U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

17.4 RELIABILITY ASSURANCE PROGRAM (RAP)

REVIEW RESPONSIBILITIES

Primary - Organization responsible for quality assurance (QA)

Secondary - Organization responsible for probabilistic risk assessment (PRA)

- Organizations responsible for the applicant's programs that implement the RAP for an operational plant

I. AREAS OF REVIEW

This standard review plan (SRP) section pertains to design certification (DC) applications and combined license (COL) applications. The RAP applies to those systems, structures, and components (SSCs) that are identified as being significant contributors to plant safety as determined by using probabilistic/PRA, deterministic, or other methods of analysis, including information obtained from sources such as the plant- and site-specific PRA, industry operating experience, relevant component failure data bases, and expert panels. The purposes of the RAP are to provide reasonable assurance that:

1. a reactor is designed, constructed, and operated in a manner that is consistent with the assumptions and risk insights for these SSCs,

2. these SSCs do not degrade to an unacceptable level during plant operations,

3. the frequency of transients that challenge SSCs is minimized, and

4. these SSCs function reliably when challenged.

The RAP is implemented in two stages. The first stage applies to reliability assurance activities that occur before the initial fuel load, which is referred to as the RAP design stage. The objective of the RAP at this stage is to ensure that SSC reliability is properly considered and designed into the plant and is implemented through the reactor design, procurement, fabrication, construction, and test activities and programs. The SSC reliabilities assumed in the design stage need to be realistic and achievable. The second stage applies to reliability assurance activities for an operating plant. The objective of the RAP during this stage is to ensure that SSC reliability is maintained during plant operations, and is implemented through existing operational programs (e.g., maintenance rule, surveillance testing, inservice inspection, inservice testing, and QA). Individual component reliability may change throughout the course of plant life due to a number of factors including aging and changes in suppliers and technology. Changes in individual component reliability values are acceptable as long as overall plant safety performance is maintained.

The RAP for the design stage may be implemented in several phases. During the first phase, SSCs are identified for inclusion in the program using probabilistic/PRA, deterministic, or other methods. The second phase is the site-specific phase, which introduces the plant's site-specific design information to the process. At this phase, the RAP is modified or appended based on considerations specific to the site. The COL applicant establishes the probabilistic/PRA, deterministic, and other methods to determine and maintain the site-specific list of SSCs under the scope of RAP. The RAP is verified via an audit conducted by the NRC staff in accordance with the guidance in this SRP and the NRC safety evaluation review process.

An applicant for a design certification is also responsible for proposing a non-system based Tier 1 inspection, test, analysis, and acceptance criteria (ITAAC) requirement for the RAP design stage. The ITAAC description is verified by the NRC safety evaluation review process. The COL holder is responsible for completing the ITAAC. Satisfactory completion of the ITAAC is verified by Inspection Manual Chapter (IMC) 2503, "Construction Inspection Program: Inspections, Tests, Analyses, and Acceptance Criteria."

In SECY-95-132,"Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems (RTNSS) in Passive Plant Designs (SECY 94-084)," Item E, Reliability Assurance Program, as approved by the staff requirement memorandum (SRM), the RAP during the operational phase can be encompassed by existing programs such as the maintenance rule (10 CFR Part 50.65), surveillance testing, inservice inspection, inservice testing, and QA, with one exception. Specifically, failures caused by design errors or operational errors that degrade non-safety SSCs included in the RAP are outside the scope of existing programs. The COL applicant should describe how its existing programs have been modified (or new programs created) to address design errors or operational errors that degrade nonsafety-related SSCs in the RAP.

The specific areas of review are as follows:

1. The QA staff reviews and audits the quality controls for developing and implementing the RAP (organization, design control, procedures and instructions, records, corrective action, and audit plans).

2. The QA staff reviews the RAP scope, purpose, and objectives.

3. The QA staff reviews the COL action item for the site-specific list of SSCs in the RAP (applicable for a COL application that references a certified design).

4. The QA staff reviews the proposed RAP ITAAC.

5. The QA staff reviews the qualification requirements for members of the expert panel if an expert panel is utilized.

6. The QA staff reviews the procurement, fabrication, construction and test requirements used to ensure that significant assumptions, such as equipment reliability, are realistic and achievable.

7. The QA staff reviews the integration of the RAP for the operational stage into existing programs.

8. The QA staff reviews the process for providing corrective action for design and operational errors that degrade nonsafety-related SSCs in the RAP.

9 The QA staff reviews the feedback mechanism for periodically evaluating reliability assumptions on the basis of actual equipment, train, or system performance, and updated industry operational experience.

The QA staff reviews the reliability performance goals for SSCs within the scope of the RAP for the operational stage.

Review Interfaces

The following aspect of the PRA is reviewed in SRP Section 9.0, specifically:

1. probabilistic/PRA methods used for identifying and prioritizing SSCs based on risk significance,

2. the SSCs that are significant contributors to plant safety determined by probabilistic/PRA methods, and

3. the industry operating experience and reliability data bases used to identify significant failure modes.

Certain objectives of the RAP for the operational stage may be addressed by the QA Program, which is reviewed under SRP Section 17.5.

Certain objectives of the RAP for the operational stage may be addressed by the Maintenance Rule Program, which is reviewed under SRP Section 17.6.

Other technical branches may need to be involved in the review of the applicant's RAP, depending on the applicant's programs (e.g., maintenance rule, surveillance testing, inservice inspection, and inservice testing) that implement the RAP for the operational stage.

Other technical branches may need to be involved in the review of the applicant's deterministic or other methods of analyses used to identify SSCs included in the RAP and the SSCs affected.

The specific acceptance criteria and review procedures are contained in the referenced SRP sections.

II. ACCEPTANCE CRITERIA

Requirements

Acceptance criteria are based on meeting the relevant requirements of the following Commission regulations:

1. Per Commission policy in the SRM on SECY 95-132, the requirement to provide a reliability assurance program is codified by incorporation within the design-specific rulemaking for an applicant for design certification. In addition, this becomes part of an application for a combined license that references that certified design. Furthermore, the RAP will be verified using the ITAAC process.

2. 10 CFR 52.47(a)(1)(vi), as it relates to ITAAC (for design certification) sufficient to assure that the SSCs in this area of review will operate in accordance with the certification.

3. 10 CFR 52.97(b)(1), as it relates to ITAAC (for combined licenses) sufficient to assure that the SSCs in this area of review have been constructed and will be operated in conformity with the license and the Commission's regulations.

SRP Acceptance Criteria

Specific SRP acceptance criteria acceptable to meet the relevant requirements of the NRC's regulations identified above are as follows for each review described in Subsection I of this SRP section. The SRP is not a substitute for the NRC's regulations, and compliance with it is not required. However, an applicant is required to identify differences between the design features, analytical techniques, and procedural measures proposed for its facility and the SRP acceptance criteria and evaluate how the proposed alternatives to the SRP acceptance criteria provide acceptable methods of compliance with the NRC regulations.

Section A below applies to a DC applicant and Section B below applies to a COL applicant referencing a certified design. Sections A and B below apply to a COL applicant that does not reference a certified design. Sections A and B.1 through 3 apply to an applicant for a construction permit and Sections B.4 through 9 apply to an applicant for an operating license.

A. DESIGN CERTIFICATION

The application describes the following RAP information:

1. The scope, purpose, and objectives. The scope, purpose, and objectives of the RAP are described in Subsections I and II of this SRP section.

2. The application of the quality elements associated with organization, design control, procedures and instructions, records, corrective action, and audit plans as follows:

   a. Organization

      (1) The organizations responsible for formulating and implementing the RAP and the coordination of RAP program activities, including those performed within the design, PRA, RAP, and risk and reliability organizations as well as work completed by the architect-engineers and other supporting organizations that develop deterministic and other methods used to identify SSCs that are significant contributors to plant safety.

      (2) How the reliability and design organizations manage interface issues. For example, how does the risk and reliability organization keep the design staff cognizant of SSCs that are significant contributors to plant safety, program needs, and status, and how does the feedback process ensure that significant design assumptions related to equipment reliability are realistic and achievable.

      (4) The risk and reliability organization participation in the design change control process for the purpose of providing RAP related inputs in the design process.

      (5) The risk and reliability organization involvement in design reviews.

   b. Design Control

      (1) The configuration control process for maintaining the list of SSCs within the scope of RAP similar to the control of a quality list.

      (2) How the design control and change processes provide a feedback mechanism for notifying the appropriate organization of changes in the design of SSCs within the scope of the RAP that could affect the probabilistic/PRA, deterministic, or other methods used to identify SSCs that are significant contributors to plant safety.

(3) The interface between the risk and reliability and the design organizations for determining that the performance of SSCs within the scope of the RAP relate to the reliability assumptions in the probabilistic/PRA, deterministic, or other methods used to identify SSCs that are significant contributors to plants safety.

(4) Engineering design controls applied for determining the SSCs within the scope of the RAP.

(5) The process for proposing an alternative design to reliability performance. For example, is the revised design reviewed to provide confidence that the current reliability assumptions are still valid.

c. The procedures and instructions used to implement the RAP.

d. The controls for records of activities involving SSCs within the scope of RAP.

e. The corrective action process applied to SSCs within the scope of RAP.

f. The audit plans for conducting QA audits of RAP activities.

3. The expert panel qualifications in the areas of personnel knowledgeable in the operation and maintenance of a plant, and experience necessary to perform the SSC selections if an expert panel is utilized.

4. Deterministic or other methods of analysis used to identify SSCs included in the RAP and the SSCs affected.

5. A non-system-based ITAAC on RAP provides reasonable assurance that the design of SSCs within the scope of the RAP is consistent with their assumed design reliability. The ITAAC acceptance criteria should ensure that the estimated reliability of each as-built SSC is at least equal to the assumed design reliability and that industry experience including operations, maintenance, and monitoring activities were assessed in estimating the reliability of these SSCs.

6. A COL action item that a COL applicant referencing a certified design will identify the site-specific SSCs within the scope of the RAP.

B. COL APPLICANT

The COL applicant should include the following RAP information:

1. The same information provided in the previous Sections A.2.a, A.2.b and A.3 and A.4 for the site-specific phase of the RAP if not previously addressed in Section A.

2. How procurement, fabrication, construction, and test specifications for the SSCs within the scope of the RAP ensure that significant assumptions, such as equipment reliability, are realistic and achievable.

3. How QA requirements are implemented during the procurement, fabrication, construction and testing of SSCs within the scope of the RAP.

4. A description of how the RAP is integrated into existing programs (e.g., maintenance rule, surveillance testing, in-service inspection, in-service testing, and QA). The description should address the following:

   a. How the reliability performance goals for SSCs within the scope of the RAP are established. For example, implementation of the maintenance rule following the guidance contained in Regulatory Guide 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," is one acceptable method for establishing performance goals provided that SSCs are categorized as high safety significant.

   b. The feedback mechanism for periodically evaluating reliability assumptions on the basis of actual equipment, train, or system performance. This description should include any key assumptions and determinations of risk significance that are derived from probabilistic/PRA, deterministic, or other methods that consider operations, maintenance, and monitoring activities for identifying component reliability and failure data. The description should also include how industry operational experience will be used to verify that reliability assumptions remain valid. (The reliability performance monitoring does not need to statistically verify the numerical values. However, it provides a feedback mechanism for periodically evaluating equipment reliability on the basis of actual equipment, train, or system performance and other operational history.)

5. The administrative processes and procedures for providing corrective actions for design and operational errors that degrade nonsafety-related SSCs within the scope of the RAP.

6. The procedures and instructions used to implement the RAP.

7. The controls for records of activities involving SSCs within the scope of RAP.

8. The corrective action process applied to SSCs within the scope of RAP.

9. The audit plans for conducting QA audits of RAP activities.

Technical Rationale

Per Commission policy contained in the SRM on SECY 95-132, RAP is codified by requiring, as part of design certification rulemaking, the RAP to be verified using the ITAAC process.

The RAP provides reasonable assurance that (1) a reactor is designed, constructed, and operated in a manner that is consistent with the assumptions and risk insights for risk-significant procurement specifications SSCs, (2) SSCs do not degrade to an unacceptable level during plant operations, (3) the frequency of transients that challenge advanced reactor SSCs are minimized, and (4) SSCs function reliably when challenged. The RAP also provides (1) a mechanism for establishing baseline reliability values for SSCs identified by the risk determination methods used to implement the Maintenance Rule (10 CFR 50.65) that is consistent with PRA reliability and availability design-basis assumptions, (2) a mechanism for establishing baseline reliability values for SSCs consistent with the defense-in-depth functions to minimize challenges to the safety-related systems, and (3) design and operational information to be used by a COL applicant/holder for ongoing plant reliability assurance activities.

III. REVIEW PROCEDURES

The reviewer will select and emphasize provisions from the above acceptance criteria as may be appropriate for a particular case. For deviations from these specific acceptance criteria, the staff should review the applicant's evaluation of how the proposed alternatives or exceptions to the SRP criteria provide an acceptable method of complying with the relevant NRC requirements identified in Subsection II.

Through review of the information provided by the applicant and review of applicable NRC audit reports, a judgment is made of the applicant's RAP. The reviewer's satisfaction with the RAP and any commitments lead to the conclusion of acceptability as described in Subsection IV of this document.

IV. EVALUATION FINDINGS

The reviewer will verify that sufficient information has been provided and that the review is sufficiently complete to support conclusions of the following type in the staff's safety evaluation report (SER). Section A below applies to a DC applicant and Section B below applies to a COL applicant referencing a certified design. Sections A and B below apply to a COL applicant that does not reference a certified design. Sections A and B.1 through 6 apply to an applicant for a construction permit and Sections B.7 and 8 apply to an applicant for an operating license.

1. DESIGN CERTIFICATION

The staff documents the following information in the SER:

The RAP is implemented during the detailed design phase to ensure that reliability assumptions are considered. Based on the review of the RAP described in the

application for the design certification, the staff concludes that the RAP is acceptable in that it satisfies the guidance in the SRM dated June 28, 1995, "Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems (RTNSS) in Passive Plant Designs (SECY 94-084)." The RAP will be codified by incorporation within the design-specific rulemaking for an applicant for design certification.

This conclusion is based on the following:

A. A staff review verified that the RAP scope, purpose, and objectives include the information needs to implement an effective RAP.

B. A staff review verified that the organization, design control, procedures and instructions, records, audits plans, and corrective action QA attributes were appropriate to implement an effective RAP. The staff also verified through the audit process that these QA attributes were properly implemented.

C. A staff review verified the acceptability of the process used for identifying SSCs that are significant contributors to plant safety determined by using deterministic or other methods of analysis. Probabilistic/PRA methods used for identifying SSCs are addressed in Section 19 of the SE.

D. A staff review verified the SSCs within the scope of the RAP based on deterministic or other methods of analysis to be acceptable. SSCs within the scope of the RAP based on probabilistic/PRA methods are addressed in Section 19 of the SE.

E. Industry operating experience and reliability data bases used to identify significant failure modes are addressed in Section 19 of the SE.

F. A staff review verified the acceptability of the non-system-based RAP ITAAC for the design stage.

G. The staff review verified the acceptability of the qualification requirements for members of the expert panel if an expert panel is utilized.

2. COL SER

The RAP is implemented while specific equipment is being designed (site specific SSCs), procured, fabricated, constructed and tested to ensure that SSC reliability is properly considered. The applicant has developed and implemented a process that ensures that SSC reliability is maintained during plant operations, and is implemented through existing operational programs.

This conclusion is based on the following:

A. A staff review verified that the organization, design control, procedures and instructions, records, audits plans, corrective action, procurement, fabrication, installation, construction, and testing QA attributes were appropriate to implement an effective RAP. The staff also verified through the audit process that these QA attributes were properly implemented.

B. A staff review verified the acceptability of the process used for identifying site-specific SSCs that are significant contributors to plant safety as determined by deterministic, or other methods of analysis. Probabilistic/PRA methods used for identifying site-specific SSCs are addressed in Section 19 of the SE.

C. A staff review verified the site-specific SSCs within the scope of the RAP based on deterministic, or other methods of analysis to be acceptable. Site-specific SSCs within the scope of the RAP based on Probabilistic/PRA methods are addressed in Section 19 of the SE.

D. Industry operating experience and reliability data bases used to identify significant failure modes are addressed in Section 19 of the SE.

E. A staff review verified the acceptability of procurement, fabrication, and test specifications for SSCs within the scope of the RAP reflect the reliability values assumed in the probabilistic/PRA, deterministic analysis, or other methods.

F. The staff review verified the acceptability of the qualification requirements for members of the expert panel if an expert panel is utilized.

G. A staff review verified the acceptability of the administrative process and procedures for providing corrective actions for design and operational errors that degrade non-safety-related SSCs within the scope of the RAP.

H. A staff review verified the acceptability of the integration of the RAP into existing programs (e.g., maintenance, surveillance testing, in-service inspection, in-service testing, and QA) (these programs should be briefly described).

I. A staff review verified the acceptability of the reliability performance goals for SSCs within the scope of the RAP for the operational stage. (Explain how the performance goals were established.)

J. A staff review verified the acceptability of the feedback mechanism for periodically evaluating reliability assumptions on the basis of actual equipment, train, or system performance and industry operational experience.

V. IMPLEMENTATION

The staff will use this SRP section in performing safety evaluations of design certifications and license applications submitted by applicants pursuant to 10 CFR Part 52. Except when the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the staff will use the method described herein to evaluate conformance with Commission regulations.

The provisions of this SRP section apply to reviews of applications docketed six months or more after the date of issuance of this SRP section, unless superceded by a later revision.

VI. REFERENCES

1. 10 CFR 50.65, “Monitoring the Effectiveness of Maintenance at Nuclear Power Plants.”

2. 10 CFR Part 50, Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants.”

3. 10 CFR Part 52, “Early Site Permits; Standard Design Certifications; and Combined Licenses to Nuclear Power Plants.”

4. IP65001, “ITAAC Matrix Inspections.”

5. SECY-94-084, “Policy and Technical Issues Associated with Regulatory Treatment of Non-Safety Systems in Passive Plant Designs.”

6. SECY 95-132, “Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems (RTNSS) in Passive Plant Designs (SECY 94-084).”

7. NUREG/CR-5424, “Eliciting and Analyzing Expert Judgement.”

8. Regulatory Guide 1.160, “Monitoring the Effectiveness of Maintenance at Nuclear Power Plants.”