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U.S. NUCLEAR REGULATORY COMMISSION

DESIGN-SPECIFIC REVIEW STANDARD FOR mPOWER^{TM} iPWR

10.4.3 TURBINE GLAND SEALING SYSTEM

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of power conversion systems

Secondary - None

I. AREAS OF REVIEW

The turbine gland sealing system (TGSS) is designed to provide a source of sealing steam to the annulus space where the turbine and large steam valve shafts penetrate their casings to prevent air leakage into and steam leakage out of these components. This includes the equipment to collect and route the systems effluents to the appropriate destination. Review of the TGSS is focused on the system features incorporated to monitor and control releases of radioactive materials in effluents.

The specific areas of review are as follows:

1. The design, design objectives, method of operation, and factors that influence gaseous radioactive material handling, e.g., source of sealing steam, system interfaces, and potential leakage paths. The review includes flow diagrams and/or piping and instrumentation diagrams (P&IDs).

2. The means provided to detect and measure radioactive leakage into or out of the system; and to preclude accidental releases of radioactive materials to the environment in amounts excess of established limits.

3. Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC). For design certification (DC) and combined license (COL) reviews, the staff reviews the applicant's proposed ITAAC associated with the structures, systems, and components (SSCs) related to this Design Specific Review Standard (DSRS) section in accordance with Standard Review Plan (SRP) Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria." The staff recognizes that the review of ITAAC cannot be completed until after the rest of this portion of the application has been reviewed against acceptance criteria contained in this DSRS section. Furthermore, the staff reviews the ITAAC to ensure that all SSCs in this area of review are identified and addressed as appropriate in accordance with DSRS Sections 14.2 and 14.3.7.

4. COL Action Items and Certification Requirements and Restrictions. For a DC application, the review will also address COL action items and requirements and restrictions (e.g., interface requirements and site parameters).

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For a COL application referencing a DC, a COL applicant must address COL action items (referred to as COL license information in certain DCs) included in the referenced DC. Additionally, a COL applicant must address requirements and restrictions (e.g., interface requirements and site parameters) included in the referenced DC.

Review Interfaces

Other DSRS/SRP sections interface with this section as follows:

1. Review of the acceptability of the seismic and quality group classifications is performed under DSRS Sections 3.2.1 and 3.2.2.

2. Review of the potential effects of high energy pipe breaks within this system on safety-related equipment is performed under DSRS Section 3.6.1.

3. Review of the provisions for controlling the release of radioactive materials from the gland seal condenser vent is performed under DSRS Section 11.3.

4. Review of the provisions for process and effluent radiological monitoring of the TGSS is performed under DSRS Section 11.5.

5. Review of the systems quality assurance programs is performed under SRPChapter 17.

6. Review of the probablistic risk assessment performed under SRPChapter 19.

7. Review of initial plant test, and system inpection, tests, analyses, and acceptance criteria under DSRS Section 14.2 and SRP Section 14.3.

For those areas of review identified above as part of the primary review responsibility of other staff, the acceptance criteria necessary for the review and their methods of application are contained in the referenced DSRS/SRP sections of the corresponding primary reviewers.

II. ACCEPTANCE CRITERIA

Requirements

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

1. General Design Criterion (GDC) 60, "Control of Releases of Radioactive Materials to the Environment," as it relates to the TGSS design for the control of releases of radioactive materials to the environment.

2. GDC 64, as it relates to the TGSS design for the monitoring of releases of radioactive materials to the environment durning normal operation, including anticipated operational occurrences.

3 10 CFR 20.1406 as it relates to the minimization of, to the extent practicable, of contamination of the facility and the environment, designs and procedures to facilitate eventual decommissioning, and to minimize, to the extent practicable, the generation of radioactive waste.

4. 10 CFR 52.47(b)(1), which requires that a DC application contain the proposed inspections, tests, analyses, and acceptance criteria (ITAAC) that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Atomic Energy Act, and the NRC's regulations.

5. 10 CFR 52.80(a), which requires that a COL application contain the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the combined license, the provisions of the Atomic Energy Act, and the NRC's regulations.

DSRS Acceptance Criteria

Specific DSRS acceptance criteria acceptable to meet the relevant requirements of the NRC's regulations identified are set forth below. The DSRS is not a substitute for the NRC's regulations, and compliance with it is not required. Identifying the differences between this DSRS section and the design features, analytical techniques, and procedural measures proposed for the facility, and discussing how the proposed alternative provides an acceptable method of complying with the regulations that underlie the DSRS acceptance criteria, is sufficient to meet the intent of 10 CFR 52.47(a)(9), "Contents of applications; technical information." The same approach may be used to meet the requirements of 10 CFR 52.79(a)(41) for COL applications.

1. GDC 60 requires the TGSS to be designed to provide for the collection and condensation of sealing steam and the venting and treatment of noncondensables. Additional acceptance criteria and review procedures are contained in the DSRS sections referenced in the "review interfaces" section of this DSRS.

2. The requirements of GDC 64 are met when the TGSS design provides means to monitor radioactive effluents in potential discharge pathways to the environment (i.e. pump discharge, ventilation, etc).

3. The requirements of 10 CFR 20.1406 are met when the interconnections between the TGSS and other plant systems are designed to preclude TGSS contamination of connecting systems, or the contamination of TGSS by connections with interfacing radioactive systems (i.e., gaseous radwaste system).

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Technical Rationale

The technical rationale for application of these acceptance criteria to the areas of review addressed by this DSRS section is discussed in the following paragraphs:

1. General Design Criterion (GDC) 60 and GDC 64 require that the nuclear power unit design include means to control and monitor suitably the release of radioactive materials in gaseous and liquid effluents produced during normal operation, including anticipated operational occurrences.

   GDC 60 is applicable to the design of the TGSS because one of the systems functions is to prevent the release of radioactive materials to the environment. The design of the TGSS is acceptable if the integrated design of the system meets the requirements of GDC 60 as related to failures in the design of the system which do not result in excessive releases of radioactivity to the environment.

   GDC 64 requires monitoring of releases of radioactive materials to the environment durning normal operation, including anticipated operational occurrences. The design of the TGSS is acceptable if the design ensures proper routing, venting, and monitoring for radioactivity, of the steam and noncondensables from the TGSS prior to their relese to the environment, so as to assure that normal releases of effluents containg radioactive materials will be controlled to within accepatble limits

   Further, the review under this DSRS section, in conjunction with review under DSRS Section 11.3 and 11.5 verifies that the design of the TGSS includes acceptable means to monitor and control the release of radioactive materials in gaseous effluents.

2. The requirements of 10 CFR 20.1406 are met when the interconnections between the TGSS and other plant systems are designed to preclude TGSS contamination of connecting systems, or the contamination of TGSS by connections with interfacing radioactive systems (i.e gaseous radwaste system). Meeting this criterion provides a level of assurance that the TGSS is designed with proper controls over normal releases of radioactive effluents to the environment.

III. REVIEW PROCEDURES

The reviewer will select material from the procedures described below, as may be appropriate for a particular case. These review procedures are based on the identified DSRS acceptance criteria. For deviations from acceptance criteria, the staff should review the applicant's evaluation of how the proposed alternatives provide an acceptable method of complying with the relevant NRC requirements identified in Subsection II.

Upon request from the reviewer, the interface reviewers will provide input for the areas of review stated in subsection I. The reviewer obtains and uses such input as required to ensure that this review procedure is complete.

The application as it relates to the TGSS is reviewed to verify that :

1. Programmatic Requirements - In accordance with the guidance in NUREG – 0800 *"Introduction," Part 2* as applied to this DSRS Section, the staff will review the programs

proposed by the applicant to satisfy the following programmatic requirements. If any of the proposed programs satisfies the acceptance criteria described in Subsection II, it can be used to augment or replace some of the review procedures. It should be noted that the wording of "to augment or replace" applies to nonsafety-related risk-significant SSCs, but "to replace" applies to nonsafety-related nonrisk-significant SSCs according to the "graded approach" discussion in NUREG-0800 "Introduction," Part 2. Commission regulations and policy mandate programs applicable to SSCs that include:

A. Maintenance Rule SRP Section 17.6 (DSRS Section 13.4, Table 13.4, Item 17, Regulatory Guides 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants." and RG 1.182; "Assessing and Managing Risk Before Maintenance Activities at Nuclear Power Plants".
B. Quality Assurance Program SRP Sections 17.3 and 17.5 (DSRS Section 13.4, Table 13.4, Item 16).
C. Technical Specifications (DSRS Section 16.0 and SRP Section 16.1) – including brackets value for DC and COL. Brackets are used to identify information or characteristics that are plant specific or are based on preliminary design information.
D. Reliability Assurance Program (SRP Section 17.4).
E. Initial Plant Test Program (Regulatory Guide 1.68, "Initial Test Programs for Water-Cooled Nuclear Power Plants, "DSRS Section 14.2, and DSRS Section 13.4, Table 13.4, Item 19).
F. ITAAC (DSRS Chapter 14).

2. The schematics and/or piping and instrument diagrams (P&IDs) reflect the source of sealing steam and the disposition of steam and noncondensables vented from the gland seal.

3. In conjunction with DSRS Section 11.3, and 11.5, the design provides for monitoring of releases of steam and non condensables from the TGSS.

4. The TGSS is designed such that interconnections between the TGSS and other plant systems are designed to preclude TGSS contamination of connecting systems, or the contamination of TGSS by connections with interfacing radioactive systems (i.e gaseous radwaste system).

For review of a DC application, the reviewer should follow the above procedures to verify that the design, including requirements and restrictions (e.g., interface requirements and site parameters), set forth in the final safety analysis report (FSAR) meets the acceptance criteria. DCs have referred to the FSAR as the design control document (DCD). The reviewer should also consider the appropriateness of identified COL action items. The reviewer may identify additional COL action items; however, to ensure these COL action items are addressed during a COL application, they should be added to the DC FSAR.

For review of a COL application, the scope of the review is dependent on whether the COL applicant references a DC, an early site permit (ESP) or other NRC approvals (e.g., manufacturing license, site suitability report or topical report).

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For review of both DC and COL applications, SRPSection 14.3 should be followed for the review of ITAAC. The review of ITAAC cannot be completed until after the completion of this section.

IV. EVALUATION FINDINGS

The reviewer verifies that the applicant has provided sufficient information and that the staff's technical review and analysis support conclusions of the following type to be included in the staff's evaluation report. The reviewer also states the bases for those conclusions.

The TGSS includes the equipment and instruments to provide a source of sealing steam to the annulus space where the turbine and large steam valve shafts penetrate their casings. The scope of our review included the source of sealing steam and the provisions incorporated to control releases of radioactive material in effluents. Programmatic requirements, including ITAAC and initial plant testing provide assurance that the TGSS will be designed, installed, and tested as described in the DCD or FSAR.

The staff concludes that the TGSS design is acceptable in that the applicant has met the requirements of GDC 60 and GDC 64 with respect to the design features in place to control and monitor releases of radioactive materials to the environment. The staff also concludes that the TGSS design meets the requirements of 10CFR20.1406 in that it is designed to preclude TGSS contamination of connecting systems, and thus minimize contamination of the associated systems, facility, and the environment.

For DC and COL reviews, the findings will also summarize the staff's evaluation of requirements and restrictions (e.g., interface requirements and site parameters) and COL action items relevant to this DSRS section.

In addition, to the extent that the review is not discussed in other SER sections, the findings will summarize the staff's evaluation of the ITAAC, including design acceptance criteria, as applicable.

V. IMPLEMENTATION

The staff will use this DSRS section in performing safety evaluations of mPower^{TM}-specific design certification (DC), or combined license (COL) applications submitted by applicants pursuant to 10 CFR Part 52. The staff will use the method described herein to evaluate conformance with Commission regulations.

Because of the numerous design differences between the mPower^{TM} and large light-water nuclear reactor power plants, and in accordance with the direction given by the Commission in SRM-COMGBJ-10-0004/COMGEA-10-0001, "Use of Risk Insights to Enhance the Safety Focus of Small Modular Reactor Reviews," dated August 31, 2010 (ML102510405), to develop risk-informed licensing review plans for each of the small modular reactor (SMR) reviews including the associated pre-application activities, the staff has developed the content of this DSRS section as an alternative method for mPower^{TM} -specific DC, COL, or ESP applications submitted pursuant to 10 CFR Part 52 to comply with 10 CFR 52.47(a)(9), "Contents of applications; technical information."

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This regulation states, in part, that the application must contain "an evaluation of the standard plant design against the Standard Review Plan (SRP) revision in effect 6 months before the docket date of the application." The content of this DSRS section has been accepted as an alternative method for complying with 10 CFR 52.47(a)(9) as long as the mPower™ DCD FSAR does not deviate significantly from the design assumptions made by the NRC staff while preparing this DSRS section. The application must identify and describe all differences between the standard plant design and this DSRS section, and discuss how the proposed alternative provides an acceptable method of complying with the regulations that underlie the DSRS acceptance criteria. If the design assumptions in the DC application deviate significantly from the DSRS, the staff will use the SRP as specified in 10 CFR 52.47 (a)(9). Alternatively, the staff may supplement the DSRS section by adding the appropriate criteria in order to address new design assumptions. The same approach may be used to meet the requirements of 10 CFR 52.79 (a)(41), for COL applications.

VI. REFERENCES

1. 10 CFR Part 20.1406, Minimization of Contamination.

2. 10 CFR Part 50, Appendix A, General Design Criterion 60, "Control of Releases of Radioactive Materials to the Environment."

3. 10 CFR Part 50, Appendix A, General Design Criterion 64, "Monitoring Radioactivity Releases."

4. 10 CFR Part 52 "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."