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UNITED STATES NUCLEAR REGULATORY COMMISSION
STANDARD REVIEW PLAN
OFFICE OF NUCLEAR REACTOR REGULATION

XX.X DETERMINING THE TECHNICAL ADEQUACY OF PRA RESULTS FOR RISK-INFORMED ACTIVITIES

BACKGROUND AND PURPOSE OF THIS SRP

The NRC's PRA Implementation Plan as proposed in Ref. 1, now replaced by the Risk-Informed Regulation Implementation Plan (see Ref. 2), identifies a wide scope of regulatory activities for which PRA provides valuable insights. This scope includes activities that require NRC review and approval, as well as other activities that are considered internal to the NRC and affect licensees and applicants in a less direct manner (e.g., generic issue prioritization).

In developing this SRP chapter, the staff considered the NRC's guidance on the use of PRA in risk-informed regulatory applications as documented in Regulatory Guide (RG) 1.174 (Ref. 3), for example, as well as the relevant industry guidance documented by the Electric Power Research Institute (EPRI) in its "Probabilistic Safety Assessment (PSA) Applications Guide" (Ref. 4). These documents make it clear that PRA information is one input into making a decision. Specifically, the decisionmaking process will use the results of the risk analyses in a manner that complements July 1, 2002 (12:20PM)traditional engineering approaches, supports the defense-in-depth philosophy, and preserves safety margins. Thus, risk analysis will inform, but it will not determine regulatory decisions.

Whenever PRA results are used as input to a regulatory decision the following must be taken into account:

- The risk evaluations performed to justify regulatory changes are expected to realistically reflect these plant-specific design, construction, and operational practices.
- The PRA analyses should be as realistic as practicable.
- The scope and level of detail of a risk analysis determine for which applications its results and derived insights are applicable, and the role those results and insights may play in the decision-making process.

- Since PRAs are models, they involve some degree of approximation. Thus it is necessary for the risk analysts to provide the decision makers with an assessment of both the degree of applicability and of the limitations of the analysis, and include an assessment of the uncertainty in the results with respect to the decision being made.

- The risk information used will vary with the application, and will depend on guidelines to be used to judge the acceptability of the application. An application must, therefore, begin with a clear definition of the proposed regulatory activity, and a definition of the acceptance guidelines or criteria, including the rules for comparing the risk information with those guidelines or criteria. When following an application specific Regulatory Guide, the acceptance criteria will typically be specified. In addition, when an application is performed in accordance with Regulatory Guide 1.174, acceptance guidelines are presented in terms of changes to the core damage frequency (CDF) and large early release frequency (LERF) from all initiating events in all modes of operation. Figures 3 and 4 of RG 1.174 present these acceptance guidelines, and section 2.2.5.5 presents guidance on how the comparison with the guidelines is to be made. When an application is not addressed by an existing regulatory guide however, it will be necessary to define an appropriate set of these criteria. The acceptance guidelines should determine the scope of the risk assessment necessary.

- For a PRA to be capable of supporting an application, it should be capable of providing the risk input that can be used in the context of the acceptance criteria. To achieve this, those aspects of the plant affected by the proposed change, for example, specific SSCs or certain required operator actions, must be identified, and the potential impact of the application on those aspects characterized. This has been referred to as establishing the cause-effect relationship resulting from the application. Then, it must be possible to map the aspects that are subject to the application onto elements of the PRA model, and the impact of the change related to changes in the PRA event probabilities. The way in which the mapping is performed will have an impact on the usefulness of the results. For example the mapping may be direct and explicit, or it may be indirect and implicit. Typically the more explicit the mapping, the more relevant the PRA input is to the decision. Similarly, the way in which the impact of the change on the probabilities, e.g. whether the approach is a conservative, bounding approach or an approach based on an engineering analysis, will have an impact on the relevance of the results.

This SRP chapter concerns any licensee request submitted for NRC review and approval for which PRA can play an effective role in the decisionmaking process. It will be used to support application-specific SRP chapters that provide guidance for several activities including the following examples:

- changes to a plant's licensing basis (SRP Chapter 19)

- changes to allowed outage times (AOTs) and surveillance test intervals (STIs) in plant-specific technical specifications (SRP Chapter 16.1)
- changes in the scope and frequency of tests on pumps and valves in a licensee's inservice test (IST) program (SRP Chapter 3.9.7)
- changes in the scope and frequency of inspections in a licensee's inservice inspection (ISI) program (draft SRP Chapter 3.9.8)

These documents will deal with reviewing the application in terms of the following:

- SSCs, operator actions and plant operational characteristics affected by the application
- the description of the cause-effect relationships between the change and the above SSCs, operator actions and plant operational characteristics
- the mapping of the cause-effect relationships onto PRA model elements
- identification of the PRA results that will be used in the decision-making
- scope of risk contributors needed to support the decision

They will also address how to address issues related to limitations in scope of the PRA, etc.

However the PRA results are used, and whatever role they play in the decision-making, it is a requirement that the PRA analysis be of sufficient quality to support that role. This SRP chapter is concerned with the assessment of the quality of the PRA input in the sense of determining whether the conclusions drawn from the PRA analysis are supportable by the underlying PRA analysis.

The industry has generated guidance documents in the form of a PRA Standard and a PSA Peer Review Process for a limited level 2 PSA for internal initiating events, and is in the process of developing PSA Standards that address external initiating events and the low

power and shutdown modes of operation. As discussed in RG XXXX, these documents may be used to provide input to the demonstration that the appropriate quality has been achieved.

The SRP provides guidance to the Staff on how to determine the scope of review of the elements of a PRA analysis used to support a specific regulatory application, based on information provided by the licensee on the results of a comparison with an industry PRA standard or the results of a peer review performed in accordance with an industry approved peer review process. This SRP chapter is intended to be used in conjunction with an application specific SRP such as SRP Chapter 19, or Chapter 3.9.8 which will focus on the appropriate use of the PRA results in an integrated decision-making process. It may also be used to support novel applications in which the licensee is expected to identify how the PRA results are used to provide information to the decision-makers.

This SRP chapter does not focus on the decision-making process itself, but on how the PRA information is characterized for the decision-makers so that it may be given an appropriate weight. This chapter takes into account the staff guidance on characterizing PRA results for use in decision-making provided in RG XXXX

REVIEW RESPONSIBILITIES

The technical nature of a licensee's request will determine which technical review branch in the NRC's Office of Nuclear Reactor Regulation (NRR) will serve as the primary review branch and as such, has overall responsibility for leading the technical review, drafting the staff safety evaluation report (SER) or other appropriate regulatory document, and coordinating input from other technical review organizations.

The Probabilistic Safety Assessment Branch (SPSB) assists the primary review branch (upon request) by reviewing the PRA information and findings submitted by the licensee. Review support includes assessing the adequacy of the scope, level of detail, and quality of the PRA used by the licensee to support the regulatory change.

REVIEW GUIDANCE AND PROCEDURES

The objective of this SRP is to provide guidance to the Staff on how to determine that the PRA results being used in a decision are supported by the underlying analysis. It must be clear that the elements of the model used to generate those results are of sufficient

technical quality, and that the assumptions and uncertainties that have the potential to affect the results used have been evaluated as being appropriate.

In order to perform the review for quality, the reviewer should first understand how the PRA is being used. The next few section define the context.

1 Use of the PRA in the Application

The reviewer should familiarize himself with the way the PRA is used in the application. This includes:

- identification of the SSCs, operator actions and plant operational characteristics affected by the application
- a description of the cause-effect relationships between the change and the above SSCs, operator actions and plant operational characteristics
- the mapping of the cause-effect relationships onto PRA model elements
- definition of the acceptance criteria or guidelines:
  - an identification of the PRA results that will be used to compare against the acceptance criteria or guidelines, and how the comparison is to be made
  - scope of risk contributors needed to support the decision
- the elements of the PRA used in the application

2 Scope of risk contributors addressed in the PRA model

Based on the definition of the application, the scope of risk contributors (internal and external initiating events, modes of plant operation) that would ideally be required of the PRA can be identified. For example, if the application is designed around using the acceptance guidelines of RG 1.174, the evaluations of CDF, ΔCDF, LERF and ΔLERF should be performed with a full scope PRA including external initiating events and all modes of operation. However, since most PRAs do not address this full scope, the decision-makers must make allowances for these omissions. Examples of approaches to making allowances include: the introduction of compensatory measures; restriction of the implementation of the proposed change to those aspects of the plant covered by the risk model; use of bounding arguments to cover the risk contributions not addressed by the model. This SRP does not address this aspect of decision-making, but is focused on what information should be provided. The reviewer's responsibility is to understand the scope of the PRA used in the decision-making, so that the appropriate Appendixes to this document can be used.

3 Elements of the PRA Model Used in Application

In order to assess the quality of the PRA input, it is first necessary to identify which elements of the PRA are called upon to provide the PRA results required by the acceptance criteria. These include not only those elements onto which the cause-effect relationships are mapped, but also all those elements that appear in the accident sequences in which the first group of elements appear. For some applications, this may be a limited set **[need example(s)]**, but for others, e.g., risk-informing the scope of special treatment requirements, all elements of the PRA model are relevant. The reviewer need only address those elements required to support the PRA results used.

4 Assessment that the PRA results used for the Application are Supported by the Underlying PRA Model

There are two aspects to assessing the acceptability and adequacy of the PRA results. First, is the assurance that the underlying PRA is technically sound. This implies the following: a) the PRA model, or those parts of the model required to support the application, represents the as-built and as-operated plant, which, in turn, implies that the the PRA is up-to-date and reflects the current design and operating practices; b) the PRA model has been developed in a manner consistent with industry practice and that it correctly reflect the dependencies of systems on one another, and on operator actions, and c) the probabilities used are appropriate for the conditions implied by the model.

The current state-of-the-art in PRA technology is that there are elements for which there are no consensus methods of analysis. Furthermore, PRAs are models, and in that sense the developers of those models rely on certain approximations to make the models tractable, and on certain assumptions to address uncertainties as to how to model certain issues. This is recognized in the application specific regulatory guides such as RG 1.174, which give guidance on how to address the uncertainties. The second aspect, therefore, is associated with the assessment that the engineering analyses, assumptions and approximations used in developing the PRA model are appropriate, and demonstrating the robustness of the conclusions with respect to the uncertainties in the analysis. This demonstration typically will involve uncertainty analyses or sensitivity analyses. This aspect is expected to be addressed in the application specific Regulatory Guides and SRP chapters.

4.1 Determination that the PRA model is current

When using risk insights based on a PRA model it is a requirement that the PRA model is up to date, and represents the current plant configuration and operating practices. The reviewer should determine that the PRA model has been revised to reflect any significant

changes in design or operational practices (including operating procedures), and that the data used to estimate the parameters is current. This may be achieved by a review of plant records documenting the updating process.

4.2 Assessment of the technical adequacy of the PRA elements required by the application

It is expected that a licensee using the Standard or peer review process has taken account of the exceptions and clarifications found in the Appendixes of the RG XXXX, and has documented the comparison with the relevant documents as endorsed. The reviewer shall focus on those elements for which there are deviations from, or discrepancies with, the requirements of the endorsed documents. It is expected that the licensee will give reasons as to why the discrepancies are not important, or otherwise provide an assessment of the impact of the discrepancy on the results.

4.3 Assessment of Engineering Analyses, Assumptions and Approximations

Since the Standards and Industry PRA Programs are not (or are not expected to be) prescriptive, there is some freedom on how to model certain elements of the PRA, so that different analysts may make different assumptions, and still meet the requirements of the Standard or have been accepted by the peer review. The choice of a specific assumption or a particular approximation may, however, influence the results of the PRA. The NRC Staff needs to be cognizant of which features of the analysis have the potential to alter the conclusions. In documenting the conclusions, the applicant shall justify the choice of their applicable assumptions and approximations by demonstrating that their conclusions are robust compared with other reasonable choices. Part of this documentation should include the peer reviewers' comments and assessment of the applicant's approach. This assumptions are an important approach to dealing with model uncertainty, and those that can influence the conclusions will be the focus of review by NRC Staff.

The way in which the impact of the change in individual SSCs is modeled is influenced by the degree of detail of the PRA model. However, the level of detail in the PRA model is not prescribed by the Standard documents or the peer review process. Thus, from a statement that the PRA has satisfied the Standard, for example, it is not possible for the Staff reviewer to have a clear picture of how well the impact of the application is modeled. The area is again expected to be an area of Staff review, and will be addressed in application-specific SRPn chapters..

<u>EVALUATION FINDINGS</u>

The reviewer should provide documentation to conclude that the elements of the PRA required to produce the results have been performed in such a way that the PRA results are fully supportable.

1 The PRA Elements have been performed in a Technically Correct Manner that conforms with Industry Good Practices

This can be determined by an assessment that the PRA elements are performed consistently with the Standard or peer review process as endorsed in the Appendixes to RG XXXX, or that, where a discrepancy exists, the approach used is equivalent to, or is superior to that referenced in the Standard or peer review process document.

2 The Assumptions, Approximations and Engineering Analyses of Significance to the Results have been Identified, and Assessed as being Appropriate

In addition, the more significant sources of uncertainty should be identified, and any assumptions designed to address those uncertainties identified as possible candidates for sensitivity studies to provide additional characterization of the results for the decision-making panel.