Draft for Comment

U.S. NUCLEAR REGULATORY COMMISSION

DESIGN SPECIFIC REVIEW STANDARD FOR NuScale SMR DESIGN

14.3.2 STRUCTURAL AND SYSTEMS ENGINEERING - INSPECTIONS, TESTS, ANALYSES, AND ACCEPTANCE CRITERIA

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of Structural Engineering

Secondary - Organization responsible for the review of Emergency Planning
Organization responsible for the review of Radiation Protection
Organization responsible for the review of Plant Systems
Organization responsible for the review of Emergency Preparedness
Organization responsible for the review of Physical Security Hardware

I. AREAS OF REVIEW

This Design-Specific Review Standard (DSRS) section addresses inspections, tests, analyses, and acceptance criteria (ITAAC) related to building structures and structural aspects of major components such as the reactor pressure vessel (RPV). ITAAC information is contained in the final safety analysis report (FSAR) of a combined license (COL) application or Tier 1 FSAR of a design certification (DC) application.

The specific areas of review are as follows:

1. Tier 1 information is reviewed for structural, mechanical, materials, and chemical engineering issues regarding building structures and structural aspects of major components such as the RPV.

2. For a DC application:

   A. The staff reviews the proposed 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 plant that incorporates the design certification is built and will operate in accordance with the design certification, the Atomic Energy Act (AEA), and the Commission's rules and regulations.

   B. The staff reviews the Tier 1 interface requirements and the applicant's justification that compliance with the interface requirements is verifiable through inspections, tests, or analysis. The interface requirements define the significant attributes and performance characteristics that the portion of the facility that is outside the scope of the design certification must have in order to support the in-scope portion of the design. The interface requirements are required to be verified by ITAAC provided in the COL.

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3. For a COL application:

   A. The staff reviews the proposed ITAAC 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 AEA, and the Commission's rules and regulations.

   B. If the application references an early site permit with ITAAC, the early site permit ITAAC must apply to those aspects of the combined license which are approved in the early site permit and staff shall verify they have been properly incorporated into the COL.

   C. If the application references a standard design certification, the ITAAC contained in the certified design must apply to those portions of the facility design which are approved in the design certification and staff shall verify they have been properly incorporated into the COL.

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

   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.

<u>Review Interfaces</u>

Other standard review plan (SRP) and DSRS sections interface with this section as follows:

1. SRP Section 14.3 provides general guidance on ITAAC information.

2. Acceptability of ITAAC information for piping design is reviewed under SRP Section 14.3.3.

3. Acceptability of ITAAC information for reactor systems is reviewed under DSRS Section 14.3.4.

4. Acceptability of ITAAC information for instrumentation and controls is reviewed under DSRS Section 14.3.5.

5. Acceptability of ITAAC information for electrical systems and components is reviewed under DSRS Section 14.3.6.

6. Acceptability of ITAAC information for plant systems is reviewed under DSRS Section 14.3.7.

7. Acceptability of ITAAC information for radiation protection aspects of the structures is reviewed under DSRS Section 14.3.8.

8. Acceptability of ITAAC information for the emergency preparedness aspects of the structures is reviewed under SRP Section 14.3.10.

9. Acceptability of ITAAC information for containment systems is reviewed under SRP Section 14.3.11.

10. Acceptability of ITAAC information for physical security hardware is reviewed under SRP Section 14.3.12.

II. ACCEPTANCE CRITERIA

Requirements

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

1. 10 CFR 52.47(b)(1), which requires that a DC application contain the proposed 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 (AEA), and the Commission's rules and regulations;

2. 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 be operated in conformity with the combined license, the provisions of the Atomic Energy Act, and the Commission's rules and regulations.

DSRS Acceptance Criteria

Specific DSRS acceptance criteria acceptable to meet the relevant requirements of the NRC's regulations identified above are set forth below. The DSRS is not a substitute for the NRC's regulations, and compliance with it is not required. As an alternative, and as described in more detail below, an applicant may identify the differences between a DSRS section and the design features (DC and COL applications only), analytical techniques, and procedural measures proposed in an application and discuss how the proposed alternative provides an acceptable method of complying with the NRC regulations that underlie the DSRS acceptance criteria.

1. The reviewer should primarily utilize the NRC rules and regulations to review the top level commitments in Tier 1. Other sources of review guidelines include Regulatory Guides (RGs), DSRS guidelines, and probabilistic risk assessment (PRA) insights from the standard design safety and severe accident analyses and operating experience. If applicable, the staff also must adhere to policy decisions by the Commission. Examples of these are contained in the SRM related to SECY-90-016, "Evolutionary Light Water Reactor (LWR) Certification Issues and Their Relationship to Current Regulatory Requirements," as modified by the Commission guidance in the SRM related to SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and

Advanced Light-Water Reactor (ALWR) Designs." The SRM related to SECY-93-087 is dated July 21, 1993.

2. Design descriptions, figures (including key dimensions) and ITAAC should be developed and grouped by systems and building structures. For building structures, the structural capability is typically verified by performing an analysis to reconcile the as-built data with the structural design bases for each safety-related building. System-specific performance tests are typically conducted to demonstrate that the system can perform its intended function. For major components, the verification of design, fabrication, testing, and performance requirements should be partially addressed in conjunction with the specific system ITAAC. The review checklists for fluid systems, electrical systems, and building structures in Appendix C of SRP Section 14.3 should be used as aids for establishing consistency and completeness for the Tier 1 information.

3. Review of the Standard Design Structural Integrity. The scope of structural design covers the major structural systems in the standard design plant, including the RPV, ASME Code Class 1, 2, and 3 piping systems, and major building structures (primary containment, reactor building, control building, turbine building, service building, and radwaste building). This includes the reactor vessel (RV), ASME Code Class 1, 2, and 3 piping systems, and major building structures (primary containment, nuclear island structures, turbine building, component cooling water (CCW) heat exchanger structures, diesel fuel storage structures (DFSSs), and radwaste building). The RPV, piping systems, and primary containment are included because they provide the defense-in-depth principle for nuclear plants. The major building structures house those systems and components that are important to safety.

   In establishing the top level requirements for structural design, the staff used the General Design Criteria (GDC) of 10 CFR Part 50, Appendix A, as its basis. The primary general design criteria pertaining to the major structural system design are GDC 1, "Quality Standards and Records," GDC 2, "Design Bases for the Protection Against Natural Phenomena," GDC 4, "Environmental and Dynamic Effects Design Basis," GDC 14, "Reactor Coolant Pressure Boundary," GDC 16, "Containment Design," and GDC 50, "Containment Design Basis."

   GDC 1 requires, in part, the need for structures, systems and components (SSCs) important to safety to be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed.

   GDC 2 requires, in part, the need to design SSCs important to safety to withstand the effects of natural phenomena such as earthquakes, tornados, hurricanes, floods, tsunami and seiches without loss of capability to perform their safety functions, including the appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena.

   GDC 4 requires, in part, the need to appropriately protect SSCs important to safety from dynamic effects, including the effects of missiles, pipe whipping, and discharging fluids that may result from equipment failures and from events and conditions outside the nuclear power unit.

GDC 14 requires the need for the reactor coolant pressure boundary to be designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture.

GDC 16 requires, in part, the need for the reactor containment and associated systems to provide an essentially leak-tight barrier against uncontrolled release of radioactivity to the environment.

GDC 50 requires, in part, the need for the reactor containment structure including access openings and penetrations to be designed so that the containment structure and its internal compartments can accommodate, without exceeding the design leakage rate and with sufficient margin, the calculated pressure and temperature conditions resulting from any loss-of-coolant accident.

Using the above GDC as its basis, the following top-level attributes should be verified by ITAAC:

A. pressure boundary integrity (GDC 14, 16 and 50)
B. normal loads (GDC 2)
C. seismic loads (GDC 2)
D. suppression pool hydrodynamic loads (GDC 4)
E. flood, wind, and tornado (GDC 2)
F. rain and snow (GDC 2)
G. pipe rupture (GDC 4)
H. design and construction compliance with applicable codes and quality standards (GDC 1)
I. containment integrity per 10 CFR 50, Appendix J (GDC 16)

In addition, to ensure that the final as-built plant conforms to the certified design, applicants should provide ITAAC to reconcile the as-built plant with the structural design basis. A summary of the top-level structural design requirements for the major structural systems that are verified by the structures and systems in Tier 1 and the piping design information in Tier 1.

4. Pressure Boundary Integrity. To ensure that the applicable requirements of GDC 14, 16, and 50 have been adequately addressed, ITAAC should be established to verify the pressure boundary integrity of the RPV, piping, and primary containment (For PWRs, RV, piping, and primary containment) for the standard design. GDC 16, GDC 50, and 10 CFR 50, Appendix J apply to the primary containment and GDC 14 applies to the RPV (RV for PWRs) and the reactor coolant pressure boundary piping systems. The pressure integrity for these major structural systems is needed to ensure the defense-in-depth principle.

   For the RPV and piping, hydrostatic tests performed in conjunction with the American Society of Mechnanical Engineers (ASME) Boiler and Pressure Vessel Code ("the Code"), Section III, should be required by ITAAC. See the standard ITAAC for hydrostatic tests in Appendix D to SRP Section 14.3. For the primary containment, a structural integrity test and containment integrated leakage rate test should be required by ITAAC to be performed on the pressure boundary components of the primary containment in accordance with the ASME Code, Section III, and 10 CFR 50, Appendix J. Because the requirements of GDC 14, 16, and 50 do not apply to the reactor, control, turbine, service, and radwaste buildings (nuclear island structures, turbine building, CCW heat exchanger structures, DFSSs, and radwaste building for PWRs), ITAAC are not required to verify the pressure integrity for these other buildings.

5. Normal Loads. To ensure that the applicable requirements of GDC 2 have been adequately addressed, ITAAC should be established to verify that the normal and accident loads have been appropriately combined with the effects of natural phenomena.

   For piping systems, ITAAC should require an analysis to reconcile the as-built piping design with the design-basis loads (which include the appropriate combination of normal and accident loads). See SRP Section 14.3.3 for additional information. For the RPV, the fabrication may be performed primarily in the vendor's shop where adherence to design drawings is tightly controlled. Therefore, ITAAC for the as-built reconciliation of normal loads with accident loads for the RPV are inappropriate. Instead, ITAAC should verify that the ASME Code-required reports exist to document that the RPV has been designed, fabricated, inspected, and tested to Code requirements to ensure adequate safety margin.

   Similarly, for safety-related buildings, ITAAC should require an analysis for reconciling the as-built plant with the structural design basis loads (which include the combination of normal and accident loads with the effects of natural phenomena). The analysis results should be documented in a structural analysis report, the scope and contents of which must be described in Tier 2. The staff may determine that the design of certain structures does not require verification by ITAAC, based on their safety significance. In particular, these ITAAC should apply only to safety-related structures and are not applicable to the turbine building and other non-safety related structures. . However, ITAAC for other design aspects of structures may be appropriate.

6. Seismic Loads. To ensure that the applicable requirements of GDC 2 have been adequately addressed, ITAAC are established to verify that the safety-related systems and structures have been designed to seismic loadings. Component qualification for seismic loads should be addressed by specific ITAAC for verifying seismic qualification. See SRP Section 14.3.3 for additional discussion.

   As discussed above for normal loads on piping systems and the RPV, ITAAC should require an analysis to reconcile the as-built piping design with the design basis loads (which include seismic loads). See also the discussion in SRP Section 14.3.3. For the RPV, ITAAC for the as-built reconciliation of seismic loads for the RPV are deemed to be inappropriate as previously discussed. Instead, ITAAC verify that the ASME Code-required reports exist for the RPV ensuring that the RPV has been designed, fabricated, inspected, and tested to ASME Code requirements.

   For safety-related buildings, ITAAC require an analysis for reconciling the as-built plant with the structural design-basis loads (which include seismic loads). The analysis results are to be documented in a structural analysis report, as discussed above. These ITAAC apply only to safety-related structures and are not applicable to the turbine building and other non-safety related structures. However, ITAAC should be established to verify that, under seismic loads, the collapse of non-safety related SSCs will not impair the safety-related functions of any safety-related SSCs located adjacent to or within the non-safety related SSCs.

For non-seismic Category I SSCs, the need for ITAAC to verify that their failure will not impair the ability of near-by safety-related SSCs to perform their safety-related functions should be assessed based on the specific design. If the design detail and as-built and as-procured information for many non-safety-related systems (e.g., field-run piping and balance-of-plant systems) is not provided by the applicant for design certification and the spatial relationship between such systems and seismic Category I SSCs cannot be established until after the as-built design information is available, the non-seismic to seismic (II/I) interaction cannot be evaluated until the plant has been constructed. Accordingly, the design criteria for ensuring acceptable II/I interactions and a commitment for the COL applicant to describe the process for completion of the design of balance-of-plant and non-safety related systems to minimize II/I interactions and proposed procedures for an inspection of the as-built plant for II/I interactions should be specified as a COL action item in Tier 2.

7. Flood, Wind, Tornado, Hurricane, Rain, and Snow. To ensure that the applicable requirements of GDC 2 have been adequately addressed, ITAAC should be established to verify that the safety-related systems and structures have been designed to withstand the effects of natural phenomena other than those associated with seismic loadings. The effects include those associated with flood, wind, tornado, hurricane, rain, and snow.

   These loadings do not apply to the RPV, the ASME Code Class 1, 2, and 3 piping systems and components, nor the primary containment because they are all housed within the safety-related buildings. For safety-related buildings, ITAAC should require an analysis for reconciling the as-built plant with the structural design basis loads (which include the flood, wind, tornado, hurricane, rain, and snow loads). Based on their safety significance, these ITAAC apply to safety-related structures.
   However, ITAAC should also be established to verify that, under flood, wind, tornado, hurricane, rain, and snow loads, the collapse of any non-safety related SSCs will not impair the safety-related functions of any safety-related SSCs located adjacent to or within the non-safety related SSCs.

   For flooding, site parameters are specified that require the maximum flood level and ground water level be below the finished plant grade level. ITAAC also require inspections to verify that divisional flood barriers and water-tight doors exist, and penetrations (except for water-tight doors) in the divisional walls are sealed up to the internal and external flood levels. In addition, for safety-related buildings, flood barriers are established up to the finished plant grade level to protect against water seepage, and flood doors and flood barrier penetrations are provided with flood protection features.

   ITAAC should require inspections to verify that water-tight doors, locations of penetrations in the division walls, and locations of safety-related electrical, instrumentation and control equipment meet their specified design commitments associated with flood protection. As a minimum, ITAAC should also require inspections to verify that water-tight doors exist, penetrations (except for water-tight doors) in the divisional walls are at least 2.5m above the floor, and safety-related electrical, instrumentation, and control equipment are located at least 20 cm above the floor surface. In addition, for safety-related buildings, ITAAC should verify that design commitments for external walls and external wall penetrations associated with flood protection features are provided and require that thickness of the external walls below flood level are at least equal to or greater than 0.6m to protect against water seepage.

8. Pipe Break. To ensure that the applicable requirements of GDC 4 have been adequately addressed, ITAAC should be established to verify that the safety-related SSCs have been designed to the dynamic effects of pipe breaks. Component qualification for the dynamic effects of pipe breaks should be addressed by a specific ITAAC for verifying component qualification. See SRP Section 14.3.3 for additional discussions.

   For the RPV, ITAAC that verify the basic configuration of the RPV system require an inspection of the critical locations that establish the bounding loads in the loss-of-coolant accidents (LOCA) analyses for the RPV to ensure that the as-built areas not exceed the postulated break areas assumed in the LOCA analyses.

   In addition, ITAAC should be established to verify by inspections of as-built, high-energy pipe break mitigation features and of the pipe break analysis report that safety-related SSCs be protected against the dynamic and environmental effects associated with postulated high-energy pipe breaks. ITAAC to verify pipe break loads are not required for the turbine, service, and radwaste buildings (turbine and radwaste buildings for PWRs) either because they are not safety-related structures or there are no high-energy lines located within the structure.

9. Codes and Standards. To ensure that the applicable requirements of GDC 1 have been adequately addressed, ITAAC should be established to verify that the design and construction of safety-related systems and components is in accordance with the codes and standards that are committed to in the applicable Tier 2 sections of the final safety analysis report (FSAR). In general, the staff considers those codes and standards endorsed by the regulations under 10 CFR 50.55a in determining which codes and standards were appropriate for Tier 1 verification. The ASME Code, Section III for Code Class 1, 2, and 3 systems and components is established as the code for the design and construction of standard design piping systems and the RPV.

   For safety-related building designs, the staff should base its safety findings on audits of standard design calculations which relied on specific codes and standards. These codes and standards are contained in the appropriate sections of design control document (DCD) Tier 2 Chapter 3.

   Inspections will be conducted as a part of ITAAC to verify that ASME Code-required documents exist that demonstrate that the RPV, piping systems and containment pressure boundaries have been designed and constructed to their appropriate Code requirements. For other ASME Code components and equipment, the verification of Code compliance will be performed in conjunction with the quality assurance programs and by the authorized inspection agency as required by the ASME Code. This DCD Tier 2 material should be considered for designation as Tier 2* information. Tier 2* information is information that, if considered for a change by an applicant or licensee that references the certified standard design, would require NRC approval prior to implementation of the change. Tier 2* material is discussed further in SRP Section 14.3.

10. As-built Reconciliation. As discussed in various sections above, to ensure that the final as-built plant structures are built in accordance with the certified design as required by

10 CFR Part 52, structural analyses should be performed which reconcile the as-built configuration of the plant structures with the structural design bases of the certified design. The structural analyses should be documented in structural analysis reports. Structural analysis reports should be verified in conjunction with ITAAC for the primary containment and the reactor, control, radwaste, and turbine buildings (nuclear island structures, radwaste building, CCW heat exchangers, DFSSs, and turbine building for PWRs). The detailed supporting information on what is required for an acceptable analysis report should be contained in DCD Tier 2 Chapter 3.

Similarly for piping systems, an as-built analysis should be performed using the as-designed and as-built information. ITAAC should verify the existence of acceptable final as-built piping stress reports that conclude the as-built piping systems are adequately designed. See SRP Section 14.3.3 for additional information.

For the RPV, the key dimensions of the RPV system should be verified by a specific ITAAC. The key dimensions of the RPV system and the acceptable variations of the key dimensions should be provided in the certified design description. Alternatively, acceptable variations and the bases for them should be provided in Tier 2.

For component qualification, tests, analyses, or a combination of tests and analyses should be performed for seismic Category I mechanical and electrical equipment (including connected instrumentation and controls) to demonstrate that the as-built equipment and associated anchorages are qualified to withstand design basis dynamic loads without loss of safety function. These test and analyses should be performed as a part of a specific ITAAC associated with verification of seismic qualification of the component including associated anchorages. See SRP Section 14.3.3 for additional information.

11. In accordance with 10 CFR 20.1406 applications must describe how facility design will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste. RG 4.21 provides guidance for meeting these requirements. RG 4.21 describes an acceptable method for demonstrating compliance with 10 CFR 20.1406. In association with RG 4.21, DC/COL-ISG-06 provides further clarification of the evaluation and acceptance criteria used to meet the requirements of 10 CFR 20.1406 and the guidelines of RG 4.21. To ensure that the applicable requirements of 10 CFR 20.1406 have been adequately addressed, ITAAC should be established to verify the existence of design features to minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

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. Application of 10 CFR 52.47(b)(1), as it relates to ITAAC (for design certification) 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 AEA, and the Commission's rules and regulations.

2. Application of 10 CFR 52.80(a), as it relates to ITAAC (for combined licenses) 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 COL, the provisions of the Atomic Energy Act, and the Commission's rules and regulations.

3. Application of 10 CFR 20.1406 as it relates to 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 and COL to minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste. This is accomplished by verifying the design features and operation of SSCs that contain or handle radioactive material as described in the COL technical submittal. Regulatory positions C.1 through C.4 of RG 4.21 describe concepts to be implemented to provide reasonable assurance that inadvertent spills, leaks, and discharges of liquid, gaseous, and solid radioactive effluents are prevented, detected, and corrected.

III. REVIEW PROCEDURES

These review procedures are based on the identified DSRS acceptance criteria. For deviations from these 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.

1. Selected Programs and Guidance - In accordance with the guidance in NUREG-0800, "Introduction - Part 2: Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: Integral Pressurized Water Reactor Edition" (NUREG-0800 Intro Part 2) as applied to this DSRS Section, the staff will review the information proposed by the applicant to evaluate whether it meets the acceptance criteria described in Subsection II of this DSRS. As noted in NUREG-0800 Intro Part 2, the NRC requirements that must be met by an SSC do not change under the SMR framework. Using the graded approach described in NUREG-0800 Intro Part 2, the NRC staff may determine that, for certain structures, systems, and components (SSCs), the applicant's basis for compliance with other selected NRC requirements may help demonstrate satisfaction of the applicable acceptance criteria for that SSC in lieu of detailed independent analyses. The design-basis capabilities of specific SSCs would be verified where applicable as part of completion of the applicable ITAAC. The use of the selected programs to augment or replace traditional review procedures is described in Figure 1 of NUREG-0800, Introduction - Part 2. Examples of such programs that may be relevant to the graded approach for these SSCs include:

   - 10 CFR Part 50, Appendix A, General Design Criteria (GDC), Overall Requirements, Criteria 1 through 5
   - 10 CFR Part 50, Appendix B, Quality Assurance (QA) Program

- 10 CFR 50.49, Environmental Qualification of Electrical Equipment (EQ) Program
- 10 CFR 50.55a, Code Design, Inservice Inspection and Inservice Testing (ISI/IST) Programs
- 10 CFR 50.65, Maintenance Rule requirements
- Reliability Assurance Program (RAP)
- 10 CFR 50.36, Technical Specifications
- Availability Controls for SSCs Subject to Regulatory Treatment of Non-Safety Systems (RTNSS)
- Initial Test Program (ITP)
- Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC)

This list of examples is not intended to be all-inclusive. It is the responsibility of the technical reviewers to determine whether the information in the application, including the degree to which the applicant seeks to rely on such selected programs and guidance, demonstrates that all acceptance criteria have been met to support the safety finding for a particular SSC.

2. In accordance with 10 CFR 52.47(a)(8),(21), and (22), and 10 CFR 52.79(a)(17), (20) and (37), for design certification or combined license applications submitted under Part 52, the applicant is required to (1) address the proposed technical resolution of unresolved safety issues and medium- and high-priority generic safety issues which are identified in the version of NUREG-0933 current on the date up to 6 months before the docket date of the application and which are technically relevant to the design; (2) demonstrate how the operating experience insights have been incorporated into the plant design; and, (3) provide information necessary to demonstrate compliance with any technically relevant portions of the Three Mile Island requirements set forth in 10 CFR 50.34(f), except paragraphs (f)(1)(xii), (f)(2)(ix), and (f)(3)(v) for a DC application, and except paragraphs (f)(1)(xii), (f)(2)(ix), (f)(2)(xxv), and (f)(3)(v) for a COL application. These cross-cutting review areas should be addressed by the reviewer for each technical subsection and relevant conclusions documented in the corresponding safety evaluation report

3. Follow the general procedures for review of Tier 1 contained in the Review Procedures section of SRP Section 14.3. Ensure that the DCD is consistent with Appendix A to SRP Section 14.3.

4. Ensure that all Tier 1 information is consistent with Tier 2 information. Figures and diagrams should be reviewed to ensure that they accurately depict the functional arrangement and requirements of the systems, including definitions, general provisions, key dimensions, and legends for figures. Reviewers should use the building structures, fluid systems and electrical systems checklists in Appendix C to SRP Section 14.3 as an aid in establishing consistent and comprehensive treatment of issues.

5. Ensure that the building structures and major components are clearly described in Tier 1, including the key performance characteristics and safety functions of SSCs based on their safety significance.

6. The reviewer should ensure that appropriate guidance is provided to other branches such that structural engineering issues in Tier 1 are treated in a consistent manner among branches.

7. Reviewers should ensure that the review of Tier 1 is coordinated with the review of site parameters in SRP Section 2.0 and piping design in SRP Section 14.3.3.

8. Reviewers should ensure that inputs from the secondary review organizations as discussed in the "Areas of Review" section above are reflected in Tier 1 information. Reviewers should ensure that review interfaces are coordinated as discussed in the "Areas of Review" section above.

9. 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 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).

10. The reviewer should ensure that the guidance contained in the issued final Interim Staff Guidance (ISG) documents associated with applications for new reactors is followed:

    - Final Interim Staff Guidance – Evaluation and Acceptance Criteria for 10 CFR 20.1406 to Support Design Certification and Combined License Application (DC/COL-ISG-06).

    - Interim Staff Guidance on Post-Combined License Commitments (ESP/DC/COL-ISG-015).

IV. EVALUATION FINDINGS

The reviewer verifies that the applicant has provided sufficient information and that the staff's technical review and analysis, as augmented by the application of programmatic requirements in accordance with the staff's technical review approach in the DSRS Introduction (Reference 25), support conclusions of the following type to be included in the staff's safety evaluation report. The reviewer also states the bases for those conclusions.

1. The reviewer verifies that sufficient information has been provided in accordance with the guidance contained in SRP Section 14.3 and this DSRS section, and concludes that the ITAAC is acceptable to satisfy the requirements of 10 CFR 52.47(b)(1) or 10 CFR 52.80(a), as applicable. A finding similar to that in the Evaluation Findings section of SRP Section 14.3 should be provided in a separate section of the SER.

2. 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.

3. The reviewer verifies that sufficient information regarding the ITAACs that are necessary to verify the design functions and the operations features of the SSCs required for compliance with the requirements of 10 CFR 20.1406 and the guidance of RG 4.21 has been provided.

V. IMPLEMENTATION

The regulations in 10 CFR 52.17(a)(1)(xii), 10 CFR 52.47(a)(9), and 10 CFR 52.79(a)(41) establish requirements for applications for ESPs, DCs, and COLs, respectively. These regulations require the application to include an evaluation of the site (ESP), standard plant design (DC), or facility (COL) against the Standard Review Plan (SRP) revision in effect six months before the docket date of the application. While the SRP provides generic guidance, the staff developed the SRP guidance based on the staff's experience in reviewing applications for construction permits and operating licenses for large light-water nuclear power reactors. The proposed small modular reactor (SMR) designs, however, differ significantly from large light-water nuclear reactor power plant designs.

In view of the differences between the designs of SMRs and the designs of large light-water power reactors, the Commission issued 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) (SRM). In the SRM, the Commission directed the staff to develop risk-informed licensing review plans for each of the SMR design reviews, including plans for the associated pre-application activities. Accordingly, the staff has developed the content of the DSRS as an alternative method for the evaluation of a NuScale-specific application submitted pursuant to 10 CFR Part 52, and the staff has determined that each application may address the DSRS in lieu of addressing the SRP, with specified exceptions. These exceptions include particular review areas in which the DSRS directs reviewers to consult the SRP and others in which the SRP is used for the review. If an applicant chooses to address the DSRS, the application should identify and describe all differences between the design features (DC and COL applications only), analytical techniques, and procedural measures proposed in an application and the guidance of the applicable DSRS section (or SRP section as specified in the DSRS), and discuss how the proposed alternative provides an acceptable method of complying with the regulations that underlie the DSRS acceptance criteria.

The staff has accepted the content of the DSRS as an alternative method for evaluating whether an application complies with NRC regulations for NuScale SMR applications, provided that the application does not deviate significantly from the design and siting assumptions made by the NRC staff while preparing the DSRS. If the design or siting assumptions in a NuScale application deviate significantly from the design and siting assumptions the staff used in preparing the DSRS, the staff will use the more general guidance in the SRP as specified in 10 CFR 52.17(a)(1)(xii), 10 CFR 52.47(a)(9), or 10 CFR 52.79(a)(41), depending on the type of application. Alternatively, the staff may supplement the DSRS section by adding appropriate criteria in order to address new design or siting assumptions.

VI. REFERENCES

1. 10 CFR 50.55a, "Codes and Standards."

2. 10 CFR 52.47, "Contents of Applications; Technical Information."

3. 10 CFR 52.80, "Contents of Applications; Additional Technical Information."

4. 10 CFR Part 50, Appendix A, General Design Criterion 1, "Quality Standards and Records."

5. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for the Protection Against Natural Phenomena."

6. 10 CFR Part 50, Appendix A, General Design Criterion 4, "Environmental and Dynamic Effects Design Basis."

7. 10 CFR Part 50, Appendix A, General Design Criterion 14, "Reactor Coolant Pressure Boundary."

8. 10 CFR Part 50, Appendix A, General Design Criterion 16, "Containment Design."

9. 10 CFR Part 50, Appendix A, General Design Criterion 50, "Containment Design Basis."

10. 10 CFR Part 50, Appendix J, Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors.

11. 10 CFR 52.97, "Issuance of Combined Licenses."

12. 10 CFR 20.1406, "Minimization of Contamination."

13. Intentionally not used

14. SECY 90-016, "Evolutionary Light Water reactor (LWR) Certification Issues and Their Relationship to Current Regulatory Requirements," January 12, 1990.

15. SECY 93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs," April 2, 1993.

16. SRM 1993-087, "SECY-93-087 – Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs," July 21, 1993.

17. ASME Boiler and Pressure Vessel Code, Section III, "Rules for Construction of Nuclear Power Plant Components."

18. RG 1.68, "Initial Test Program for Water-Cooled Nuclear Power Plants."

19. RG 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants."

20. RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)."

21. Regulatory Guide 1.215, “Guidance for ITAAC Closure Under 10 CFR Part 52.”

22. RG 4.21, “Minimization of Contamination and radioactive Waste generation: Life-Cycle Planning.”

23. Final Interim Staff Guidance DC/COL-ISG-06, “Final Interim Staff Guidance – Evaluation and Acceptance Criteria for 10 CFR 20.1406 to Support Design Certification and Combined License Applications.”

24. Interim Staff Guidance ESP/DC/COL-ISG-015, Post-Combined License Commitments.”

25. NUREG-0800 Introduction Part 2: Integral Pressurized Water Reactors Edition (ML12142A237).