliance on plant specific analysis should include consideration of whether the code is capable of providing the necessary information, and the model is representative of the specific plant to which the results are to be applied. For example, two items are believed not to be well modeled using MARCH, BWRSAR, or MAAP: a) The need or RPT to prevent reactivity and pressure excursion in the RPV within the initial 20 seconds of an ATWS b) The ability of a DBA LOCA to be mitigated in the short term (71 min.) by operation of condensate.	Reliance on plant specific analysis should include consideration of whether the code is capable of providing the necessary information and the model is representative of the specific plant to which the results are to be applied. For example, two items are believed not to be well modeled using MARCH, OR BWRSAR, or MAAP: a) The need or RPT to prevent reactivity and pressure excursion in the RPV within the initial 20 seconds of an ATWS b) The ability of a DBA LOCA to be mitigated in the short term by operation of condensate. The generic BWROG document NEDO-24708A using the code SAFE is judged to be a useful reference for confirming plant specific analyses. This calculation should be used to support results from codes such as MAAP. An example of an area where the use of the NEDO-24708A would prove useful is to identify that RCIC alone as an injection source is not adequate under SORV conditions. Generic calculations from NEDE-24222 should be used to check ATWS success criteria and plant specific calculations.	Reliance on plant specific analysis shall include consideration of whether the code is capable of providing the necessary information and the model is representative of the specific plant to which the results are to be applied. For example, two items are believed not to be well modeled using MARCH or BWRSAR, or MAAP: a) The need or RPT to prevent reactivity and pressure excursion in the RPV within the initial 20 seconds of an ATWS b) The ability of a DBA LOCA to be mitigated in the short term by operation of condensate. The generic BWROG document NEDO-24708A using the code SAFE is judged to be a useful reference for confirming plant specific analyses. This calculation should be used to support results from codes such as MAAP. An example of an area where the use of the NEDO-24708A would prove useful is to identify that RCIC alone as an injection source is not adequate under SORV conditions. Generic calculations from NEDE-24222 should be used to check ATWS success criteria and plant specific calculations.

Table 5-3

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: SUCCESS CRITERIA AND THERMAL HYDRAULIC ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
TH-6	GENERIC ASSESSMENTS • Application of the generic assessments account for limitations of the generic analysis when applied to the specific plant	Reliance on generic analysis should include consideration of whether the code is capable of providing the necessary information.	Reliance on generic analysis should include consideration of whether the code is capable of providing the necessary information.	Reliance on generic analysis shall include consideration of whether the code is capable of providing the necessary information.
TH-7	BEST ESTIMATE CALCULATIONS (e.g., MAAP, RETRAN, SAFER-GESTER) • Application of the T & H codes account for the limitations of each of the codes	Confidence in the thermal hydraulic analysis used to support the success criteria may be established by: • comparison with similar plant results • accounting for differences in the unique plant features • comparison with other plant specific code results	Confidence in the thermal hydraulic analysis used to support the success criteria should be established by: • comparison with similar plant results • accounting for differences in the unique plant features • comparison with other plant specific code results	Confidence in the thermal hydraulic analysis used to support the success criteria shall be established by: • comparison with similar plant results • accounting for differences in the unique plant features • comparison with other plant specific code results
			Success criteria are generally based on models that simulate the conditions during postulated scenarios. However, the adequacy of the simulation varies with the computer model and the scenario. A description of the limitations of the model should be documented for those cases in which the model is used. This should include both potential conservatisms and limitations that may void the use of the computer model.	Success criteria are generally based on models that simulate the conditions during postulated scenarios. However, the adequacy of the simulation varies with the computer model and the scenario. A description of the limitations of the model should be documented for those cases in which the model is used. This should include both potential conservatisms and limitations that may void the use of the computer model.
			The success criteria should provide a proper basis for the probabilistic analysis. General references should be provided, and the specific case references for each success criteria should be provided to assure traceability if needed in the future.	The success criteria should provide a proper basis for the probabilistic analysis. General references should be provided, and the specific case references for each success criteria should be provided to assure traceability if needed in the future.
		Realistic thermal hydraulic calculations to support timing estimates may be used in the HRA evaluations.	Realistic thermal hydraulic calculations to support timing estimates should be used in the HRA evaluations.	Realistic thermal hydraulic calculations to support timing estimates should be used in the HRA evaluations.

Table 5-3

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: SUCCESS CRITERIA AND THERMAL HYDRAULIC ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
TH-8	ROOM HEATUP CALCULATIONS • Documented evaluation available to support the modeling decisions, OR • Plant specific realistic calculations or tests are available to support the modeling decisions regarding room heatup.	System success criteria to assure adequate mission time capability should be established with room cooling calculations or tests. These calculations or tests should coincide with the accident sequence conditions or be justified.	System success criteria to assure adequate mission time capability should be established with room cooling calculations or tests. These calculations or tests should coincide with the accident sequence conditions or be justified. Room heatup calculations may be performed using a computer code such as the GOTHIC code.	System success criteria to assure adequate mission time capability should be established with room cooling calculations or tests. These calculations or tests should coincide with the accident sequence conditions or be justified. Room heatup calculations should be performed using a computer code such as the GOTHIC code.
TH-9	DOCUMENTATION • Documentation provides the basis of the Thermal Hydraulic Analysis, is traceable to plant specific or generic analysis, and demonstrates the reasonableness of the success criteria.	Documentation should provide the basis for meeting each of the criteria TH-4 through TH-8. The documentation shall describe the results consistent with the process. Conservative, optimistic, or simplifying assumptions or conditions may be identified or specific justification may be provided for their use.	Documentation should provide the basis for meeting each of the criteria TH-4 through TH-8. The documentation shall describe the results consistent with the process. Conservative, optimistic, or simplifying assumptions or conditions should be identified or specific justification shall be provided for their use. Specific Success Criteria related items that should be documented including the following: • room cooling treatment • DFP alignment success probability when performed under SBO conditions involving load shedding of all essential lighting (if applicable) • RCIC & DFP success given SBO • RCIC success following Emergency Depressurization • Depressurization requirement for Medium LOCA with RCIC initially available (conservative assumption)	Documentation should provide the basis for meeting each of the criteria TH-4 through TH-8. The documentation shall describe the results consistent with the process. Conservative, optimistic, or simplifying assumptions or conditions shall be identified or specific justification shall be provided for their use. Specific Success Criteria related items that should be documented including the following: • room cooling treatment • DFP alignment success probability when performed under SBO conditions involving load shedding of all essential lighting (if applicable) • RCIC & DFP success given SBO • RCIC success following Emergency Depressurization • Depressurization requirement for Medium LOCA with RCIC initially available (conservative assumption)

Table 5-3

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: SUCCESS CRITERIA AND THERMAL HYDRAULIC ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
TH-10	• Documentation reflects the process used	Documentation may reflect process features.	Documentation should provide the basis for the thermal hydraulic analysis methodology and the success criteria development process.	Documentation shall provide the basis for the thermal hydraulic analysis methodology and the success criteria development process.
TH-11	• Documentation includes an independent review for the documented results	Independent review may be performed and documented by knowledgeable personnel.	Independent review should be performed and documented by knowledgeable personnel.	Independent review should be performed and documented by knowledgeable personnel.

Table 5-4

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: SYSTEMS ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
SY-1	GUIDANCE • Describes the process used	The Fault Tree Handbook or equivalent may be used to provide general guidance on the logic model constriction.	The documentation of the system analysis should be sufficiently well described in the documented results to act as guidance for future updates and revisions. The development and content of the system notebooks (including the system modeling, e.g., fault trees) and their relationship to the event tree models should be provided by the documentation. This should include: • the operating experience for the system • the system fault tree • model assumptions • the various model uses of the system with its values • the success criteria and bases • supports required • system operation under accident conditions • effects on initiating events • common cause groups identified and included in the system • relationship to critical safety functions The Fault Tree Handbook or equivalent should be used to provide general guidance on the logic model constriction. Guidance for modeling systems, such as naming conventions or standard component failure models, should be included in the guidance and documentation.	A specific guidance document should be available that specifies the process for system analysis including the updating process. The development and content of the system notebooks (including the system modeling, e.g., fault trees) and their relationship to the event tree models should be provided by the documentation. This should include: • the operating experience for the system • the system fault tree • model assumptions • the various model uses of the system with its values • the success criteria and bases • supports required • system operation under accident conditions • effects on initiating events • common cause groups identified and included in the system • relationship to critical safety functions The Fault Tree Handbook or equivalent should be used to provide general guidance on the logic model constriction. Guidance for modeling systems, such as naming conventions or standard component failure models, should be included in the guidance and documentation.

Table 5-4

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: SYSTEMS ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
SY-2	• Consistent with industry practices	General adherence to accepted industry approaches is included.	The documentation should provide a reasonable basis for performing the system analysis and should maintain consistency with proven approaches.	The guidance for system analysis should be complete and detailed and should maintain consistency with proven approaches.
SY-3	• Sufficient detail provided for reproducing the evaluation	Guidance may be available to supply general approaches used.	The guidance should be sufficient to provide a means to obtain equivalent results.	The guidance shall be sufficiently detailed to reproduce the results.
SY-4	SYSTEM MODELS (e.g., Fault Trees) • The system models are available for review	The fault tree models and system descriptions should address all trains of a redundant system, not just a single train.	The fault tree models and system descriptions should address all trains of a redundant system, not just a single train.	The fault tree models and system descriptions should address all trains of a redundant system, not just a single train.
SY-5	• The models and analyses are consistent with the as-built, as-operated plant including EOPs and AOPs (See also AS-19)	The models and analyses should be consistent with the as-built, as-operated plant including EOPs and AOPs (See also AS-19) Exceptions may be noted; or level of detail may be minimal if justified. The operating experience with the system may be reviewed to ensure that important system characteristics are modeled appropriately.	The models and analyses should be consistent with the as-built, as-operated plant including EOPs and AOPs (See also AS-19) Procedurally directed operator actions (both positive and negative impacts) that substantially influence the fault tree structure or its probability should be accounted for. This should include operator training input on the interpretation of proceduralized steps. The operating experience with the system should be reviewed to ensure that important system characteristics are modeled appropriately.	The models and analyses shall be consistent with the as-built, as-operated plant including EOPs and AOPs (See also AS-19) Procedurally directed operator actions (both positive and negative impacts) that substantially influence the fault tree structure or its probability shall be accounted for. This shall include operator training input on the interpretation of proceduralized steps. The operating experience with the system shall be reviewed to ensure that important system characteristics are modeled appropriately.

Table 5-4

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: SYSTEMS ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA: Risk Ranking Prioritization	SUBTIER CRITERIA: Risk Informed Decisions	SUBTIER CRITERIA: Risk-Based Decisions
SY-6	• The structure of the system model provides detail down to at least the major active component level (e.g., pumps and valves)	The fault tree models should provide detail down to the major active component level. Exceptions for some systems may occur when they are dominated by operator actions, specific phenomenological effects, or are "black-boxed" such as the scram system. Systems that have sometimes not been modeled in detail include: • Power conversion system • Instrument Air • keep fill system The justification for limited modeling should be documented. The component boundaries used in the fault tree model shall be consistent with the boundary definition used in the data analysis element.	The fault tree models should provide detail down to the major active component level. Exceptions for some systems may occur when they are dominated by operator actions, specific phenomenological effects, or are "black-boxed" such as the scram system. Systems that have sometimes not been modeled in detail include: • Power conversion system • Instrument Air • keep fill system The justification for limited modeling should be documented. The component boundaries used in the fault tree model should be consistent with the boundary definition used in the data analysis element.	The fault tree models should provide detail down to the major active component level. Exceptions for some systems may occur when they are dominated by operator actions, specific phenomenological effects, or are "black-boxed" such as the scram system. Systems that have sometimes not been modeled in detail include: • Power conversion system • Instrument Air • keep fill system The justification for limited modeling should be documented. The component boundaries used in the fault tree model shall be consistent with the boundary definition used in the data analysis element.
SY-7	• The level of detail of the system models reflects certain passive components that may impact CDF.[6]	Select passive components may be included.	Critical passive components such as check valves, strainers, and tanks should be included if they can influence the CDF or LERF.	Critical passive components such as check valves, strainers, and tanks shall be included if they can influence the CDF or LERF.

Table 5-4

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: SYSTEMS ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
SY-8	• The system models contain at a minimum the following (if applicable): - Common cause failure contributors - Test and maintenance unavailabilities - Operator errors that can influence system operability (where appropriate) - False instrument signals that can cause failures of the system(8) - Operator interface dependencies across systems or trains	The system models may contain at a minimum the following (if applicable): • Common cause failure contributors • Test and maintenance unavailabilities • Operator errors that can influence system operability (where appropriate) • False instrument signals that can cause failures of the system(8) • Operator interface dependencies across systems or trains	The system models should contain at a minimum the following (if applicable): • Common cause failure contributors • Test and maintenance unavailabilities • Operator errors that can influence system operability (where appropriate) • False instrument signals that can cause failures of the system(8) • Operator interface dependencies across systems or trains	The system models shall contain at a minimum the following (if applicable): • Common cause failure contributors • Test and maintenance unavailabilities • Operator errors that can influence system operability (where appropriate) • False instrument signals that can cause failures of the system(8) • Operator interface dependencies across systems or trains
SY-9	• Modules used in the system models are well correlated to their constituent components and capable of providing importance and parametric effects on a component level.	The traceability of basic events to modules and to cutsets may be present in the model and documentation.	The traceability of basic events to modules and to cutsets should be transparent to the user and a reviewer.	The traceability of basic events to modules and to cutsets shall be transparent to the user and a reviewer.

Table 5-4

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: SYSTEMS ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA: Risk Ranking Prioritization	SUBTIER CRITERIA: Risk Informed Decisions	SUBTIER CRITERIA: Risk-Based Decisions
SY-10	• Spatial or environmental dependencies (e.g., internal floods, room cooling, etc.) are addressed for each system within the system model or in the accident sequence evaluation[5].	Spatial hazards that may impact system operation may be identified in the system notebook and accounted for in the system fault tree or the accident sequence evaluation. Environmental hazards that may impact system operation may be identified in the system notebook and accounted for in the system fault tree or accident sequence evaluation. Results of plant walkdowns may be used as a source of information and resolution of issues. Explicit treatment of containment vent effects and containment failure effects on system operation should be included. Conservative evaluations of impacts on systems may be part of the model.	Spatial hazards that may impact system operation should be identified in the system notebook and accounted for in the system fault tree or the accident sequence evaluation. Environmental hazards that may impact system operation should be identified in the system notebook and accounted for in the system fault tree or accident sequence evaluation. Results of plant walkdowns should be used as a source of information and resolution of issues. Explicit treatment of containment vent effects and containment failure effects on system operation shall be included. Conservative evaluations should not distort the CDF, LERF, or the risk profile.	Spatial hazards that may impact system operation shall be identified in the system notebook and accounted for in the system fault tree or the accident sequence evaluation. Environmental hazards that may impact system operation shall be identified in the system notebook and accounted for in the system fault tree or accident sequence evaluation. Results of plant walkdowns shall be used as a source of information and resolution of issues. Explicit treatment of containment vent effects and containment failure effects on system operation shall be included. Conservative evaluations should be avoided. This may require substantial deterministic evaluations.

Table 5-4

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: SYSTEMS ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
SY-11	In some accident sequences, systems are expected to perform in degraded environments (e.g., inside containment after a LOCA). While equipment is generally qualified for such an environment, there should be some evidence that a search has been made for equipment that is not so qualified (e.g., statements that necessary equipment is qualified.) Other examples of degraded environments include: • SRV Operability (small LOCA, drywell spray, severe accident) (for BWRs) • Steamline breaks outside containment • Debris that could plug screens/filters (both internal and external to the plant), and heating of the water supply (e.g., BWR suppression pool, PWR containment sump) that could affect pump operability • Loss of NPSH • Steam binding of pumps	In some accident sequences, systems are expected to perform in degraded environments (e.g., inside containment after a LOCA). While equipment is generally qualified for such an environment, there should be some evidence that a search has been made for equipment that is not so qualified (e.g., statements that necessary equipment is qualified.) Other examples of degraded environments include: • SRV Operability (small LOCA, drywell spray, severe accident) (for BWRs) • Steamline breaks outside containment • Debris that could plug screens/filters (both internal and external to the plant), and heating of the water supply (e.g., BWR suppression pool, PWR containment sump) that could affect pump operability • Loss of NPSH • Steam binding of pumps The evaluation of plant or accident sequence conditions that may adversely impact system operation should be included.	In some accident sequences, systems are expected to perform in degraded environments (e.g., inside containment after a LOCA). While equipment is generally qualified for such an environment, there should be evidence that a search has been made for equipment that is not so qualified (e.g., statements that necessary equipment is qualified.) Other examples of degraded environments include: • SRV Operability (small LOCA, drywell spray, severe accident) (for BWRs) • Steamline breaks outside containment • Debris that could plug screens/filters (both internal and external to the plant), and heating of the water supply (e.g., BWR suppression pool, PWR containment sump) that could affect pump operability • Loss of NPSH • Steam binding of pumps The evaluation of plant or accident sequence conditions that may adversely impact system operation should be included.	In some accident sequences, systems are expected to perform in degraded environments (e.g., inside containment after a LOCA). While equipment is generally qualified for such an environment, there shall be evidence that a search has been made for equipment that is not so qualified (e.g., statements that necessary equipment is qualified.) Other examples of degraded environments include: • SRV Operability (small LOCA, drywell spray, severe accident) (for BWRs) • Steamline breaks outside containment • Debris that could plug screens/filters (both internal and external to the plant), and heating of the water supply (e.g., BWR suppression pool, PWR containment sump) that could affect pump operability • Loss of NPSH • Steam binding of pumps The evaluation of plant or accident sequence conditions that may adversely impact system operation shall be included.

Table 5-4

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: SYSTEMS ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
SY-11 (cont'd)		There may be conditions in which the system or its components are required to operate beyond the licensing design basis. This may be included in the model if justified based on: • expert judgement • test or operational data • calculations • vendor input Examples include: • room temperatures above EQ limits • minimum flow valve fails closed	There may be conditions in which the system or its components are required to operate beyond the licensing design basis. This should be included in the model if justified based on: • expert judgement • test or operational data • calculations • vendor input Examples include: • room temperatures above EQ limits • minimum flow valve fails closed	There may be conditions in which the system or its components are required to operate beyond the licensing design basis. This shall be included in the model if justified based on: • expert judgement • test or operational data • calculations • vendor input Examples include: • room temperatures above EQ limits • minimum flow valve fails closed
SY-12	• Support system requirements are accounted for	Support systems should be explicitly accounted for in the modeling process. This may include: • fault tree linking • dependency matrices that are translated into event tree structure or event tree logic rules or into dependent failure probabilities. Conservative treatment of support system dependencies may be included in the model evaluation.	Support systems should be explicitly accounted for in the modeling process. This may include: • fault tree linking • dependency matrices that are translated into event tree structure or event tree logic rules or into dependent failure probabilities. Support system treatment should be realistic based on realistic success criteria and realistic timing.	Support systems shall be explicitly accounted for in the modeling process. This may include: • fault tree linking • dependency matrices that are translated into event tree structure or event tree logic rules or into dependent failure probabilities. Support system treatment shall be realistic based on realistic success criteria and realistic timing.
SY-13	• The inventories of air, power, and cooling sufficient to support the mission time (or potential deficiencies) are identified and included in the model as appropriate. (Also refer to Elements TH and DE regarding definition of success criteria)	The inventories of air, power, and cooling sufficient to support the mission time (or potential deficiencies) may be identified and included in the model as appropriate. (Also refer to Elements TH and DE regarding definition of success criteria) Conservative evaluations of impacts on systems may be part of the model.	The inventories of air, power, and cooling sufficient to support the mission time (or potential deficiencies) should be identified and included in the model as appropriate. (Also refer to Elements TH and DE regarding definition of success criteria) Conservative evaluations should not distort the CDF, LERF, or the risk profile.	The inventories of air, power, and cooling sufficient to support the mission time (or potential deficiencies) shall be identified and included in the model as appropriate. (Also refer to Elements TH and DE regarding definition of success criteria) Conservative evaluations should be avoided. This may require substantial deterministic evaluations.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: SYSTEMS ANALYSIS

		SUBTIER CRITERIA		
Designator	CRITERIA	Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
SY-14	• The system boundary included in the system model is clearly discerned from a simplified schematic of system	The system boundary included in the system model may be clearly discerned from a simplified schematic of system.	The system boundary included in the system model should be clearly discerned from a simplified schematic of system.	The system boundary included in the system model should be clearly discerned from a simplified schematic of system.
SY-15	• The system model analysis considered generic system failure modes observed in industry[9]	The system model analysis may consider generic system failure modes observed in industry[9]	The system model analysis should consider generic system failure modes observed in industry[9]	The system model analysis shall consider generic system failure modes observed in industry[9]
SY-16	• The system model analysis included plant specific failure modes[7], [9]	Plant specific search of system operating experience may be performed and the results may be used to identify plant specific failure modes for the system.	Plant specific search of system operating experience should be performed and the results may be used to identify plant specific failure modes for the system. An FMEA or equivalent technique may be used to identify component or system failures that are plant specific.	Plant specific search of system operating experience shall be performed and the results may be used to identify plant specific failure modes for the system. An FMEA or equivalent technique should be used to identify component or system failures that are plant specific

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: SYSTEMS ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
SY-17	• The success criteria for the system are based on: - Generic thermal hydraulic analysis OR - Realistic thermal hydraulic analysis OR - Plant specific thermal hydraulic analysis	The success criteria for the system may be based on generic thermal hydraulic analysis. Conservative treatment of system success criteria may be included in the following: • A review of sequence specific conditions (e.g., RPV, containment, reactor building, steam tunnel, control room) may be used to ensure that system operation is not adversely impacted due to those conditions (e.g., trip signal, exhausted inventories, unacceptable operating conditions). • As part of the success criteria assessment there may be cases where the success criteria change during the accident progression. This aspect of time phase analysis may be included for a realistic evaluation. • System success criteria may be consistent with the accident sequence demands, e.g., number of pumps, HRA timing, interlocks necessary to be bypassed.	The success criteria for the system should be based on realistic thermal hydraulic analysis. Certain conservative success criteria may be included in non-risk significant sequences as follows if they do not distort the risk profile: • A review of sequence specific conditions (e.g., RPV, containment, reactor building, steam tunnel, control room) should be used to ensure that system operation is not adversely impacted due to those conditions (e.g., trip signal, exhausted inventories, unacceptable operating conditions). • As part of the realistic success criteria assessment there may be cases where the success criteria change during the accident progression. This aspect of time phase analysis should be included for a realistic evaluation. • System success criteria should be consistent with the accident sequence demands, e.g., number of pumps, HRA timing, interlocks necessary to be bypassed.	The success criteria for the system shall be based on Realistic plant specific thermal hydraulic analysis. • A review of sequence specific conditions (e.g., RPV, containment, reactor building, steam tunnel, control room) shall be used to ensure that system operation is not adversely impacted due to those conditions (e.g., trip signal, exhausted inventories, unacceptable operating conditions). • As part of the realistic success criteria assessment there may be cases where the success criteria change during the accident progression. This aspect of time phase analysis shall be included for a realistic evaluation. • System success criteria shall be consistent with the accident sequence demands, e.g., number of pumps, HRA timing, interlocks necessary to be bypassed.
SY-18	• The system model nomenclature is developed in a consistent manner to allow model manipulation and to represent the same designator when a component failure mode is used in multiple systems or trains.	e system model nomenclature may be developed in a consistent manner to allow model manipulation and to represent the same designator when a component failure mode is used in multiple systems or trains.	system model nomenclature should be developed in a consistent manner to allow model manipulation and to represent the same designator when a component failure mode is used in multiple systems or trains.	system model nomenclature shall be developed in a consistent manner to allow model manipulation and to represent the same designator when a component failure mode is used in multiple systems or trains.

Table 5-4

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: SYSTEMS ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
SY-19	• The systems used in the event trees have detailed system model development to support them unless they are generally treated with point estimate values, e.g.: - SRVs (for BWRs) - RPS - Diesel Generators - Switchyard The following impact on Grades is suggested for the above sample items: - Point Estimates - Conditional Probabilities (Split Fractions) - Linked Fault Trees or Cutsets	The systems used in the event trees may have detailed system model development to support them.	The systems used in the event trees should have detailed system model development to support them. Exceptions may include: • SRVs (for BWRs) • RPS • Diesel Generators • Switchyard	The systems used in the event trees shall have detailed system model development to support them. Exceptions may include: • SRVs (for BWRs) • RPS • Diesel Generators • Switchyard
SY-20	• The system models are used to quantify the accident sequences by: - Point Estimates Only - Conditional Probabilities (Split Fractions) - Linked Fault Trees or Cut Sets	• The system models are used to quantify the accident sequences by: - Point Estimates Only	The system models are used to quantify the accident sequences by • Conditional Probabilities (Split Fractions) • Linked Fault Trees or Cut Sets	The system models are used to quantify the accident sequences by • Conditional Probabilities (Split Fractions) • Linked Fault Trees or Cut Sets
SY-21	• The impact of the system model on initiating events has been examined (see also IE-10, IE-17)	• The impact of the system model on initiating events should be examined (see also IE-10, IE-17) and may be incorporated into the model in a conservative manner.	• The impact of the system model on initiating events should be examined (see also IE-10, IE-17) and should be incorporated into the model in a realistic manner.	• The impact of the system model on initiating events shall be examined (see also IE-10, IE-17) and should be incorporated into the model in a realistic manner.
SY-22	• The assumptions for the system model logic model are identified	• The assumptions for the system model logic model should be identified	• The assumptions for the system model logic model should be identified	• The assumptions for the system model logic model shall be identified

Table 5-4

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: SYSTEMS ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
SY-23	• The system operation under accident conditions is identified in the system notebook	• The system operation under accident conditions should be identified in the system notebook and may be incorporated into the model in a conservative manner.	• The system operation under accident conditions should be identified in the system notebook and should be incorporated into the model in a realistic manner.	• The system operation under accident conditions shall be identified in the system notebook and should be incorporated into the model in a realistic manner.
SY-24	• System/component repair and recovery actions and modeling, if used, are identified and documented (see also QU-18)	• System/component repair and recovery actions and modeling, if used, should be identified and documented (see also QU-18) • Conservative evaluations of impacts on systems may be part of the model.	• System/component repair and recovery actions and modeling, if used, should be identified and documented (see also QU-18) • Conservative evaluations should not distort the CDF, LERF, or the risk profile.	• System/component repair and recovery actions and modeling, if used, shall be identified and documented (see also QU-18) • Conservative evaluations should be avoided. This may require substantial deterministic evaluations.
SY-25	<u>DOCUMENTATION</u> • Reflects the process used		Documentation should provide the basis for meeting each of the criteria SY-4 through SY-24. The documentation should describe the results consistent with the process.	Documentation shall provide the basis for meeting each of the criteria SY-4 through SY-24. The documentation shall describe the results consistent with the process.

Table 5-4

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: SYSTEMS ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
SY-26	• Includes an independent review for the documented results	The system analysis should be reviewed.	Independent review of documented results is one of the pillars on which the integrity and quality of engineering work rests. Because of the complexity of the PSA model, it is desirable to have a thorough independent review of the system modeling. Independent review should be performed and documented by knowledgeable personnel, such as the system engineer. Guidance for modeling systems, such as naming conventions or standard component failures models, should be included in the guidance and documentation.	Independent review of documented results is one of the pillars on which the integrity and quality of engineering work rests. Because of the complexity of the PSA model, it is desirable to have a thorough independent review of the system analysis modeling. Independent review shall be performed and documented by knowledgeable personnel, such as the system engineer. Guidance for modeling systems, such as naming conventions or standard component failures models, shall be included in the guidance and documentation.
SY-27	• Provides the basis of the system model and is traceable to plant specific or generic analysis	Documentation may reflect process features.	Documentation should provide the basis for system analysis process.	Documentation shall provide the basis for system analysis process.

Table 5-5

INDUSTRY PRA PEER REVIEW PROCESS SUBTIER CRITERIA: DATA ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
DA-1	GUIDANCE • Describes the process used	General description of the data analysis may be provided. The data guidance document may provide guidance on the selection of generic data from industry sources. The treatment of rectification in the data analysis should have clear guidance. Guidance should be provided on the development of the disallowed maintenance or mutually exclusive maintenance file.	The documentation of the data analysis should be sufficiently well described in the documented results to act as guidance for future updates and revisions. The document should provide guidance on the use of plant specific data, common cause data and methods, and the selection of generic data from industry sources. The document should provide guidance in the assignment of the proper error factor to assign for particular component failure rates when the error factors are not provided in the reference. The document should include guidance on data compilation and interpretation, component boundaries, Bayesian approach, and examples. The treatment of rectification in the data analysis should be clearly stated. Guidance should be provided on the development of the disallowed maintenance or mutually exclusive maintenance file.	A specific guidance document should be available that specifies the process for data analysis including the updating process. Guidance on the incorporation of plant specific data into initiating event frequencies, component failure rates, and common cause data shall be provided. The data guidance document shall provide guidance on the selection of generic data from industry sources. The data guidance document may provide guidance in the assignment of the proper error factor to assign for particular component failure rates when the error factors are not provided in the reference. The data guidance document should include direction on data compilation and interpretation, component boundaries, Bayesian approach, and examples. A description of the overall process used for selecting and applying data should be provided. The treatment of rectification in the data analysis should have clear guidance. Guidance should be provided on the development of the disallowed maintenance or mutually exclusive maintenance file.

Table 5-5

INDUSTRY PRA PEER REVIEW PROCESS SUBTIER CRITERIA: DATA ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA: Risk Ranking Prioritization	SUBTIER CRITERIA: Risk Informed Decisions	SUBTIER CRITERIA: Risk-Based Decisions
DA-2	• Consistent with industry practices	General adherence to accepted industry approaches is included.	The documentation should provide a reasonable basis for performing the data analysis and should maintain consistency with proven approaches.	The guidance for data analysis should be complete and detailed and should maintain consistency with proven approaches.
DA-3	• Sufficient detail provided for reproducing the evaluation	Guidance may be available to supply general approaches used.	The guidance should be sufficient to provide a means to obtain equivalent results.	The guidance shall be sufficiently detailed to reproduce the results.
DA-4	FAILURE PROBABILITIES • The random independent component failure probability data used in the evaluation are based on generic data sources that may be conservative. OR	The random independent component failure probability data used in the evaluation may be based on generic data sources that may be conservative.	The random independent component failure probabilities should be realistic compared with past generic data evaluations at least for dominant contributors.	The random independent component failure probability data used in the evaluation and where it can be justified shall be based on accumulated plant specific experience; otherwise, realistic generic data is used
	• The random independent component failure probabilities are realistic compared with past generic data evaluations at least for dominant contributors. OR	The use of generic data should involve the use of reasonable generic data sources that represent recent nuclear power experience, if available. The definition of component failures should encompass only those failures that would disable the component function over the PRA mission time.	The use of generic data should involve the use of reasonable generic data sources that represent recent nuclear power experience, if available. The definition of component failures should encompass only those failures that would disable the component function over the PRA mission time.	The plant specific data evaluation should be based on a plant specific Bayesian update of accumulated industry experience for similar components. The definition of component failures shall encompass only those failures that would disable the component function over the PRA mission time.
	• The random independent component failure probability data used in the evaluation and where it can be justified is based on accumulated plant specific experience; otherwise, realistic generic data is used.	Some limited plant specific data may be incorporated into the PRA as it supports specific risk ranking applications. This data analysis shall be consistent with the risk-informed decision requirements.	The treatment of rectification in the data analysis should have clear guidance. Some limited plant specific data may be incorporated into the PRA as it supports specific risk informed applications. This data analysis shall be consistent with the risk-based decision requirements.	Plant specific data collection shall include failures of equipment coupled with either data on success or reasonable estimates of total demands. "Run" failure rates may be difficult to obtain because of limited run times of equipment. Plant specific estimates may therefore be unrealistic.

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INDUSTRY PRA PEER REVIEW PROCESS SUBTIER CRITERIA: DATA ANALYSIS

		SUBTIER CRITERIA		
Designator	CRITERIA	Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
DA-4 (cont'd)				The data collection period should be generally consistent with the as-built, as-operated plant being analyzed. The treatment of rectification in the data analysis should be realistic and the bases well documented. Selection of components requiring plant specific data shall be based on a stated criteria, e.g., RAW > 2 or FV > 1.005.
DA-5	• For plant specific data development, similar components have been grouped together in a reasonable manner and the grouping is supported by the documentation.	Plant specific data development, as applicable, shall meet the requirements in the risk-informed decisions.	Grouping of components for data collection purposes should account for the following: • Size • Service condition • Frequency of demands • Environmental condition The groups should be sufficiently similar to justify the derivation of plant specific data. The component boundary should be explicitly defined such that the PRA model, the data collection, the use of common cause BETA or MGL factors, and the use of generic data for Bayesian update are all consistent.	Grouping of components for data collection purposes shall account for the following: • Size • Service condition • Frequency of demands • Environmental condition The groups shall be sufficiently similar to justify the derivation of plant specific data. The component boundary shall be explicitly defined such that the PRA model, the data collection, the use of common cause BETA or MGL factors, and the use of generic data for Bayesian update are all consistent.

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INDUSTRY PRA PEER REVIEW PROCESS SUBTIER CRITERIA: DATA ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
DA-6	• For basic events derived using standby failure rate data, the plant specific surveillance test intervals have been identified and used in the analysis.	Surveillance test intervals identified in maintenance procedures or surveillance test requirements may be used to estimate the intervals between component testing. For components not normally tested or tested at relatively long intervals, the demand failure rates from generic data sources may not be appropriate. To account for the longer surveillance intervals, a standby failure rate (/ hr) and the approximation λ T/2 for the failure probability may be used.	Surveillance test intervals identified in maintenance procedures or surveillance test requirements should be used to estimate the intervals between component testing. For components not normally tested or tested at relatively long intervals, the demand failure rates from generic data sources may not be appropriate. To account for the longer surveillance intervals, a standby failure rate (/ hr) and the approximation λ T/2 for the failure probability should be used.	Surveillance test intervals identified in maintenance procedures or surveillance test requirements shall be used to estimate the intervals between component testing and this evaluation shall be augmented by confirmation of these results with plant staff. For components not normally tested or tested at relatively long intervals, the demand failure rates from generic data sources may not be appropriate. To account for the longer surveillance intervals, a standby failure rate (/ hr) and the approximation λ T/2 for the failure probability should be used.
DA-7	<u>SYSTEM/TRAIN MAINTENANCE UNAVAILABILITIES</u> [1] • The system/train maintenance unavailabilities are derived based on generic data sources. <u>OR</u> • The maintenance unavailabilities reflect plant specific practices and are reasonable or are higher than the projected maintenance goals used by the utility. <u>OR</u> • The system/train maintenance unavailabilities are derived based on plant specific data.	The system/train maintenance unavailabilities may be derived based on generic data sources or data from similar plants. The disallowed maintenance (or mutually exclusive) file should be developed based on plant Technical Specifications or procedures.	The maintenance unavailabilities reflect plant specific practices and should be reasonable or higher than the projected Maintenance Rule goals used by the utility. The use of vendor data bases should be avoided. The disallowed maintenance (or mutually exclusive) file should be developed based on plant Technical Specifications or procedures.	The system/train maintenance unavailabilities shall be derived based on plant specific data representing the as-built, as-operated plant. The use of vendor data bases should be avoided. The disallowed maintenance (or mutually exclusive) file should be developed based on plant Technical Specifications or procedures.

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INDUSTRY PRA PEER REVIEW PROCESS SUBTIER CRITERIA: DATA ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
DA-8	COMMON CAUSE FAILURE PROBABILITIES • The common cause failure probabilities are referenced to acceptable data sources.(2)	The CCF data should reference an up to date source, e.g., the NRC INEL report. This latest NRC compilation of CCF probabilities is considered to be the best available CCF assessment. (See NUREG/CR-6268) The component boundaries should be consistent with the common cause data used to characterize the component.	The CCF data should reference an up to date source, e.g., the NRC INEL report. This latest NRC compilation of CCF probabilities is considered to be the best available CCF assessment. (See NUREG/CR-6268) The component boundaries shall be consistent with the common cause data used to characterize the component.	The CCF data should reference an up to date source, e.g., the NRC INEL report. This latest NRC compilation of CCF probabilities is considered to be the best available CCF assessment. (See NUREG/CR-6268) The component boundary should be explicitly defined such that the PRA model, the data collection, the use of common cause BETA or MGL factors, and the use of generic and plant specific data for Bayesian update are all consistent.
DA-9	• The common cause failure probabilities are realistic based on generic data source comparisons.	Conservative bias may exist in the common cause failure probabilities and their implementation. Common cause failure modes of "fail to run" and "fail to start" should be applied as appropriate and as available data would support.	Mostly realistic common cause failure probabilities and modeling should be used consistent with available data. Common cause failure modes of "fail to run" and "fail to start" should be applied as appropriate and as available data would support.	Realistic estimates of common cause failure probabilities shall be used including plant specific mapping of failure modes. Common cause failure modes of "fail to run" and "fail to start" shall be applied as appropriate and as available data would support.
DA-10	• Common cause groups to which the common cause failure probability applies have been derived based on sound judgment and are documented.	Common cause groups should be established using a logical, systematic process that considers similarity in: • service conditions (standby vs. running) • environment • design • maintenance • lubrication • fuel • spatial interactions	Common cause groups shall be established using a logical, systematic process that considers similarity in: • service conditions (standby vs. running) • environment • design • maintenance • lubrication • fuel • spatial interactions	Common cause groups shall be established using a logical, systematic process that considers similarity in: • service conditions (standby vs. running) • environment • design • maintenance • lubrication • fuel • spatial interactions

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Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
DA-11	• Justification is provided for treatment of common cause failure of on-site AC sources that include consideration of: - Design diversity - Common maintenance crews - Common I&C technicians - Similarity of procedures - Common fuel oil - Common lube oil - Common heating/cooling designs		The consideration of CCF of on-site AC power sources should specifically address all the on-site diesels in detail. While there may be design diversity, there are important CCF considerations remaining including: • Common maintenance crews • Common I&C Techs. • Similarity of Procedures • Common fuel oil • Common lube oil • Possible similarity of heating/ cooling loops • Testing similarities (e.g., unloaded)	The consideration of CCF of on-site AC power sources shall specifically address all the on-site diesels in detail. While there may be design diversity, there are important CCF considerations remaining including: • Common maintenance crews • Common I&C Techs. • Similarity of Procedures • Common fuel oil • Common lube oil • Possible similarity of heating/ cooling loops • Testing similarities (e.g., unloaded) The common cause failure probability for all on-site diesels shall include a quantitative assessment that shall be reflected in the PRA model.
DA-12	• NUREG/CR-4780 (EPRI NP-5613 or equivalent) systematic approach used to provide plant specific grouping of similar system components for CCF treatment	---	NUREG/CR-4780 (EPRI NP-5613 or equivalent) systematic approach should be used to provide plant specific grouping of similar system components for CCF treatment	NUREG/CR-4780 (EPRI NP-5613 or equivalent) systematic approach shall be used to provide plant specific grouping of similar system components for CCF treatment
DA-13	• Dominant contributors for sequences include MGL for more than 2 redundant trains	The Beta factor method may be used for more than 2 redundant components.	Dominant contributors for sequences should include the MGL or equivalent methodology for more than 2 redundant trains	Dominant contributors for sequences shall include the MGL or equivalent methodology for more than 2 redundant trains

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Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
DA-14	• Full intent of NUREG/CR-4780 (EPRI NP-5613 or equivalent) included: - Plant specific screening of common cause data	---	---	Full intent of NUREG/CR-4780 (EPRI NP-5613 or equivalent) shall be included: • Plant specific screening of common cause data
DA-15	<u>UNIQUE UNAVAILABILITIES OR MODELING ITEMS</u> • Documentation of the failure probabilities from plant specific or generic sources that do not fit into the basic event database, e.g.: - AC Power Recovery - EDG Mission Time - Repair and Recovery Model - LOOP Given Transient	The bases for the unique unavailability items may be based on generic data, conservative estimates, or plant specific data. AC recovery may be based on available generic data.	The unique unavailabilities should be based on plant specific data (if available) otherwise realistic estimates based on plant specific as-built, as-operated features. AC recovery should be based on available and applicable data.	The unique unavailabilities shall be based on plant specific data (if available) otherwise realistic estimates based on plant specific as-built, as-operated features. AC recovery shall be based on available and applicable data.

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INDUSTRY PRA PEER REVIEW PROCESS SUBTIER CRITERIA: DATA ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
	- BOP Unavailability - Pipe/tank Rupture Failure Probability - ATWS-related RPS Failures - RCP Seal Failure (for PWRs) - % of time Pressurizer PORVs blocked during operation (PWRs) - PORV demand probability given an initiating event - % of time SG PORVs or atmospheric dump valves blocked during operation - ARI (for BWRs) - RPT (for BWRs) - PCS Recovery (for BWRs) - SORV (for BWRs)	Repair modeling should in general be applied only if extended times are available. Recovery modeling shall be tied with repair modeling when equipment must be restored to a usable condition. Recovery modeling may address issues related to operator interaction (HRA), repair (failure mode dependent), access, environment, etc.	Repair modeling should in general be applied only if extended times are available. Recovery modeling shall be tied with repair modeling when equipment must be restored to a usable condition. Recovery modeling should address issues related to operator interaction (HRA), repair (failure mode dependent), access, environment, etc.	Repair modeling should in general be applied only if extended times are available. Recovery modeling shall be tied with repair modeling when equipment must be restored to a usable condition. Recovery modeling shall address issues related to operator interaction (HRA), repair (failure mode dependent), access, environment, etc.
DA-16	• Conservatively biased values OR • The values are judged conservative only for those contributors of non-dominant sequences OR • These failure probabilities are justified to the current state of the technology	Conservatively biased values may be used.	The values should be conservative only for those contributors of non-dominant sequences	These failure probabilities shall be justified to the current state of the technology

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Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decisions	Risk-Based Decisions
DA-17	<u>DOCUMENTATION</u> • Reflects the process used		Documentation should provide the basis for meeting each of the criteria DA-4 through DA-16. The documentation shall describe the results consistent with the process.	Documentation shall provide the basis for meeting each of the criteria DA-4 through DA-16. The documentation shall describe the results consistent with the process.
DA-18	• Includes an independent review for the documented results		Independent review should be performed and documented by knowledgeable personnel.	Independent review shall be performed and documented by knowledgeable personnel.
DA-19	• Provides the basis of the data treatment and is traceable to plant specific or generic analysis.		Documentation should provide the basis for data analysis process.	Documentation shall provide the basis for data analysis process.
DA-20	• The generic and plant specific data bases are available for inspection and use.		The data base should be documented and traceable to the sources of plant specific, and generic data sources for failure and maintenance events, demands and operating time, common cause events, treatment of restoration of components in the maintenance data, and the assumptions and methods used to derive data parameter values.	The data base shall be documented and traceable to the sources of plant specific, and generic data sources for failure and maintenance events, demands and operating time, common cause events, treatment of restoration of components in the maintenance data, and the assumptions and methods used to derive data parameter values.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: HUMAN RELIABILITY ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decision Making	Risk Based Decision Making
HR-1	<u>GUIDANCE</u> • Describes the process used	N/A	The documentation of the HRA should be sufficiently well described in the documented results to act as guidance for future updates and revisions.	A specific guidance document should be available that specifies the process for HRA including the updating process. Guidance on the rules used for replacing screening HEPs with best estimate HEPs in Post Processors (so-called "Recovery" substitutions) shall be provided (if applicable). The explanation should include the specific steps performed in the recovery process. The guidance should address the PSF for complexity, limited resources, time, stress, and uncertainty in instrumentation.
HR-2	• Consistent with industry practices	General adherence to accepted industry approaches should be included.	The documentation should provide a reasonable basis for performing the HRA and should maintain consistency with proven approaches.	The guidance for HRA should be complete and detailed and should maintain consistency with proven approaches.
HR-3	• Sufficient detail provided for reproducing the evaluation	Guidance may be available to supply general approaches used.	The guidance should be sufficient to provide a means to obtain equivalent results.	The guidance shall be sufficiently detailed to reproduce the results.
HR-4	<u>PRE-INITIATOR HUMAN ACTIONS</u> • Pre-initiator Human Interactions (HIs) were considered in the PRA	Pre-initiators may be included in the PRA explicitly, especially for latent failures that can cause multiple redundant components to fail or may be included with failure rate data for independent failures.	Pre-initiators should be included in the PRA explicitly, especially for latent failures that can cause multiple redundant components to fail.	Pre-initiators shall be included in the PRA explicitly, especially for latent failures that can cause multiple redundant components to fail.
HR-5	• A systematic process is used to identify the Pre-Initiator Human Errors to be included in the PRA (e.g., miscalibration of instruments)	A systematic process may be used to identify the Pre-Initiator Human Errors to be included in the PRA (e.g., miscalibration of instruments)	A systematic process should be used to identify the Pre-Initiator Human Errors to be included in the PRA (e.g., miscalibration of instruments) This should include a review of plant procedures and training in order to identify those latent failures that may defeat multiple redundant equipment.	A systematic process shall be used to identify the Pre-Initiator Human Errors to be included in the PRA (e.g., miscalibration of instruments) This shall include a review of plant procedures and training in order to identify those latent failures that may defeat multiple redundant equipment.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: HUMAN RELIABILITY ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA: Risk Ranking Prioritization	SUBTIER CRITERIA: Risk Informed Decision Making	SUBTIER CRITERIA: Risk Based Decision Making
HR-6	• Screening HEPs are used in the quantification of the pre-initiator HEPs OR • Best estimate HEPs are used in the quantification of pre-initiator HEPs for dominant contributors OR • Assessment of plant procedures and plant specific operating experience are explicitly included in the identification and quantification process for the HIs.	Preinitiator HEPs may be screened from further consideration if: • Equipment position is monitored • Equipment is automatically re-aligned • Post maintenance functional test is performed. Screening HEPs may be used in the quantification of the pre-initiator HEPs.	Preinitiator HEPs may be screened from further consideration if: • Equipment position is monitored • Equipment is automatically re-aligned • Post maintenance functional test is performed. Best estimate HEPs should be used in the quantification of pre-initiator HEPs for dominant contributors, including recovery.	Preinitiator HEPs may be screened from further consideration if: • Equipment position is monitored • Equipment is automatically re-aligned • Post maintenance functional test is performed. Best estimate HEPs shall be used in the quantification of pre-initiator HEPs for dominant contributors, including recovery Assessment of plant procedures and plant specific operating experience shall be explicitly included in the identification and quantification process for the HIs.
HR-7	• Those pre-initiator actions with the possibility of adversely impacting baseline CDF or LERF are included in the quantification.	Those pre-initiator actions with the possibility of adversely impacting baseline CDF or LERF should be included in the quantification.	Those pre-initiator actions with the possibility of adversely impacting baseline CDF or LERF shall be included in the quantification.	Those pre-initiator actions with the possibility of adversely impacting baseline CDF or LERF shall be included in the quantification.
HR-8	POST-INITIATOR HUMAN ACTIONS • Post-Initiator HIs were considered in the PRA	HEPs for initiation, control, isolation, and alignment of prevention and mitigation systems should be included.	HEPs for initiation, control, isolation, and alignment of prevention and mitigation systems shall be included.	HEPs for initiation, control, isolation, and alignment of prevention and mitigation systems shall be included.
HR-9	• A systematic process is used to identify the Post-Initiator Human Errors to be included in the PRA.	A systematic process may be used to identify the Post-Initiator Human Errors to be included in the PRA.	A systematic process should be used to identify the Post-Initiator Human Errors to be included in the PRA.	A systematic process shall be used to identify the Post-Initiator Human Errors to be included in the PRA.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: HUMAN RELIABILITY ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA: Risk Ranking Prioritization	SUBTIER CRITERIA: Risk Informed Decision Making	SUBTIER CRITERIA: Risk Based Decision Making
HR-10	• Assessment of plant procedures and plant specific operating experience are explicitly included in the identification and quantification process for the HIs.	Assessment of plant procedures and plant specific operating experience should be explicitly included in the identification and quantification process for the HIs.	Assessment of plant procedures and plant specific operating experience should be explicitly included in the identification and quantification process for the HIs. Interviews with operators, trainers, or supervisors should be included in the assessment.	Assessment of plant procedures and plant specific operating experience shall be explicitly included in the identification and quantification process for the HIs. Interviews with operators, trainers, or supervisors shall be included in the assessment.
HR-11	• The symptoms available during the postulated accident sequence are evaluated and input into the HRA process.	The accident sequence specific symptoms should be used as part of the input to the HRA process.	The accident sequence specific symptoms shall be used as part of the input to the HRA process.	The accident sequence specific symptoms shall be used as part of the input to the HRA process.
HR-12	• HEP values are internally consistent within the PRA.	HEP values should provide the correct relative error probabilities within the PRA. This means that the use of screening HEPs should be minimized.	HEP values should provide the correct relative error probabilities within the PRA. This means that the use of screening HEPs shall be minimized.	HEP values shall provide the correct relative error probabilities within the PRA.
HR-13 (1)	• Screening HEPs are used in the quantification of dominant contributors.	Screening HEPs shall not be used in the quantification of dominant contributors to CDF or LERF.	Screening HEPs shall not be used in the quantification of dominant contributors to CDF or LERF.	Screening HEPs shall not be used in the quantification of dominant contributors to CDF or LERF.
HR-14	• Operator actions have been reviewed by the operating staff and their impact is included in the HRA evaluation; OR • Dominant operator actions have been reviewed by the operating staff and their input has been included in the HRA evaluation.	Operator actions may be reviewed by the operating staff and their impact is included in the HRA evaluation; AND Dominant operator actions may be reviewed by the operating staff and their input has been included in the HRA evaluation.	Operator actions should be reviewed by the operating staff and their impact is included in the HRA evaluation; OR Dominant operator actions shall be reviewed by the operating staff and their input has been included in the HRA evaluation. AND	Operator actions shall be reviewed by the operating staff and their impact is included in the HRA evaluation; AND

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: HUMAN RELIABILITY ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA: Risk Ranking Prioritization	SUBTIER CRITERIA: Risk Informed Decision Making	SUBTIER CRITERIA: Risk Based Decision Making
HR-14 (cont'd)			HRA assumptions and assertions should be consistent with operator training and procedures. One way to ensure the assumptions are consistent with training and actual conditions is to obtain a review by operations or training personnel. Therefore, the operating staff (or equivalent personnel should review the HRA calculations, especially the assumptions made in the analysis.	HRA assumptions and assertions should be consistent with operator training and procedures. One way to ensure the assumptions are consistent with training and actual conditions is to obtain a review by operations or training personnel. Therefore, the operating staff (or equivalent personnel should review the HRA calculations, especially the assumptions made in the analysis.
HR-15 (1)	• Best estimate HEPs are used in the quantification of dominant contributors.	Conservative HEPs may be used in the PRA quantification.	Best estimate HEPs shall be used in the quantification of dominant contributors.	Best estimate HEPs shall be used in the quantification of dominant contributors.
HR-16	• Emphasis of the Human Reliability Analysis is to identify that the HI is folded correctly into the model and that the HI: - Reflects the procedures (EOPs & AOPs) - Reflects training - Reflects simulator results (if applicable)	The HEP should be developed such that it accurately reflects the: • Procedures (EOPs and AOPs) • Training on the implementation • Simulator Responses These should all be reflective of the accident sequence that is being modeled. The HEP should then be included in the model to represent those sequence specific actions for which it was developed.	The HEP should be developed such that it accurately reflects the: • Procedures (EOPs and AOPs) • Training on the implementation • Simulator Responses These should all be reflective of the accident sequence that is being modeled. The HEP should then be included in them model to represent those sequence specific actions for which it was developed.	The HEP shall be developed such that it accurately reflects the: • Procedures (EOPs and AOPs) • Training on the implementation • Simulator Responses These shall all be reflective of the accident sequence that is being modeled. The HEP shall then be included in them model to represent those sequence specific actions for which it was developed.
HR-17	• The performance shaping factors such as time available, time to perform, stress, complexity, etc. are included in the quantification.	Performance shaping factors formulated for the specific accident sequence and the associated HEP (including time available, time to perform, stress, complexity, available indication, resource limitations on the back shift etc. may be included in the quantification as applicable. Contributors to the total HEP should be incorporated in the assessment; e.g.: • Diagnosis • Manipulation	Performance shaping factors formulated for the specific accident sequence and the associated HEP (including time available, time to perform, stress, complexity, available indication, resource limitations on the back shift etc. should be included in the quantification as applicable. Contributors to the total HEP shall be incorporated in the assessment; e.g.: • Diagnosis • Manipulation	Performance shaping factors formulated for the specific accident sequence and the associated HEP (including time available, time to perform, stress, complexity, available indication, resource limitations on the back shift etc. shall be included in the quantification as applicable. Contributors to the total HEP shall be incorporated in the assessment; e.g.: • Diagnosis • Manipulation

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: HUMAN RELIABILITY ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA: Risk Ranking Prioritization	SUBTIER CRITERIA: Risk Informed Decision Making	SUBTIER CRITERIA: Risk Based Decision Making
HR-17 (cont'd)			The post-initiator HEP should address the: • Accident sequence specific timing • Accident sequence specific procedural guidance • Adverse environment associated with the accident sequence • The instrumentation availability for the accident sequence These factors may then result in sequence specific HEPs. The HRA assessment should account for potential delays in the cues to begin actions and account for competing effects if multiple failures have occurred. Ex-control Room human action times for travel and manipulation should be supported by operator interviews, JPMs, or observations. Assumptions to be confirmed by operations, training or a walkdown should include: • Number of personnel available • Indication availability • Availability of keys for key locks (control room or remote) • Security access • Pathway hazards for remote access	The post-initiator HEP shall address the: • Accident sequence specific timing • Accident sequence specific procedural guidance • Adverse environment associated with the accident sequence • The instrumentation availability for the accident sequence These factors may then result in sequence specific HEPs. The HRA assessment shall account for potential delays in the cues to begin actions and account for competing effects if multiple failures have occurred. Ex-control Room human action times for travel and manipulation should be supported by operator interviews, JPMs, or observations. Assumptions to be confirmed by operations, training or a walkdown shall include: • Number of personnel available • Indication availability • Availability of keys for key locks (control room or remote) • Security access • Pathway hazards for remote access
HR-18	• The performance shaping factor for time available for an action and the time required to take an action are developed on a plant specific basis.	The performance shaping factor for time available for an action and the time required to take an action may be developed on a plant specific basis.	The performance shaping factor for time available for an action and the time required to take an action should be developed on a plant specific basis.	The performance shaping factor for time available for an action and the time required to take an action shall be developed on a plant specific basis.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: HUMAN RELIABILITY ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA: Risk Ranking Prioritization	SUBTIER CRITERIA: Risk Informed Decision Making	SUBTIER CRITERIA: Risk Based Decision Making
HR-19	• The time available for action is based on: - generic T & H analysis OR - plant specific T & H analysis	The time available for action may be based on: • generic T & H analysis Power uprate effects should be included. The time of cues for taking an operator action may be identified.	The time available for an action to be taken should be based on plant specific thermal hydraulic analysis or appropriate generic analysis that accounts for plant specific features. Power uprate effects should be included. The time of cues for taking an operator action should be identified.	The time available for an action to be taken shall be based on plant specific thermal hydraulic analysis. Power uprate effects shall be included. The time of cues for taking an operator action shall be identified.
HR-20	• The time required to complete the actions is based on observation or operations staff input.	The time required to complete the actions may be based on observation or operations staff input.	The time required to complete the actions should be based on observation or operations staff input.	The time required to complete the actions shall be based on observation or operations staff input.
HR-21	• The recovery actions are included systematically in the model; OR The recovery actions are included selectively in the model for dominant cut sets.	The recovery actions may be included selectively in the model for dominant cut sets.	The recovery actions should be included systematically in the model Model coding of basic events should allow the identification of operator actions: pre-initiators, post-initiators, repair and recovery.	The recovery actions shall be included systematically in the model. Model coding of basic events should allow the identification of operator actions: pre-initiators, post-initiators, repair and recovery.
HR-22	• The models and analysis are consistent with the operating procedures and training.	The models and analysis should be consistent with the operating procedures and training.	The models and analysis shall be consistent with the operating procedures and training.	The models and analysis shall be consistent with the operating procedures and training.
HR-23	• Operator actions including recovery are not credited unless a procedure is available or operator training has included the action as part of crew's training.	Operator actions including recovery should not be credited unless a procedure is available or operator training has included the action as part of crew's training.	Operator actions including recovery should not be credited unless a procedure is available or operator training has included the action as part of crew's training.	Operator actions including recovery are not credited unless a procedure is available or operator training has included the action as part of crew's training.
HR-24	• Inter-unit cross ties are only credited if procedures and training are available.	Inter-unit cross ties should be only credited if procedures and training are available.	Inter-unit cross ties should be only credited if procedures and training are available.	Inter-unit cross ties shall be only credited if procedures and training are available.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: HUMAN RELIABILITY ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA Risk Ranking Prioritization	SUBTIER CRITERIA Risk Informed Decision Making	SUBTIER CRITERIA Risk Based Decision Making
HR-25	• Inter-unit cross ties are accurately accounted for under conditions of outage for the other unit and special initiating events.	Inter-unit cross ties should be accurately accounted for under conditions of outage for the other unit and special initiating events.	Inter-unit cross ties should be accurately accounted for under conditions of outage for the other unit and special initiating events.	Inter-unit cross ties shall be accurately accounted for under conditions of outage for the other unit and special initiating events.
HR-26	DEPENDENCE AMONG ACTIONS • The dependence among human actions is evaluated in the PSA process.	The dependence among human actions should be evaluated in the PSA process.	The dependence among human actions shall be evaluated in the PSA process.	The dependence among human actions shall be evaluated in the PSA process.
HR-27	• Identification of sequences that, but for low human error rates in recovery actions, would have been dominant contributors to core damage frequency is included as a test of modeling adequacy. Equivalent techniques may also be used.	Identification of sequences that, but for low human error rates in recovery actions, would have been dominant contributors to core damage frequency may be included as a test of modeling adequacy. Equivalent techniques may also be used. For those HEPs quantified, the total operating crew failure probability is a single cutset or sequence should not be less than 1E-6 unless additional justification is provided. For example, sequences with time lines greater than 24 hours could be justified to have a total HEP contribution less than 5E-7.	Identification of sequences that, but for low human error rates in recovery actions, would have been dominant contributors to core damage frequency should be included as a test of modeling adequacy. Equivalent techniques may also be used. For those HEPs quantified, the total operating crew failure probability is a single cutset or sequence should not be less than 1E-6 unless additional justification is provided. For example, sequences with time lines greater than 24 hours could be justified to have a total HEP contribution less than 5E-7.	Identification of sequences that, but for low human error rates in recovery actions, would have been dominant contributors to core damage frequency shall be included as a test of modeling adequacy. Equivalent techniques may also be used. For those HEPs quantified, the total operating crew failure probability is a single cutset or sequence should not be less than 1E-6 unless additional justification is provided. For example, sequences with time lines greater than 24 hours could be justified to have a total HEP contribution less than 5E-7.
HR-28	DOCUMENTATION • Reflects the process used	NA	Documentation should provide the basis for meeting each of the criteria HR-4 through HR-10. The documentation should describe the results consistent with the process.	Documentation shall provide the basis for meeting each of the criteria HR-4 through HR-10. The documentation shall describe the results consistent with the process.
HR-29	• Includes an independent review for the documented results	Independent review may be performed and documented by knowledgeable personnel.	Independent review should be performed and documented by knowledgeable personnel.	Independent review should be performed and documented by knowledgeable personnel.

Table 5-6

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: HUMAN RELIABILITY ANALYSIS

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decision Making	Risk Based Decision Making
HR-30	• Provides the basis of the HRA and is traceable to plant specific or generic analysis.	Documentation may provide the basis for HRA process.	Documentation should provide the basis for HRA process.	Documentation shall provide the basis for HRA process.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: STRUCTURAL RESPONSE

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decision Making	Risk Based Decision Making
ST-1	GUIDANCE • Describes the process used	---	The documentation of the structural analysis should be sufficiently well described in the documented results to act as guidance for future updates and revisions.	A specific guidance document should be available that specifies the process for structural analysis including the updating process. Guidance for the structural evaluation for the following should be included for both Level 1 and Level 2 challenges: • RPV (ATWS and non-ATWS) • Containment • Pipe • Flood Barriers • Reactor Buildings
ST-2	• Consistent with industry practices	General adherence to accepted industry approaches should be included.	The documentation should provide a reasonable basis for performing the structural analysis and should maintain consistency with proven approaches.	The guidance for structural analysis should be complete and detailed and should maintain consistency with proven approaches.
ST-3	• Sufficient detail provided for reproducing the evaluation	Guidance may be available to supply general approaches used.	The guidance should be sufficient to provide a means to obtain equivalent results.	The guidance shall be sufficiently detailed to reproduce the results.

Table 5-7

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: STRUCTURAL RESPONSE

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decision Making	Risk Based Decision Making
ST-4	RPV CAPABILITY (ATWS) • Failure Limit considered, OR • Best estimate failure condition considered (ASME Service Level C used)	The definition of the RPV ultimate capacity for various challenges should be provided. This may include: • Overpressure • Pressurized thermal shock • Debris attack (Level 2/LERF only) This definition may include conservatisms in the evaluation. This may include UFSAR evaluations of Service Level C or number of SRVs required for different challenges (e.g., transient, ATWS).	The definition of the RPV ultimate capacity for various challenges should be provided. This may include: • Overpressure • Pressurized thermal shock • Debris attack (Level 2/LERF only) This definition may include conservatisms in the evaluation.	A best estimate of the RPV ultimate capacity for the following challenges shall be provided. This shall include: • Overpressure • Pressurized thermal shock • Debris attack (Level 2/LERF only)

Table 5-7

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: STRUCTURAL RESPONSE

Designator	CRITERIA	SUBTIER CRITERIA: Risk Ranking Prioritization	SUBTIER CRITERIA: Risk Informed Decision Making	SUBTIER CRITERIA: Risk Based Decision Making
ST-5	CONTAINMENT • Conservative estimate of failure probability is used OR • Realistic estimate of failure probability is used based on detailed plant specific structural examination	The containment ultimate capacity for the various challenges that are evaluated in the PRA should be provided. This may include: • Overpressure • High pressure and temperature • Dynamic loading • Combustible gas events • Debris Contact • Steam Explosion • Direct Containment Heating This containment capacity may include conservatisms in the evaluation and may be based on comparison of the plant specific features with a reference plant analysis. Generic containment failure modes may be used as a starting point for the containment failure mode assessment. Containment failure paths and size of failures may be included in the evaluation if they may influence LERF assessment.	The containment ultimate capacity for the various challenges that are evaluated in the PRA should be provided. This should include: • Overpressure • High pressure and temperature • Dynamic loading • Combustible gas events • Debris Contact • Steam Explosion • Direct Containment Heating This containment capacity may include conservatisms in the evaluation. The evaluation of the containment capacity should be plant specific. Generic containment failure modes should be used as a starting point for the containment failure mode assessment. Behavior of containment seals, penetrations, and hatches should be fully addressed beyond the design basis temperature and pressure for contributing failure modes and failure pathways. The PRA should provide a best estimate evaluation of containment structural capability which assesses all potential impacts. This includes: • Impact on Level 1 -- adverse impacts on core damage prevention • Impact on release • Impact on suppression pool bypass	A best estimate plant specific containment ultimate capacity evaluation for the following challenges shall be provided: • Overpressure • High pressure and temperature • Dynamic loading • Combustible gas events • Debris Contact • Steam Explosion • Direct Containment Heating Generic containment failure modes should be used as a starting point for the containment failure mode assessment. Behavior of containment seals, penetrations, and hatches should be fully addressed beyond the design basis temperature and pressure for contributing failure modes and failure pathways. The PRA shall provide a best estimate evaluation of containment structural capability which assesses all potential impacts. This includes: • Impact on Level 1 -- adverse impacts on core damage prevention • Impact on release • Impact on suppression pool bypass

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: STRUCTURAL RESPONSE

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decision Making	Risk Based Decision Making
ST-5 (cont'd)			Unique containment characteristics should be explicitly assessed in the plant specific analysis. Examples include the following: 1. External Ring Header 2. External Wetwell to Drywell Vacuum Breaker Lines 3. Single Ply external expansion bellows 4. Dynamic Torus Loading 5. Reactor Building to torus vacuum breakers 6. Free Standing Steel vs. Concrete Containment failure paths and size of failures should be included in the evaluation if they may influence LERF assessment.	Unique containment characteristics shall be explicitly assessed in the plant specific analysis. Examples include the following: 1. External Ring Header 2. External Wetwell to Drywell Vacuum Breaker Lines 3. Single Ply external expansion bellows 4. Dynamic Torus Loading 5. Reactor Building to torus vacuum breakers 6. Free Standing Steel vs. Concrete Containment failure paths and size of failures shall be included in the evaluation if they may influence LERF assessment.
ST-6	• Level 2 analysis considers multiple pathways from the containment	Multiple containment failure pathways should be included in the evaluation of containment performance for Level 2. (Specifically, DW head, DW shell, wetwell airspace, and wetwell waterspace failures should all be included in the probabilistic assessment and Level 2 evaluation.) In addition, if coincident multiple failure modes are possible during a single accident scenario, the impact on radionuclide release should be incorporated.	Multiple containment failure pathways shall be included in the evaluation of containment performance for Level 2. (Specifically, DW head, DW shell, wetwell airspace, and wetwell waterspace failures shall all be included in the probabilistic assessment and Level 2 evaluation.) In addition, if coincident multiple failure modes are possible during a single accident scenario, the impact on radionuclide release should be incorporated.	Multiple containment failure pathways shall be included in the evaluation of containment performance for Level 2. (Specifically, DW head, DW shell, wetwell airspace, and wetwell waterspace failures shall all be included in the probabilistic assessment and Level 2 evaluation.) In addition, if coincident multiple failure modes are possible during a single accident scenario, the impact on radionuclide release shall be incorporated.
ST-7	REACTOR BUILDING (for BWRs) • Blowout panels considered	Reactor building or auxiliary buildings should be assessed to determine the failure location given a release from the RPV or the containment. This should include the blowout panels.	Reactor building or auxiliary buildings should be assessed to determine the failure location given a release from the RPV or the containment. This should include the blowout panels.	Reactor building or auxiliary buildings should be assessed to determine the failure location given a release from the RPV or the containment. This should include the blowout panels.
ST-8	• Level 2 analysis considers multiple pathways from the reactor building	Reactor Building failure modes that can lead to reduced decontamination factors and higher releases to the environment should be considered. This should include failure modes involving failures low in the reactor building and coincident failures higher in the Reactor Building leading to accelerated air flow and low DF.	Reactor Building failure modes that can lead to reduced decontamination factors and higher releases to the environment should be considered. This should include failure modes involving failures low in the reactor building and coincident failures higher in the Reactor Building leading to accelerated air flow and low DF.	Reactor Building failure modes that can lead to reduced decontamination factors and higher releases to the environment shall be considered. This shall include failure modes involving failures low in the reactor building and coincident failures higher in the Reactor Building leading to accelerated air flow and low DF.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: STRUCTURAL RESPONSE

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decision Making	Risk Based Decision Making
ST-9	PIPE OVERPRESSURE (ISLOCA) • Conservative estimate is used OR • Generic realistic estimate is used OR • Plant specific realistic estimate is used	The pipe ultimate capacity under the conditions of exposure to high pressure (e.g., RPV pressure for incipient ISLOCA) should be provided. This may include conservatisms in the evaluation.	The pipe ultimate capacity under conditions of exposure to high pressure (e.g., RPV pressure for incipient ISLOCA) shall be provided on a realistic basis using methods specified by NRC in NUREG/CR-5603, NUREG/CR-5124, or their equivalent and may use typical pipe configuration and sizes in the evaluation to provide a realistic but generic or typical failure probability.	The pipe ultimate capacity under conditions of exposure to high pressure (e.g., RPV pressure for incipient ISLOCA) shall be provided on a realistic basis using methods specified by NRC in NUREG/CR-5603, NUREG/CR-5124, or their equivalent and shall use plant specific pipe parameters.
ST-10	FLOOD BARRIER INTEGRITY • Internal flooding analysis considers flood barrier (e.g., doors) structural capability and features when these barriers are credited for limiting flood propagation	As part of the containment flooding accident sequence evaluation, the spatial effects of flooding should address the flood propagation paths. These path investigations should include: • Flood barrier penetration, failure, or inadvertent openings (e.g., doors) • Ventilation penetration pathways • Spray of the flood waters • Floor gratings • Drains • Drain system check valves Flood propagation should consider the failure modes of each in the assessment of flood accident sequences.	As part of the containment flooding accident sequence evaluation, the spatial effects of flooding should address the flood propagation paths. These path investigations should include: • Flood barrier penetration, failure, or inadvertent openings (e.g., doors) • Ventilation penetrations • Spray of the flood waters • Floor gratings • Drains • Drain system check valves Flood propagation should consider the failure modes of each in the assessment of flood accident sequences.	As part of the containment flooding accident sequence evaluation, the spatial effects of flooding shall address the flood propagation paths. These path investigations shall include: • Flood barrier penetration, failure, or inadvertent openings (e.g., doors) • Ventilation penetrations • Spray of the flood waters • Floor gratings • Drains • Drain system check valves Flood propagation shall consider the failure modes of each in the assessment of flood accident sequences.
ST-11	DOCUMENTATION • Reflects the process used		Documentation should provide the basis for meeting each of the criteria ST-4 through ST-10. The documentation should describe the results consistent with the process.	Documentation shall provide the basis for meeting each of the criteria ST-4 through SY-10. The documentation shall describe the results consistent with the process.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: STRUCTURAL RESPONSE

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decision Making	Risk Based Decision Making
ST-12	• Includes an independent review for the documented results	The system analysis should be reviewed.	Independent review should be performed and documented by knowledgeable personnel, such as a structural engineer.	Independent review should be performed and documented by knowledgeable personnel, such as a structural engineer.
ST-13	• Provides the basis of the treatment and is traceable to plant specific or generic analysis.	Documentation may reflect process features.	Documentation should provide the basis for structural analysis process.	Documentation shall provide the basis for structural analysis process.

Table 5-8

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: QUANTIFICATION AND RESULTS INTERPRETATION

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decision Making	Risk Based Decision Making
QU-1	GUIDANCE • Describes the process used	N/A	The documentation of the quantification process should be sufficiently well described in the documented results to act as guidance for future updates and revisions.	A specific guidance document should be available that specifies the process for quantification including the updating process.
QU-2	• Consistent with industry practices	General adherence to accepted industry approaches should be included.	The documentation should provide a reasonable basis for performing the quantification and should maintain consistency with proven approaches.	The guidance for quantification should be complete and detailed and should maintain consistency with proven approaches.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: QUANTIFICATION AND RESULTS INTERPRETATION

Designator	CRITERIA	SUBTIER CRITERIA: Risk Ranking Prioritization	SUBTIER CRITERIA: Risk Informed Decision Making	SUBTIER CRITERIA: Risk Based Decision Making
QU-3	• Sufficient detail provided for reproducing the evaluation	Guidance may be available to supply general approaches used. (See also QU-4, QU-6, QU-7)	• The guidance should be sufficient to provide a means to obtain equivalent results. • The mutually exclusive event file presents the combinations which are assumed not to occur in the final cutset result due to plant maintenance practices or operation. Examples include technical specifications, administrative procedures and non-physical cutsets. Entries in the mutually exclusive file should be documented regarding the basis for their removal from the final solution.. (See also QU-4, QU-6, QU-7)	• The guidance shall be sufficiently detailed to reproduce the results. • The guidance should include the specific steps performed. • The mutually exclusive event file presents the combinations which are assumed not to occur in the final cutset result due to plant maintenance practices or operation. Examples include technical specifications, administrative procedures and non-physical cutsets. Entries in the mutually exclusive file should be documented regarding the basis for their removal from the final solution. • Guidance should be provided regarding: (1) the treatment of non-minimal sequences and/or cutsets as part of the results interpretation and use of the model; (2) establishing maximum fault tree truncation limits, based on a number of decades below the FT quantification, the number of cutsets obtained, or convergence; (3) The sensitivity/uncertainty analysis to be performed should be identified; (4) description of levels of detail for ET nodes; (5) when and how to use transfers; (6) how to set up the computer files, what truncation limits to use. • This should ensure consistency between updates. (See also QU-4, QU-6, QU-7)

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: QUANTIFICATION AND RESULTS INTERPRETATION

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decision Making	Risk Based Decision Making
QU-4	CODE • The base computer code and its inputs have been tested and demonstrated to produce reasonable answers.[(3), (4)]	Cutset truncation based on cutset order shall not be performed. For evaluations in which the rare event approximation does not apply, the computer code or its application to the PRA should properly account for this situation. If success branches of event trees are less than 0.9, the numerically correct estimate shall be used.	Cutset truncation based on cutset order shall not be performed. For evaluations in which the rare event approximation does not apply, the computer code or its application to the PRA should properly account for this situation. If success branches of event trees are less than 0.9, the numerically correct estimate shall be used. The same truncation limit used in evaluating system failures shall be used in the complementary success branches. Use of independent modules should not allow reduction in the truncation limit. The review and confirmation of the house event file and the disallowed maintenance (DAM) file should be performed to ensure quality. These files can fundamentally change the model results and are difficult to check intuitively.	Cutset truncation based on cutset order shall not be performed. For evaluations in which the rare event approximation does not apply, the computer code or its application to the PRA should properly account for this situation. If success branches of event trees are less than 0.9, the numerically correct estimate shall be used. The same truncation limit used in evaluating system failures shall be used in the complementary success branches. Use of independent modules should not allow reduction in the truncation limit. The review and confirmation of the house event file and the disallowed maintenance (DAM) file shall be performed to ensure quality. These files can fundamentally change the model results and are difficult to check intuitively.
QU-5	• The simplified model (cutset model) is demonstrated to produce reasonable results for typical applications.[(2)]	The simplified model (cutset model) may be demonstrated to produce reasonable results for typical applications.	The simplified model (cutset model) may be demonstrated to produce reasonable results for typical applications.	The simplified model (cutset model) may be demonstrated to produce reasonable results for typical applications.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: QUANTIFICATION AND RESULTS INTERPRETATION

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decision Making	Risk Based Decision Making
QU-6	• Applications are not limited by the capabilities of the computer code.	Each computer code in use has its own inconsistencies that make it difficult for inexperienced users. There should be written guidance or set of code limitations that treat such issues as: • Transfers between event trees may not carry the success terms or previous failure terms • Truncation limits in fault trees different than sequence truncation values • K of N gate limits • For high conditional failure probabilities in event trees, some codes may not quantitatively account for the success branch probability being less than 1.0.	Each computer code in use has its own inconsistencies that make it difficult for inexperienced users. There should be written guidance or set of code limitations that treat such issues as: • Transfers between event trees may not carry the success terms or previous failure terms • Truncation limits in fault trees different than sequence truncation values • K of N gate limits • For high conditional failure probabilities in event trees, some codes may not quantitatively account for the success branch probability being less than 1.0.	Each computer code in use has its own inconsistencies that make it difficult for inexperienced users. There should be written guidance or set of code limitations that treat such issues as: • Transfers between event trees may not carry the success terms or previous failure terms • Truncation limits in fault trees different than sequence truncation values • K of N gate limits • For high conditional failure probabilities in event trees, some codes may not quantitatively account for the success branch probability being less than 1.0.
QU-7	SIMPLIFIED MODEL • The simplified model (e.g., solved cutset) limitations are clearly identified.	The use of the "cutset" model or the "saved sequence" model, or any other simplified model should have a set of limitations documented that allow the user to check whether the limitations would impact the application.	The use of the "cutset" model or the "saved sequence" model, or any other simplified model should have a set of limitations documented that allow the user to check whether the limitations would impact the application. The RISKMAN "saved sequence" model or fault tree linked code cutset models have a number of limitations when it comes to applications. These limitations are in general well known. However the limitations should be documented for both future members of the PSA group or the users of the PSA such as the Maintenance Rule Expert Panel. These limitations include issues related to asymmetry in the model or in conditions related to truncation limits that lead to incorrect or misleading importance measures.	The use of the "cutset" model or the "saved sequence" model, or any other simplified model should have a set of limitations documented that allow the user to check whether the limitations would impact the application. The RISKMAN "saved sequence" model or fault tree linked code cutset models have a number of limitations when it comes to applications. These limitations are in general well known. However the limitations should be documented for both future members of the PSA group or the users of the PSA such as the Maintenance Rule Expert Panel. These limitations include issues related to asymmetry in the model or in conditions related to truncation limits that lead to incorrect or misleading importance measures.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: QUANTIFICATION AND RESULTS INTERPRETATION

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decision Making	Risk Based Decision Making
QU-8	DOMINANT SEQUENCES/ CUTSETS • The dominant cut sets or sequences[1] - Make physical sense	A review of the dominant cutsets should be performed to demonstrate the reasonableness of the cutset results and to identify that there are no anomalies in the cutset results.	A review of the dominant cutsets shall be performed to demonstrate the reasonableness of the cutset results and to identify that there are no anomalies in the cutset results.	A review of the dominant cutsets shall be performed to demonstrate the reasonableness of the cutset results and to identify that there are no anomalies in the cutset results.
QU-9	- Include common cause potential where appropriate	Common cause failure probabilities may be included for key groups and the use of the latest common cause data may be used.	Common cause failure probabilities should be included for key groups and the latest common cause data should be used.	Common cause failure probabilities shall be included for key groups and the latest common cause data shall be used, plus a search for plant specific applicability of the common cause data shall be performed consistent with NUREG/CR-4780.
QU-10	- Include dependency among human actions when multiple HEPs are in the same cutset or sequence	The dependence among human actions should be evaluated in the PSA process. Identification of sequences that, but for low human error rates, would have been dominant contributors to core damage frequency may be included as a test of modeling adequacy. Equivalent techniques may also be used.	The dependence among human actions shall be evaluated in the PSA process. Identification of sequences that, but for low human error rates, would have been dominant contributors to core damage frequency should be included as a test of modeling adequacy. Equivalent techniques may also be used.	The dependence among human actions shall be evaluated in the PSA process. Identification of sequences that, but for low human error rates in, would have been dominant contributors to core damage frequency shall be included as a test of modeling adequacy. Equivalent techniques may also be used.
QU-11	- Are not missing potentially dominant cut sets or sequences for similar plants. Possible reasons for differences include: (a) physical plant or procedural differences among plants; (b) documented assumptions; (c) detailed modeling or data to supplant assumptions.	The cutsets from similar plants may be reviewed to ensure that dominant cutsets which have been observed at other plants should not be present in the analyzed plant.	The cutsets from similar plants should be reviewed to ensure that dominant cutsets which have been observed at other plants should not be present in the analyzed plant.	The cutsets from similar plants shall be reviewed to ensure that dominant cutsets which have been observed at other plants should not be present in the analyzed plant.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: QUANTIFICATION AND RESULTS INTERPRETATION

		SUBTIER CRITERIA		
Designator	CRITERIA	Risk Ranking Prioritization	Risk Informed Decision Making	Risk Based Decision Making
QU-12	• Asymmetry: The model asymmetry is well described in terms of: - modeling - plant support systems - normally running equipment - cross-ties to an adjacent unit	The system notebooks, the event tree notebook, or the results summary may provide a description of the asymmetries in systems or in the modeling of systems.	The system notebooks, the event tree notebook, or the results summary should provide a description of the asymmetries in systems or in the modeling of systems. The design, data, operating philosophy, and operating conditions that can lead to asymmetries in the importance of components, systems, or system trains should be documented. This information should be useful in assessing implications of failures, on-line outage decisions, modifications, and accident response.	The system notebooks, the event tree notebook, or the results summary shall provide a description of the asymmetries in systems or in the modeling of systems. The design, data, operating philosophy, and operating conditions that can lead to asymmetries in the importance of components, systems, or system trains should be documented. This information should be useful in assessing implications of failures, on-line outage decisions, modifications, and accident response.
QU-13	• Asymmetry: Any modeling quantitative asymmetry (e.g., one train of dual-train system modeled as in-service, other in standby) is documented and is well understood so that applications affected by asymmetry can be determined.	Asymmetries in quantitative modeling may be explained and examined to provide application users the necessary understanding regarding why such asymmetries are present in the model.	Asymmetries in quantitative modeling should be explained and examined to provide application users the necessary understanding regarding why such asymmetries are present in the model.	Asymmetries in quantitative modeling shall be explained and examined to provide application users the necessary understanding regarding why such asymmetries are present in the model.
QU-14	• Circular logic can sometimes occur when using linked fault trees. The PSA process appropriately accounts for support system dependencies in a consistent fashion that avoids so-called circular logic.	The methods of eliminating circular logic may result in incorrect quantitative results, e.g., non-conservative. The cutting of circular logic in the model should be explained and should not introduce non-conservatisms in the model.	The methods of eliminating circular logic may result in incorrect quantitative results, e.g., non-conservative. The cutting of circular logic in the model should be explained and shall not introduce non-conservatisms in the model.	The methods of eliminating circular logic may result in incorrect quantitative results, e.g., non-conservative. The cutting of circular logic in the model should be explained and shall not introduce non-conservatisms in the model.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: QUANTIFICATION AND RESULTS INTERPRETATION

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decision Making	Risk Based Decision Making
QU-15	NON-DOMINANT SEQUENCES/CUTSETS[1] • The non-dominant cut sets or sequences - Make physical sense	Non-dominant accident sequences may be reviewed to ensure the cutsets are reasonable and have physical meaning.	Non-dominant accident sequences should be reviewed to ensure the cutsets are reasonable and have physical meaning. The use of conservatisms in the IPE search for vulnerabilities is appropriate. However, in evolving the PSA to be used for risk-informed applications , overly conservative assumptions (even in non-dominant sequences) should be eliminated to avoid biasing the results.	Non-dominant accident sequences shall be reviewed to ensure the cutsets are reasonable and have physical meaning. The use of conservatisms in the IPE search for vulnerabilities is appropriate. However, in evolving the PSA to be used for risk-informed applications , overly conservative assumptions (even in non-dominant sequences) should be eliminated to avoid biasing the results.
QU-16	- Include common cause potential or there are equivalent cutsets that do include the common cause potential	Common cause failure probabilities may be included for key groups and the use of the latest common cause data may be used.	Common cause failure probabilities should be included for key groups and the use of the latest common cause data should be used.	Common cause failure probabilities shall be included for key groups and the use of the latest common cause data shall be used.
QU-17	- Include dependency among human actions when multiple HEPs are in the same cutset or sequence	The dependence among human actions should be evaluated in the PSA process. Identification of sequences that, but for low human error rates, would have been dominant contributors to core damage frequency may be included as a test of modeling adequacy. Equivalent techniques may also be used.	The dependence among human actions shall be evaluated in the PSA process. Identification of sequences that, but for low human error rates, would have been dominant contributors to core damage frequency should be included as a test of modeling adequacy. Equivalent techniques may also be used.	The dependence among human actions shall be evaluated in the PSA process. Identification of sequences that, but for low human error rates in, would have been dominant contributors to core damage frequency shall be included as a test of modeling adequacy. Equivalent techniques may also be used.
QU-18	RECOVERY ANALYSIS • Recovery actions credited in the evaluation are either proceduralized or have reasonable likelihood of success when the TSC/EOF are manned.	Recovery actions credited in the evaluation should be either proceduralized or have reasonable likelihood of success when the TSC/EOF are manned.	Recovery actions credited in the evaluation shall be either proceduralized or have reasonable likelihood of success when the TSC/EOF are manned.	Recovery actions credited in the evaluation shall be either proceduralized or have reasonable likelihood of success when the TSC/EOF are manned.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: QUANTIFICATION AND RESULTS INTERPRETATION

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decision Making	Risk Based Decision Making
QU-19	• Recovery actions that are included in the quantification process are included on selected dominant accident sequences; OR • Recovery actions that are included in the quantification process are included in all applicable sequences and cut sets	Recovery actions that are included in the quantification process may be included on selected dominant accident sequences.	Recovery actions that are included in the quantification process should be included in all applicable sequences and cut sets.	Recovery actions that are included in the quantification process shall be included in all applicable sequences and cut sets.
QU-20	• Transfers of sequences among event trees are treated explicitly.	Transfers of sequences among event trees may be treated explicitly.	Transfers of sequences among event trees should be treated explicitly.	Transfers of sequences among event trees shall be treated explicitly.
QU-21	TRUNCATION • The truncation of accident sequences based on frequency is a key decision made by PSA analysts that may affect the future PRA applications. The PSA Applications Guide implies that truncation limits be low enough to support the evaluation of dependencies among systems, structures, and components.	The truncation of accident sequences from the model may eliminate some dependencies that are judged insignificant for CDF or LERF.	The truncation of accident sequences should be performed at a sufficiently low cutoff value that significant dependencies that may affect applications are not eliminated. Entire groups of sequences (e.g., ATWS, LOOP) should not be completely truncated unless thorough documentation is provided regarding the technical bases for truncation. It is noted that accident sequences may have been eliminated from the quantified model before the truncation test is applied. The elimination of certain sequences (e.g., LOCA * Failure to scram, or Breaks outside containment) should not be done using the GL 88-20 type screening (or equivalent) and without consideration of the impact on Level 2.	The truncation of accident sequences shall be performed at a sufficiently low cutoff value that significant dependencies that may affect applications are not eliminated. Entire groups of sequences (e.g., ATWS, LOOP) should not be completely truncated unless thorough documentation is provided regarding the technical bases for truncation. It is noted that accident sequences may have been eliminated from the quantified model before the truncation test is applied. The elimination of certain sequences (e.g., LOCA * Failure to scram, or Breaks outside containment) should not be done using the GL 88-20 type screening (or equivalent) and without consideration of the impact on Level 2.

Table 5-8

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: QUANTIFICATION AND RESULTS INTERPRETATION

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decision Making	Risk Based Decision Making
QU-22	• Example truncation values used in a base PSA are given. These should be treated as examples only. The screening truncation of events or failure modes retained in the model are as follows for screened out events: Level 1 LERF (per year)	The screening truncation of events or failure modes may be as follows for screened out events: < 0.01 * CDF Base <u>AND</u> < 0.01 * LERF Base	The screening truncation of events or failure modes should be as follows for screened out events: < 0.0001 * CDF Base <u>AND</u> < 0.0001 * LERF Base	The screening truncation of events or failure modes shall be as follows (or more stringent) for screened out events: < 0.00001 * CDF Base <u>AND</u> < 0.00001 * LERF Base
QU-23	• The truncation values used in the system fault trees and accident sequences are sufficiently low to support their use in representative applications.	The truncation of accident sequences from the model may eliminate some dependencies that are judged insignificant for CDF or LERF.	The truncation of accident sequences should be performed at a sufficiently low cutoff value that significant dependencies that may affect applications are not eliminated. Entire groups of sequences (e.g., ATWS, LOOP) should not be completely truncated unless thorough documentation is provided regarding the technical bases for truncation. It is noted that accident sequences may have been eliminated from the quantified model <u>before</u> the truncation test is applied. The elimination of certain sequences (e.g., LOCA * Failure to scram, or Breaks outside containment) should not be done using the GL 88-20 type screening (or equivalent) and without consideration of the impact on Level 2.	The truncation of accident sequences shall be performed at a sufficiently low cutoff value that significant dependencies that may affect applications are not eliminated. Entire groups of sequences (e.g., ATWS, LOOP) should not be completely truncated unless thorough documentation is provided regarding the technical bases for truncation. It is noted that accident sequences may have been eliminated from the quantified model <u>before</u> the truncation test is applied. The elimination of certain sequences (e.g., LOCA * Failure to scram, or Breaks outside containment) should not be done using the GL 88-20 type screening (or equivalent) and without consideration of the impact on Level 2.
QU-24	• There is evidence of convergence towards a stable result	There may be evidence of convergence towards a stable result.	There should be evidence of convergence towards a stable result.	There shall be evidence of convergence towards a stable result.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: QUANTIFICATION AND RESULTS INTERPRETATION

Designator	CRITERIA	SUBTIER CRITERIA Risk Ranking Prioritization	 Risk Informed Decision Making	 Risk Based Decision Making
QU-25	• If the fault tree linking approach is used, "delete" terms (cutset complements) are used to account for the successes in event sequences as appropriate to assure that the correct cut sets are generated.	If the fault tree linking approach is used, "delete" terms (cutset complements) should be used to account for the successes in event sequences as appropriate to assure that the correct cut sets are generated. This includes the treatment of transfers among event trees where the "successes" may not be transferred between event trees.	If the fault tree linking approach is used, "delete" terms (cutset complements) shall be used to account for the successes in event sequences as appropriate to assure that the correct cut sets are generated. This includes the treatment of transfers among event trees where the "successes" may not be transferred between event trees.	If the fault tree linking approach is used, "delete" terms (cutset complements) shall be used to account for the successes in event sequences as appropriate to assure that the correct cut sets are generated. This includes the treatment of transfers among event trees where the "successes" may not be transferred between event trees.
QU-26	• The quantification process identifies and deletes mutually exclusive cutsets.	The quantification process should identify and delete mutually exclusive cutsets. The process for identifying and eliminating mutually exclusive cutsets from the model may be documented.	The quantification process shall identify and delete mutually exclusive cutsets. The process for identifying and eliminating mutually exclusive cutsets from the model should be documented.	The quantification process shall identify and delete mutually exclusive cutsets. The process for identifying and eliminating mutually exclusive cutsets from the model shall be documented.
QU-27	UNCERTAINTY • A search is performed for unique or unusual sources of uncertainty not present in the typical or generic plant analysis.	A search may be performed for unique or unusual sources of uncertainty not present in the typical or generic plant analysis.	A search should be performed for unique or unusual sources of uncertainty not present in the typical or generic plant analysis. A qualitative presentation should be available for causes of uncertainty, such as: • possible optimistic or conservative success criteria, • suitability of the reliability data, • possible modeling uncertainties (asymmetry or other modeling limitations due to the method selected), • degree of completeness in the selection of initiating events, • possible spatial dependencies • etc.	A search shall be performed for unique or unusual sources of uncertainty not present in the typical or generic plant analysis. A qualitative presentation should be available for causes of uncertainty, such as: • possible optimistic or conservative success criteria, • suitability of the reliability data, • possible modeling uncertainties (asymmetry or other modeling limitations due to the method selected), • degree of completeness in the selection of initiating events, • possible spatial dependencies • etc.

Table 5-8

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: QUANTIFICATION AND RESULTS INTERPRETATION

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decision Making	Risk Based Decision Making
QU-28	• If there are unusual sources of uncertainty, special sensitivity evaluations or quantitative uncertainty assessments are performed to support the base conclusion and future applications.	If there are unusual sources of uncertainty, special sensitivity evaluations or quantitative uncertainty assessments may be performed to support the base conclusion and future applications.	If there are unusual sources of uncertainty, special sensitivity evaluations or quantitative uncertainty assessments should be performed to support the base conclusion and future applications.	If there are unusual sources of uncertainty, special sensitivity evaluations or quantitative uncertainty assessments shall be performed to support the base conclusion and future applications.
QU-29	• The capability to perform focused sensitivities to support the PSA applications is available.	The capability to perform focused sensitivities to support the PSA applications should be available.	The capability to perform focused sensitivities to support the PSA applications shall be available.	The capability to perform focused sensitivities to support the PSA applications shall be available.
QU-30	• A parametric uncertainty evaluation is performed that propagates the uncertainty distribution through the model sufficient to produce a valid mean value of CDF. OR	A parametric uncertainty evaluation may be performed that propagates the uncertainty distribution through the model sufficient to produce a valid mean value of CDF. OR	---	---
QU-30 (cont'd)	• A quantification of selected uncertainties is performed, or the impact of the selected uncertainties on the final risk measures is estimated. OR • A quantitative uncertainty evaluation is performed using selected sensitivities to establish the approximate uncertainty bands. OR	A quantification of selected uncertainties may be performed, or the impact of the selected uncertainties on the final risk measures is estimated. OR A quantitative uncertainty evaluation may be performed using selected sensitivities to establish the approximate uncertainty bands.	A quantification of selected uncertainties should be performed, or the impact of the selected uncertainties on the final risk measures is estimated. OR A quantitative uncertainty evaluation should be performed using selected sensitivities to establish the approximate uncertainty bands. OR	

Table 5-8

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: QUANTIFICATION AND RESULTS INTERPRETATION

		SUBTIER CRITERIA		
Designator	CRITERIA	Risk Ranking Prioritization	Risk Informed Decision Making	Risk Based Decision Making
	• A comparison is made between the plant specific PSA and a similar generic study with "full" uncertainty evaluation. The differences in the plant, model, or data are used to identify whether there are any differences that would impact the calculated uncertainty band or obviate the ability to use the uncertainty band. OR • A complete quantification of all sources of uncertainty is performed and the final estimates for risk measures is presented along with the uncertainty distribution.		A comparison should be made between the plant specific PSA and a similar generic study with "full" uncertainty evaluation. The differences in the plant, model, or data are used to identify whether there are any differences that would impact the calculated uncertainty band or obviate the ability to use the uncertainty band.	A comparison shall be made between the plant specific PSA and a similar generic study with "full" uncertainty evaluation. The differences in the plant, model, or data are used to identify whether there are any differences that would impact the calculated uncertainty band or obviate the ability to use the uncertainty band. OR A complete quantification of all sources of uncertainty shall be performed and the final estimates for risk measures is presented along with the uncertainty distribution.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: QUANTIFICATION AND RESULTS INTERPRETATION

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decision Making	Risk Based Decision Making
QU-31	RESULTS SUMMARY • The PSA results summary identifies the dominant contributors.	The PSA results summary should identify the dominant contributors. The accident sequence results by sequence, sequence types, and total should be reviewed and compared to similar plants to assure reasonableness and to identify any exceptions.	The PSA results summary shall identify the dominant contributors. The accident sequence results by sequence, sequence types, and total should be reviewed and compared to similar plants to assure reasonableness and to identify any exceptions. A detailed description of the Top 10 to 100 accident cutsets should be provided because they are be important in ensuring that the model results are well understood and that modeling assumption impacts are likewise well known. Similarly, the dominant accident sequences or functional failure groups should also be discussed. These functional failure groups should be based on a scheme similar to that identified by NEI in NEI 91-04, Appendix B.	The PSA results summary shall identify the dominant contributors. The accident sequence results by sequence, sequence types, and total shall be reviewed and compared to similar plants to assure reasonableness and to identify any exceptions. A detailed description of the Top 10 to 100 accident cutsets shall be provided because they are be important in ensuring that the model results are well understood and that modeling assumption impacts are likewise well known. Similarly, the dominant accident sequences or functional failure groups shall also be discussed. These functional failure groups should be based on a scheme similar to that identified by NEI in NEI 91-04, Appendix B.
QU-32	• Reflects the process used.	NA	Documentation should provide the basis for meeting each of the criteria QU-4 through QU-30. The documentation should describe the results consistent with the process.	Documentation shall provide the basis for meeting each of the criteria QU-4 through QU-31. The documentation shall describe the results consistent with the process.
QU-33	• Includes an independent review for the documented results.	Independent review may be performed and documented by knowledgeable personnel.	Independent review should be performed and documented by knowledgeable personnel.	Independent review shall be performed and documented by knowledgeable personnel.
QU-34	• Provides the basis and is traceable to plant specific or generic analysis.	Documentation may provide the basis for quantification process.	Documentation should provide the basis for quantification process.	Documentation shall provide the basis for quantification process.

Table 5-9

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: LEVEL 2 / LERF EVALUATION

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decision Making	Risk Based Decision Making
L2-1	GUIDANCE • Describes the process used	N/A	The documentation of the Level 2/LERF process should be sufficiently well described in the documented results to act as guidance for future updates and revisions.	A specific guidance document should be available that specifies the process for Level 2/LERF including the updating process.
L2-2	• Consistent with industry practices	General adherence to accepted industry approaches should be included.	The documentation should provide a reasonable basis for performing the quantification and should maintain consistency with proven approaches.	The guidance for Level 2/LERF analyses should be complete and detailed and should maintain consistency with proven approaches.
L2-3	• Sufficient detail provided for reproducing the evaluation	Guidance may be available to supply general approaches used.	The guidance should be sufficient to provide a means to obtain equivalent results.	The guidance shall be sufficiently detailed to reproduce the results.
L2-4	SUCCESS CRITERIA • The success criteria are identified	Success criteria for Level 2/LERF should be documented. Examples include the following: • core cooling adequacy for in-vessel recovery • timing for in-vessel recovery • Prevention of RPV breach due to core melt progression • Hydrogen deflagration survivability • Hydrogen burn impact for steam inerted containment prior to spray initiation. • Containment boundary survivability Those parameters (e.g., containment leakage rate) to be used as the basis for assigning containment bypass or failure should be defined, and acceptable values shall be specified.	Success criteria for Level 2/LERF shall be documented. Examples include the following: • core cooling adequacy for in-vessel recovery • timing for in-vessel recovery • Prevention of RPV breach due to core melt progression • Hydrogen deflagration survivability • Hydrogen burn impact for steam inerted containment prior to spray initiation. • Containment boundary survivability Those parameters (e.g., containment leakage rate) to be used as the basis for assigning containment bypass or failure should be defined, and acceptable values shall be specified.	Success criteria for Level 2/LERF shall be documented. Examples include the following: • core cooling adequacy for in-vessel recovery • timing for in-vessel recovery • Prevention of RPV breach due to core melt progression • Hydrogen deflagration survivability • Hydrogen burn impact for steam inerted containment prior to spray initiation. • Containment boundary survivability Those parameters (e.g., containment leakage rate) to be used as the basis for assigning containment bypass or failure should be defined, and acceptable values shall be specified.

Table 5-9

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: LEVEL 2 / LERF EVALUATION

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decision Making	Risk Based Decision Making
L2-5	• The success criteria are supported by thermal hydraulic analysis, system capability evaluations, or industry studies	Generic conclusions formulated for similar plants may be used to define success criteria to prevent LERF. These calculations shall be consistent with the plant being evaluated in the PSA or adjustments shall be made to the success criteria to account for the differences.	Generic conclusions formulated for similar plants may be used to define success criteria to prevent LERF. These calculations shall be consistent with the plant being evaluated in the PSA or adjustments shall be made to the success criteria to account for the differences.	Plant specific thermal hydraulic calculations using a computer code capable of assessing severe accident core melt progression should be used to define the success criteria to prevent LERF. These success criteria should be checked against similar calculations for similar plants.
L2-6	• The success criteria are judged realistic	The success criteria should be judged realistic or conservative.	The success criteria should be judged realistic	The success criteria shall be judged realistic
L2-7	LEVEL 1/LEVEL 2 INTERFACE • The link between the Level 1 and Level 2 is sufficient and adequately documented to provide the transfer of information from the Level 1 analysis to the Level 2 containment evaluation.	The transfer of information between Level 1 and Level 2 may use plant damage states to characterize groups of Level 1 core damage sequences with similar characteristics and impacts on severe accident melt progression. This treatment tends to have a wider uncertainty band on the results than other possible techniques. The use of multipliers (conditional probabilities) (see NUREG/CR-6595) to obtain LERF from CDF avoids the full calculation of Level 2 when the Level 1 changes. However, such multipliers shall be used carefully in developing applications that require LERF calculations because the changes to dependencies in the Level 1 model may not be reflected in the multipliers.	The transfer of information from Level 1 to Level 2 should be performed in a manner that maximizes the ability to accurately reflect dependencies due to conditions, equipment status, or operator errors in Level 1 that may adversely impact the Level 2 mitigation assessment. The use of multipliers (conditional probabilities) (see NUREG/CR-6595) to obtain LERF from CDF avoids the full calculation of Level 2 when the Level 1 changes. However, such multipliers shall be used carefully in developing applications that require LERF calculations because the changes to dependencies in the Level 1 model may not be reflected in the multipliers.	The transfer of information from Level 1 to Level 2 shall be performed in a manner that maximizes the ability to accurately reflect dependencies due to plant conditions, equipment status, or operator errors in Level 1 that may adversely impact the Level 2 mitigation assessment. The use of multipliers (conditional probabilities) (see NUREG/CR-6595) to obtain LERF from CDF avoids the full calculation of Level 2 when the Level 1 changes. However, such multipliers shall not be used in developing applications that require LERF.

Table 5-9

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: LEVEL 2 / LERF EVALUATION

Designator	CRITERIA	SUBTIER CRITERIA: Risk Ranking Prioritization	SUBTIER CRITERIA: Risk Informed Decision Making	SUBTIER CRITERIA: Risk Based Decision Making
L2-8	PHENOMENA CONSIDERED[(1),(3)] • The phenomena that may control the LERF radionuclide release characterization are included.	The phenomena that may control the LERF radionuclide release characterization should be included qualitatively. The Level 2 should address in a quantitative fashion a substantial number of issues affecting LERF that are believed potential contributors especially during PSA applications involving different plant configurations. These Level 2 issues include the following: • In-vessel Recovery • RPV vent & Containment Vent • Containment flood • Containment isolation • IC multiple tube rupture (if applicable) • ISLOCA • Deinerted operation	The phenomena that may control the LERF radionuclide release characterization shall be included quantitatively. The Level 2 shall address in a quantitative fashion a substantial number of issues affecting LERF that are believed potential contributors especially during PSA applications involving different plant configurations. These Level 2 issues include the following: • In-vessel Recovery • RPV vent & Containment Vent • Containment flood • Containment isolation • IC multiple tube rupture (if applicable) • ISLOCA • Deinerted operation	The phenomena that may control the LERF radionuclide release characterization shall be included quantitatively. The Level 2 shall address in a quantitative fashion a substantial number of issues affecting LERF that are believed potential contributors especially during PSA applications involving different plant configurations. These Level 2 issues include the following: • In-vessel Recovery • RPV vent & Containment Vent • Containment flood • Containment isolation • IC multiple tube rupture (if applicable) • ISLOCA • Deinerted operation
L2-8 (cont'd)		• Steam explosions • Vacuum breaker failure (Internal & External) • Hydrodynamic loads under high pool level • Recriticality	• Steam explosions • Vacuum breaker failure (Internal & External) • Hydrodynamic loads under high pool level • Recriticality	• Steam explosions • Vacuum breaker failure (Internal & External) • Hydrodynamic loads under high pool level • Recriticality

Table 5-9

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: LEVEL 2 / LERF EVALUATION

Designator	CRITERIA	SUBTIER CRITERIA: Risk Ranking Prioritization	SUBTIER CRITERIA: Risk Informed Decision Making	SUBTIER CRITERIA: Risk Based Decision Making
		• Containment boundary multiple failures, e.g., Shell failure as a subsequent containment failure • DCH • Vapor suppression failure • Direct Containment Heating • Pressurization of the pedestal cavity following vessel failure if there is substantial water in the cavity • High drywell temperatures leading to degradation of penetrations into the wetwell • The use of drywell sprays	• Containment boundary multiple failures, e.g., Shell failure as a subsequent containment failure • DCH • Vapor suppression failure • Direct Containment Heating • Pressurization of the pedestal cavity following vessel failure if there is substantial water in the cavity • High drywell temperatures leading to degradation of penetrations into the wetwell • The use of drywell sprays	• Containment boundary multiple failures, e.g., Shell failure as a subsequent containment failure • DCH • Vapor suppression failure • Direct Containment Heating • Pressurization of the pedestal cavity following vessel failure if there is substantial water in the cavity • High drywell temperatures leading to degradation of penetrations into the wetwell • The use of drywell sprays
L2-9 (4)	• (BWRs): The phenomena that may affect accident management actions and planning are included. OR • (PWRs): If plant specific features are not consistent with those assumed in Owners Group SAMG analyses, the L2 model addresses any plant-specific phenomena that may affect accident management actions and planning.	(BWRs): The phenomena that may affect accident management actions and planning should be included.	(BWRs): The phenomena that may affect accident management actions and planning should be included.	(BWRs): The phenomena that may affect accident management actions and planning shall be included.
L2-10	• The phenomena that may influence applications are included.	See L2-8	See L2-8	See L2-8

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: LEVEL 2 / LERF EVALUATION

Designator	CRITERIA	SUBTIER CRITERIA Risk Ranking Prioritization	 Risk Informed Decision Making	 Risk Based Decision Making
L2-11	HEPs AND SYSTEM PERFORMANCE • System performance has been evaluated to account for the adverse conditions that may be present during the core melt progression response.	System performance shall be evaluated to account for the adverse conditions that may be present during the core melt progression response. The ability to adequately characterize system performance using solely a Level 1 model may be difficult because of the substantial impacts core melt progression effects may have on the system operability (real or procedural). Level 2 system performance should be explicitly broken out as separate evaluations recognizing the environmental conditions. However, some conservatisms in the system performance evaluation may exist due to the lack of detailed information regarding environmental conditions and equipment survivability.	System performance shall be evaluated to account for the adverse conditions that may be present during the core melt progression response. The ability to adequately characterize system performance using solely a Level 1 model may be difficult because of the substantial impacts core melt progression effects may have on the system operability (real or procedural). Level 2 system performance should be explicitly broken out as separate evaluations recognizing the environmental conditions. However, the best estimate evaluation may have large uncertainties due to uncertainties regarding the environmental conditions and the equipment survivability.	System performance shall be evaluated to account for the adverse conditions that may be present during the core melt progression response. The ability to adequately characterize system performance using solely a Level 1 model may be difficult because of the substantial impacts core melt progression effects may have on the system operability (real or procedural). Level 2 system performance shall be explicitly broken out as separate evaluations recognizing the environmental conditions. Detailed calculations of the environmental conditions and a detailed survey of the equipment survivability (not EQ) shall be performed to support the system performance during severe accident melt progression and provide a realistic estimate of the systems performance.
L2-12	• Success of human actions has been evaluated to account for the adverse conditions that may be present during the core melt progression response.	Success of human actions shall be evaluated to account for the adverse conditions that may be present during the core melt progression response. The ability to adequately characterize operator performance using solely a Level 1 model may be difficult because of the substantial impacts core melt progression effects may have on the operator HEP. Level 2 operator actions should be explicitly broken out as separate evaluations recognizing the environmental conditions and the adverse effects of the actions. However, some conservatisms in the human performance evaluation may exist due to the lack of detailed information regarding environmental conditions.	Success of human actions shall be evaluated to account for the adverse conditions that may be present during the core melt progression response. The ability to adequately characterize operator performance using solely a Level 1 model may be difficult because of the substantial impacts core melt progression effects may have on the operator HEP. Level 2 operator actions should be explicitly broken out as separate evaluations recognizing the environmental conditions and the adverse effects of the actions. However, the best estimate evaluation may have large uncertainties due to uncertainties regarding the environmental.	Success of human actions shall be evaluated to account for the adverse conditions that may be present during the core melt progression response. The ability to adequately characterize operator performance using solely a Level 1 model may be difficult because of the substantial impacts core melt progression effects may have on the operator HEP. Level 2 operator actions shall be explicitly broken out as separate evaluations recognizing the environmental conditions and the adverse effects of the actions. Detailed calculations of the environmental conditions shall be performed to support the human performance during severe accident melt progression.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: LEVEL 2 / LERF EVALUATION

Designator	CRITERIA	SUBTIER CRITERIA: Risk Ranking Prioritization	SUBTIER CRITERIA: Risk Informed Decision Making	SUBTIER CRITERIA: Risk Based Decision Making
L2-13	• Containment and system functional failures are conservatively treated OR • Containment and system functional failures are treated realistically for dominant contributors	Containment and system functional failures may be conservatively treated.	Containment and system functional failures should be treated realistically for dominant contributors.	Containment and system functional failures should be treated realistically for dominant contributors.
L2-14	CONTAINMENT CAPABILITY ASSESSMENT • Containment capability is analyzed under severe accident conditions for its survivability	Containment should be analyzed under severe accident conditions for its survivability.	Containment shall be analyzed under severe accident conditions for its survivability.	Containment shall be analyzed under severe accident conditions for its survivability.
L2-15	• Both static and dynamic effects are included (2), (3)	Both static and dynamic effects should be included. Quasi static containment capability evaluations alone are not adequate to address all severe accident phenomena.	Both static and dynamic effects shall be included. Quasi static containment capability evaluations alone are not adequate to address all severe accident phenomena.	Both static and dynamic effects shall be included. Quasi static containment capability evaluations alone are not adequate to address all severe accident phenomena.
L2-16	• All postulated failure modes identified by IDCOR or NRC Staff in NUREG-1150 are considered (2), (3)	All postulated containment failure modes identified by IDCOR or NRC Staff in NUREG-1150 should be considered. The containment isolation failure assessment should be retained in the model. Applications involving ranking the isolation system or considering configurations that have altered reliability for containment isolations would be adversely impacted by the non-inclusion of containment isolation.	All postulated containment failure modes identified by IDCOR or NRC Staff in NUREG-1150 shall be considered. The containment isolation failure assessment should be retained in the model. Applications involving ranking the isolation system or considering configurations that have altered reliability for containment isolations would be adversely impacted by the non-inclusion of containment isolation.	All postulated containment failure modes identified by IDCOR or NRC Staff in NUREG-1150 shall be considered. The containment isolation failure assessment shall be retained in the model. Applications involving ranking the isolation system or considering configurations that have altered reliability for containment isolations would be adversely impacted by the non-inclusion of containment isolation.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: LEVEL 2 / LERF EVALUATION

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decision Making	Risk Based Decision Making
L2-17	• For Ice Condenser and BWR Mark III containments only: Geometric details impacting the hydrogen related phenomena (i.e., heat sink distribution, circulation paths, ignition sources, water availability, and gravity drain paths) should be documented in a readily comprehensible form, together with representative combustible transients.	For Ice Condenser and BWR Mark III containments only: Geometric details impacting the hydrogen related phenomena (i.e., heat sink distribution, circulation paths, ignition sources, water availability, and gravity drain paths) should be documented in a readily comprehensible form, together with representative combustible transients.	For Ice Condenser and BWR Mark III containments only: Geometric details impacting the hydrogen related phenomena (i.e., heat sink distribution, circulation paths, ignition sources, water availability, and gravity drain paths) should be documented in a readily comprehensible form, together with representative combustible transients.	For Ice Condenser and BWR Mark III containments only: Geometric details impacting the hydrogen related phenomena (i.e., heat sink distribution, circulation paths, ignition sources, water availability, and gravity drain paths) shall be documented in a readily comprehensible form, together with representative combustible transients.
L2-18	• Both leakage and large failures are included in the analysis	Containment failure sizes of leak and rupture may be conservatively treated. The degree of conservatism may be difficult to ascertain because of competing effects related to the containment pressurization.	A best estimate representation of the containment failure sizes should be included in the model. This best estimate evaluation should be based on a plant specific structural analysis or a generic evaluation that has been adjusted to account for plant specific features.	A realistic representation of the containment failure sizes shall be in included in the model based on a plant specific structural evaluation. If the results differ significantly from similar plant evaluations, the technical basis for the differences shall be clearly identified.
L2-19	• Containment failure modes are treated realistically in the analysis	A conservative assessment of possible containment failure modes may be included in the PRA.	Containment failure modes should be treated on a best estimate basis in the analysis.	Containment failure modes shall be treated realistically in the analysis.
L2-20	• The containment analysis is: - Conservative OR - Realistic	The containment analysis may be conservative.	The containment analysis should be a best estimate and account for plant specific features.	The containment analysis shall be realistic and plant specific.
L2-21	ENDSTATE DEFINITION • The Level 2 end states support the applications currently envisioned.	The Level 2 end states should support the applications currently envisioned. The release categories may be assigned to the end states of the Level 2 analysis using insights from previous PRA work and judgements regarding the effectiveness of various release pathway mitigation measures.	The Level 2 end states shall support the applications currently envisioned. The Level 2 release categories should have a deterministic code calculation to support the subtle differences in the sequence that can influence release.	The Level 2 end states shall support the applications currently envisioned. The Level 2 release categories shall have a deterministic code calculation to support the subtle differences in the sequence that can influence release.

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INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: LEVEL 2 / LERF EVALUATION

Designator	CRITERIA	SUBTIER CRITERIA Risk Ranking Prioritization	 Risk Informed Decision Making	 Risk Based Decision Making
L2-22	LERF DEFINITION • The LERF definition is consistent with the following guidance, and is documented: - Regulatory Guide 1.174 OR - PSA Applications Guide or other Owners Group-specific definitions [(5)]	• The LERF definition should be consistent with the following guidance, and is documented: - Regulatory Guide 1.174 OR - PSA Applications Guide or other Owners Group-specific definitions [(5)]	• The LERF definition shall be consistent with the following guidance, and is documented: - Regulatory Guide 1.174 OR - PSA Applications Guide or other Owners Group-specific definitions [(5)]	• The LERF definition shall be consistent with the following guidance, and is documented: - Regulatory Guide 1.174 OR - PSA Applications Guide or other Owners Group-specific definitions [(5)]
L2-23	• The LERF definitions use Emergency Action Levels (EAL) bases if required; and the EAL bases are documented.	The LERF definitions should use Emergency Action Levels (EAL) bases if required; and the EAL bases are documented.	The LERF definitions shall use Emergency Action Levels (EAL) bases if required; and the EAL bases are documented.	The LERF definitions shall use Emergency Action Levels (EAL) bases if required; and the EAL bases are documented.
L2-24	CONTAINMENT EVENT TREES (CETs) • The CETs: - Include all the functional events required to meet a safe stable condition - Include the phenomena cited under phenomena	The methodology should provide a logical framework to probabilistically assess the accident sequences that can lead to LERF end states. The CETs: • Should include all the functional events required to meet a safe stable condition or a non-LERF state • Should include the phenomena cited under phenomena	The methodology shall provide a logical framework to probabilistically assess the accident sequences that can lead to LERF end states. The methodology should provide a best estimate LERF assessment. The CETs: • Shall include all the functional events required to meet a safe stable condition or a non-LERF state • Shall include the phenomena cited under phenomena	The methodology shall provide a logical framework to probabilistically assess the accident sequences that can lead to LERF end states. The methodology should provide a best estimate LERF assessment. The CETs: • Shall include all the functional events required to meet a safe stable condition or a non-LERF state • Shall include the phenomena cited under phenomena

Table 5-9

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: LEVEL 2 / LERF EVALUATION

Designator	CRITERIA	SUBTIER CRITERIA: Risk Ranking Prioritization	SUBTIER CRITERIA: Risk Informed Decision Making	SUBTIER CRITERIA: Risk Based Decision Making
L2-25	• The CETs: - Include the systems and HEPs necessary - Are consistent with the EOPs - Include reasonable recovery actions	Truncation of Level 1 sequences to avoid transfer to Level 2 shall not be performed unless they meet the truncation limits in QU. The CETs should: • Include the systems and HEPs necessary • Are consistent with the EOPs • Include reasonable recovery actions While "conservative" modeling is typically judged sufficient for IPEs, the neglect of the in-vessel recovery is not realistic, and is not appropriate for accident management applications. That is, by assuming the vessel serves no purpose in altering the accident sequence trajectory, opportunities for risk reduction measures are lost. If the damaged core is retained in-vessel, questions of direct containment heating, core-concrete interaction, debris quench on the drywell floor, etc., become moot. Use of the vessel to partition the risk reduces the importance of modeling highly uncertain containment damage processes, reducing the overall analysis uncertainty as well. Recognizing that saving the core in the vessel (e.g., by use of AC power recovery, fire suppression water, etc.), results in risk reduction for certain accident management actions and provides a better estimate of the risk associated with severe accidents.	Truncation of Level 1 sequences to avoid transfer to Level 2 shall not be performed unless they meet the truncation limits in QU. The CETs shall: • Include the systems and HEPs necessary • Are consistent with the EOPs • Include reasonable recovery actions While "conservative" modeling is typically judged sufficient for IPEs, the neglect of the in-vessel recovery is not realistic, and is not appropriate for accident management applications. That is, by assuming the vessel serves no purpose in altering the accident sequence trajectory, opportunities for risk reduction measures are lost. If the damaged core is retained in-vessel, questions of direct containment heating, core-concrete interaction, debris quench on the drywell floor, etc., become moot. Use of the vessel to partition the risk reduces the importance of modeling highly uncertain containment damage processes, reducing the overall analysis uncertainty as well. Recognizing that saving the core in the vessel (e.g., by use of AC power recovery, fire suppression water, etc.), results in risk reduction for certain accident management actions and provides a better estimate of the risk associated with severe accidents.	Truncation of Level 1 sequences to avoid transfer to Level 2 shall not be performed unless they meet the truncation limits in QU. The CETs shall: • Include the systems and HEPs necessary • Are consistent with the EOPs • Include reasonable recovery actions While "conservative" modeling is typically judged sufficient for IPEs, the neglect of the in-vessel recovery is not realistic, and is not appropriate for accident management applications. That is, by assuming the vessel serves no purpose in altering the accident sequence trajectory, opportunities for risk reduction measures are lost. If the damaged core is retained in-vessel, questions of direct containment heating, core-concrete interaction, debris quench on the drywell floor, etc., become moot. Use of the vessel to partition the risk reduces the importance of modeling highly uncertain containment damage processes, reducing the overall analysis uncertainty as well. Recognizing that saving the core in the vessel (e.g., by use of AC power recovery, fire suppression water, etc.), results in risk reduction for certain accident management actions and provides a better estimate of the risk associated with severe accidents.
L2-26	<u>DOCUMENTATION</u> • Documentation reflects the process used	NA	Documentation should provide the basis for meeting each of the criteria L2-4 through L2-25. The documentation should describe the results consistent with the process.	Documentation shall provide the basis for meeting each of the criteria L2-4 through L2-25. The documentation shall describe the results consistent with the process.

Table 5-9

INDUSTRY PRA PEER REVIEW SUBTIER CRITERIA: LEVEL 2 / LERF EVALUATION

Designator	CRITERIA	SUBTIER CRITERIA		
		Risk Ranking Prioritization	Risk Informed Decision Making	Risk Based Decision Making
L2-27	• Includes an independent review for the documented results	Independent review may be performed and documented by knowledgeable personnel.	Independent review should be performed and documented by knowledgeable personnel.	Independent review shall be performed and documented by knowledgeable personnel.
L2-28	• Provides the basis of the containment performance analysis and the analysis is traceable to plant specific or generic analysis.	Documentation may provide the basis for quantification process.	Documentation should provide the basis for quantification process.	Documentation shall provide the basis for quantification process.