

# Draft for Comment



## U.S. NUCLEAR REGULATORY COMMISSION DESIGN-SPECIFIC REVIEW STANDARD FOR NuScale SMR DESIGN

### 6.6 INSERVICE INSPECTION AND TESTING OF CLASS 2 AND 3 COMPONENTS

#### REVIEW RESPONSIBILITIES

**Primary -** Organization responsible for the review of the inspection, testing, evaluation, and repair of mechanical equipment and components

**Secondary -** Organization responsible for the review of probabilistic risk assessment (PRA), if a risk-informed ISI program is submitted.

#### I. AREAS OF REVIEW

Inservice inspection (ISI) and inservice testing (IST) programs are based on the requirements of 10 CFR 50.55a, which requires that Code Class components meet the applicable inspection requirements set forth in Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (hereinafter "ASME Section XI"). ISI includes preservice examinations prior to initial plant startup as required by Articles IWC-2200, IWD-2200, IWE/IWL-2200, and IWF-2200 of ASME Section XI. Certain inservice testing requirements are set forth in ASME Section XI. Pressure, hydrostatic and leak tests for Code Class 2 and 3 components are addressed in ASME Section XI, Articles IWC-5000 and IWD-5000, and acceptance test alternatives to examinations for supports (other than dynamic restraints) for Code Class 2 and 3 components are addressed in ASME Section XI, Article IWF-1200. However, inspection and testing requirements for Code Class 2 and 3 components such as pumps, valves and dynamic restraints are set forth in the ASME Code for Operation and Maintenance of Nuclear Power Plants (hereinafter "the ASME OM Code") and are addressed in the review performed under DSRS Section 3.9.6, "Functional Design, Qualification, and Inservice Testing Programs for Pumps, Valves, and Dynamic Restraints."

This DSRS does not address those unique aspects of the NuScale design that may limit the effective use of ASME Section XI, to ensure the safe operation of the plant. These unique aspects will be addressed by the applicant and reviewed by the staff on a case-by-case basis. When innovative designs are applied to ASME code components, it is the responsibility of the applicant to assure that the corresponding ASME Section XI inspection requirements are evaluated for sufficiency and supplemented as necessary to ensure that structural and leak-tight integrity is maintained. The applicant should also assure that all SSCs that require inservice inspection, including those that are not addressed in ASME Section XI, are appropriately inspected and tested commensurate with the importance of the safety functions to be performed.

The specific areas of review are as follows:

1. Components Subject to Examination. The descriptive information in the applicant's technical submittal is reviewed to establish that all ASME Code Class 2 and Class 3 components, as defined in ASME Section III, Article NCA-2000, "Classification of Components," subject to examination are included in the ISI Program. Such components include safety-related components and nonsafety-related, risk significant components that are subject to Regulatory Treatment of Nonsafety Systems (RTNSS) based on the selection criteria in Section C.IV.9.3 of Regulatory Guide 1.206.
2. Accessibility. The descriptive information, including drawings, is reviewed to establish that the ASME Section XI, Article IWA-1500, "Accessibility," provisions for system accessibility are included in the applicant's layout and design of these systems.
3. Examination Categories and Methods. The required examination categories and methods included in Articles IWA-2000, IWC-2000, IWD-2000, and IWF-2000, "Examination and Inspection," of ASME Section XI are reviewed.
4. Inspection and Testing Intervals. The required examinations, inspections and tests listed in the applicant's technical submittal and/or plant Technical Specifications or short-term availability controls are reviewed and compared to the requirements in ASME Section XI, Articles IWA-2000, IWC-2000, IWD-2000, and IWF-2000, to verify that they will be performed within the designated inspection interval.
5. Evaluation of Examination Results. The information concerning repair procedures is reviewed for compliance with ASME Section XI, Article IWA-4000, "Repair/Replacement Activities." . The information concerning evaluation of examination results is reviewed for compliance with ASME Section XI, Articles IWC-3000 and IWD-3000, "Acceptance Standards," and IWF-3000, "Standards for Examination Evaluations,". If the applicable ASME Code edition states that these requirements are in the course of preparation, the review should address suitable alternative provisions, such as those provided in ASME Section XI, Article IWB-3000 or those in later approved editions of the Code, as proposed by the applicant.
6. System Pressure Tests. The pressure test program is reviewed for compliance with ASME Section XI, Articles IWC-5000 and IWD-5000, "System Pressure Tests," to establish that leakage and signs of structural distress are inspected as required by the ASME Code.
7. Structural Supports: The ISI program for examinations or alternative tests for fixed structural supports is reviewed for compliance with ASME Section XI, Article IWF-1200, "Component Supports subject to Examination and Test," to establish that signs of structural distress are inspected as required by the ASME Code.
8. Code Exemptions from Examination. The ASME Code exemptions, as permitted by ASME Section XI, Articles IWC-1220 and IWD-1220, "Components Exempt from Examination," and IWF-1230, "Supports Exempt from Examination," are reviewed.
9. Relief Requests. Relief requests intended to be used are reviewed

10. Code Cases. The acceptability of any ASME Section XI or ASME OM Code Cases that the applicant may have invoked in connection with the ISI programs will be verified.
11. 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 SSCs related to this Design Specific Review Standard (DSRS) section in accordance with NUREG-0800, 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 SRP Section 14.3.
12. 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).  
  
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.
13. Operational Program Description and Implementation. For a COL application, the staff reviews the Preservice Inspection and Inservice Inspection and Testing program description and the proposed implementation milestones. The staff also reviews the applicant's technical submittal Table 13.4-x to ensure that the Inservice Inspection and Testing of Class 2 and 3 Components Program and associated milestones are included.
14. For a COL application, the staff reviews the Containment Inspection Program submitted under DSRS Section 3.8 or 6.6 to assure the program meets the requirements of IWE/IWL-2200..
15. Risk-Informed ISI Programs. Risk-informed ISI programs may be submitted for NRC staff review and authorization as an alternative to the regulations pursuant to § 50.55a(z). The risk informed program is reviewed to verify that the applicant or licensee has demonstrated that either the program provides an acceptable level of quality and safety or that compliance with the current regulations would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

#### Review Interfaces

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

1. The review of the adequacy of programs for assuring the integrity of bolting and threaded fasteners is performed under DSRS Section 3.13, "Threaded Fasteners."
2. The review to ensure that systems and components are appropriately classified in accordance with regulatory requirements and NRC quality group classification guidance, including verification that quality group B and C components meet the requirements for Code Class 2 and 3 components, respectively, is performed under SRP Section 3.2.2,

"System Quality Group Classification," and SRP Section 5.2.1.1, "Compliance with the Codes and Standards Rule, 10 CFR 50.55a."

3. The review of the design and ITAAC for ASME Code Class 1, 2, and 3 supports is performed under SRP Section 3.9.3, "ASME Code Class 1, 2, and 3 Components, and Component Supports, and Core Support Structures."
4. The review of the inservice testing programs for pumps, valves and dynamic restraints that are designated as ASME Code Class 1, 2, or 3 or are otherwise designated as safety-related is performed under DSRS Section 3.9.6, "Functional Design, Qualification, and Inservice Testing Programs for Pumps, Valves, and Dynamic Restraints."
5. The review of risk-informed inservice inspection and testing programs is performed in a coordinated manner jointly under DSRS Sections 3.9.7, "Risk-Informed Inservice Testing," 3.9.8, "Risk-Informed Inservice Inspection of Piping," and 19.1, "Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities." In addition, a RI-ISI program submittal may be reviewed as an ASME Code Case approved under Regulatory Guide (RG) 1.147 under this Section.
6. The review of preservice inspection and inservice inspection requirements for ASME Code Class 1 components of the reactor coolant pressure boundary is performed under SRP Section 5.2.4, "Reactor Coolant Pressure Boundary Inservice Inspection and Testing."
7. The review of the inservice inspection requirements for steam generator tubes is performed under DSRS Section 5.4.2.2, "Steam Generator Tube Inservice Inspection."
8. The review of plant programs for surveillance, testing, inspection, and maintenance of safety-related and/or risk significant cooling water systems is performed under DSRS Sections 5.4.7, "Residual Heat Removal (RHR) System," 6.2.2, "Containment Heat Removal Systems," 6.3, "Emergency Core Cooling System," 9.2.5, "Ultimate Heat Sink Tank" and its associated refill system, 9.3.4, "Reactor Coolant Inventory and Purification System, and 9.2.2, "Chilled Water System." These programs are coordinated with the ISI programs reviewed under this DSRS section, SRP section 3.9.3, DSRS Section 3.9.6, and with the risk informed assessment under the DSRS sections identified in the interface number 4 above.
9. The reviews of required quality assurance controls for inspection and testing activities and of the associated procedural controls for monitoring equipment performance and conditions are performed under SRP Sections 17.2 and 17.5.
10. The augmented ISI program, as specified in DSRS Section 3.6.2, that provides assurance against postulated piping failures of high-energy fluid systems between containment isolation valves is reviewed.
11. For COL reviews of operational programs, the review of the applicant's implementation plan is performed under SRP Section 13.4, "Operational Programs."

12. For COL reviews of technical specifications and short-term availability controls, the review of the applicant's implementation of ISI in surveillance requirements and administrative controls such as procedures, programs and manuals for ISI programs is performed under DSRS Sections 16.0, "Technical Specifications."
13. The review of the risk significance of SSCs is performed under SRP Section 19.0.

## II. ACCEPTANCE CRITERIA

### Requirements

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

1. 10 CFR 50.36 as it pertains to surveillance requirements and administrative controls using procedures and record keeping for periodic inspections and testing implementing the ASME Code for Class 2 and 3 systems and components. The inservice testing program for Class 2 and 3 components is found in Specification 5.5.8 of the Standard Technical Specifications administrative controls and is invoked in various surveillance requirements in the Standard Technical Specifications.
2. 10 CFR 50.65 as it pertains to monitoring the performance or condition of SSCs against licensee-established goals in a manner sufficient to provide reasonable assurance that the safety-related and/or risk significant SSCs are capable of fulfilling their intended functions where licensee-established goals shall be commensurate with safety and, where practical, take into account industrywide operating experience reflected in codes and standards.
3. 10 CFR 50.55a as it pertains to specification of the preservice and periodic inspection and testing requirements of the ASME Code and the ASME OM Code for Class 2 and 3 systems and components. 10 CFR 50.55a(f) stipulates inservice testing requirements; 10 CFR 50.55a(g) stipulates inservice inspection requirements.
4. GDC 36 found in Appendix A to 10 CFR Part 50, as it pertains to designing the emergency core cooling system (ECCS) to permit appropriate periodic inspection of important safety components.
5. GDC 37 found in Appendix A to 10 CFR Part 50, as it pertains to designing the ECCS to permit appropriate testing to assure structural integrity, leak tightness, and the operability of the system.
6. GDC 39 found in Appendix A to 10 CFR Part 50, as it pertains to designing the containment heat removal system to permit inspection of important components.
7. GDC 40 found in Appendix A to 10 CFR Part 50, as it pertains to designing the containment heat removal system to permit appropriate pressure and functional testing.
8. GDC 42 found in Appendix A to 10 CFR Part 50, as it pertains to designing the containment atmosphere cleanup systems to permit appropriate inspection of important components (i.e hydrogen recombiners, containment atmosphere sampling lines, and isolation valves.)

9. GDC 43 found in Appendix A to 10 CFR Part 50, as it pertains to designing the containment atmosphere cleanup systems to permit appropriate periodic functional testing to assure structural integrity of components and the operability and performance of components of the system.
10. GDC 45 found in Appendix A to 10 CFR Part 50, as it pertains to designing the cooling water systems to permit appropriate periodic inspection and testing of important components. (i.e, pumps, valves, piping and heat exchangers as appropriate under this DSRS section or under DSRS section 3.9.6).
11. GDC 46 found in Appendix A to 10 CFR Part 50, as it pertains to designing the cooling water systems to permit appropriate pressure and functional testing to assure structural and leaktight integrity of it components and operability of active components (i.e.pumps and valves) (see DSRS Section 3.9.6).
12. 10 CFR Part 50, Appendix B, as it pertains to inspections, tests, and associated procedural controls and documentation of results to assure the quality of the ISI programs implementation.
13. 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 U.S. Nuclear Regulatory Commission's (NRC's) regulations.
14. 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.
15. 10 CFR 50.55a(g)(3), which requires that a Class 1, 2, and 3 components (including supports) be designed and provided with access to enable the performance of inservice examinations of these components and must meet the preservice examination requirements set forth in the additions and addenda of Section XI of the ASME Boiler and Pressure Vessel Code incorporated by reference in paragraph (a)(1)) of 10 CFR 50.55a or the optional ASME Code cases listed in NRC RG 1.147, Revision 17.

#### 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. Components Subject to Inspection. The applicant's definition of ASME Code Class 2 and 3 components and systems subject to an ISI program is acceptable if it is in agreement with the NRC quality group classification system or the definitions in ASME Section III, Article NCA-2000. The classification of components by the applicant is subject to review under DSRS Section 3.2.2 for compliance with safety criteria pertaining to component classification. Where a specific item will be subject to inspection requirements different in any way from the ASME Section XI requirements corresponding to the item's Code Class, the exceptions for the item, including the inservice inspection requirements to be applied, should be clearly identified and described. Exceptions involving less stringent inspection requirements for Code Class 2 or 3 items other than those required by ASME Section XI must be adequately justified. (Refer to DSRS Section 3.2.2 or ASME Section III, Article NCA-2000.)
2. Accessibility. The design and arrangement of Class 2 and 3 systems must include allowances for adequate clearances to conduct the examinations specified in ASME Section XI, Articles IWC-2000, IWD-2000, and IWF2000, at the frequency specified. The design and arrangement of system components are acceptable if adequate clearance is provided in accordance with ASME Section XI, Article IWA-1500, and 10 CFR 50.55a(g)(3). Special design considerations are given to those systems that are intended to be examined during normal reactor operation
3. Examination Categories and Methods. The examination categories and requirements specified in the applicant's technical submittal are acceptable if they are in agreement with the rules of ASME Section XI, Articles IWA-2000, IWC-2000, IWD-2000, IWE/IWL-2000, and IWF-2000. Every area subject to examination should fall within one or more of the examination categories and must be examined at least to the extent specified.

The applicant's examination techniques and procedures used for preservice inspection and inservice inspection are acceptable if they are in agreement with the following criteria:

- A. The methods, techniques, and procedures for visual, surface, or volumetric examination are in accordance with ASME Section XI, Article IWA-2000.
- B. Alternative examination methods, combination of methods, or newly developed techniques other than those given in A. above are acceptable provided that the results are equivalent or superior. The acceptance standards for these alternate methods are given in ASME Section XI, Articles IWC-3000, IWD-3000, and IWF-3000.
- C. The methods, procedures, and requirements regarding qualification of personnel performing ultrasonic examination reflect the guidance provided in Appendix VII, "Qualification of Nondestructive Examination Personnel for Ultrasonic Examination," to Division 1 of ASME Section XI.
- D. Performance demonstration for ultrasonic examination procedures, equipment, and personnel used to detect and size flaws are in accordance with the requirements of Appendix VIII, "Performance Demonstration for Ultrasonic Examination Systems," to ASME Section XI, Division 1.

4. Inspection Intervals. The ISI program schedule provided in the applicant's technical submittal is acceptable if the required examinations and pressure tests are specified for completion during each interval, hereinafter designated as the "inspection interval," and as required by ASME Section XI, Articles IWA-2000, IWC-2000, IWD-2000, and IWF-2000.
5. Evaluation of Examination Results. The methods for evaluation of examination results are reviewed for compliance with Articles IWC-3000, IWD-3000, and IWF-3000 in the Code. If the applicable edition of the Code states that these articles are in the course of preparation, the rules of Article IWB-3000 shall apply. The repair procedures are acceptable if they are in compliance with ASME Section XI, Article IWA-4000.
6. System Pressure Tests. The program provided in the applicant's technical submittal for Class 2 and 3 system pressure testing is acceptable if it meets the criteria of ASME Section XI, Articles IWC-5000 and IWD-5000.
7. Structural Supports: The program provided in the applicant's technical submittal for examinations or alternative tests for fixed structural supports of Class 2 and 3 SSCs is acceptable if it meets the criteria of ASME Section XI, Article IWF-1200.
8. Augmented ISI to Protect Against Postulated Piping Failures. The augmented ISI program for high-energy fluid system piping between containment isolation valves is acceptable if it specifies the following requirements:
  - A. Protective measures, structures, and guard pipes should not prevent the access required to conduct the inservice examinations specified in the Division 1 of ASME Section XI.
  - B. For those portions of high energy fluid system piping between containment isolation valves, the extent of inservice examination completed during each inspection interval should provide 100% volumetric examination of circumferential and longitudinal pipe welds within the boundary of these portions of piping.
  - C. For those portions of high-energy fluid system piping enclosed in guard pipes, inspection ports should be provided in the guard pipes to permit the required examination of circumferential pipe welds. Inspection ports should not be located in that portion of the guard pipe passing through the annulus of dual barrier containment structures.
  - D. The areas subject to examination should be defined in accordance with ASME Section XI, Article IWC-2000, Examination Category C-F for Class 2 piping welds.
9. Code Exemptions. The exemptions from Code examination requirements identified by the applicant are acceptable if they have been permitted by ASME Section XI, Articles IWC-1220 or IWD-1220 or IWF-1230.



10. Relief Requests. At the DC or COL application stage, there should be no requests for relief from the ASME Section XI examination requirements that are found to be impractical due to the limitations of design, geometry, or materials of construction of components that are evaluated in accordance with 10 CFR 50.55a. Interferences due to design, geometry and materials of construction must be eliminated during the design stages to enable the performance of PSI/ISI examinations in accordance with the regulations.
11. Code Cases. The exemptions from Code examination requirements identified by the applicant or licensee are acceptable if they have been permitted by appropriate ASME code cases. If a Risk Informed ISI program is to be used at a later date, the appropriate Code Case should be specified.
12. Operational Programs. For COL reviews, the description of the operational program and proposed implementation milestones for the Preservice Inspection and Inservice Inspection and testing programs for Class 2 and 3 components are reviewed in accordance with the requirements of 10 CFR 50.55a, "Codes and Standards." The implementation milestone for the inservice inspection program is when the plant enters into commercial operation.
13. Risk Informed ISI Program. When submitting a risk informed ISI program, the applicant or licensee should provide all information necessary to meet the other DSRS acceptance criteria in this SRP, including:
  - A. Components subject to inspection
  - B. Accessibility
  - C. Examination Categories and Methods
  - D. Inspection Intervals
  - E. Evaluation of Examination Results
  - F. System Pressure Tests
  - G. Structural Supports
  - H. Augmented ISI
  - I. Code Exemptions
  - J. Relief Requests
  - K. Code Cases
  - L. Proposed Implementation Milestones

As an alternative to the requirements of 50.55a, a risk-informed ISI program is acceptable if it clearly demonstrates one of the following:

- A. That the proposed alternative provides an acceptable level of quality and safety in comparison to the current requirements.
- B. Compliance with the current regulations would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Therefore, when describing each ISI program area, the applicant should include the following information for each case in which the program requirements are proposed as an alternative to the requirements of 10 CFR 50.55a or ASME Section XI:

- A. The requirement(s) for which the alternative is requested

- B. The proposed alternative(s)
- C. The basis for seeking authorization of the alternative

### 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. Consistent with the provisions of 10 CFR 50.65(a), GDC 1 and 10 CFR Part 50, Appendix B, as related to performance and condition monitoring requirements and quality assurance controls for inspections and testing, 10 CFR 50.55a, "Codes and Standards," requires, in paragraph (a)(1), that structures, systems, and components (SSCs) be designed, fabricated, erected, constructed, tested, inspected, and maintained to quality standards commensurate with the importance of the safety function to be performed. Throughout the service life of a pressurized water cooled nuclear power reactor, its Code Class 2 and Class 3 systems and components must meet the requirements of ASME Section XI and of the ASME OM Code. 10 CFR 50.55a(g) addresses inservice inspection requirements, and 10 CFR 50.55a(f) addresses inservice testing requirements. ASME Section XI defines, for each Code Class, the time interval for ISI, the scope of the inspection activity, the inspection sample, sample selection methodology, the method of inspection, the acceptance criteria for various types and sizes of material flaws identified during the inspection, and various other related technical details required for properly performing the required inservice inspection activity. Compliance with the requirements of 10 CFR 50.55a ensures that periodic inspections will be performed on all Class 2 and Class 3 components for the purpose of detecting incipient degradations, leakage, indications of mechanical or structural distress caused by aging, fatigue, and/or corrosion, prior to jeopardizing the ability of the affected systems or components to perform their intended safety functions. Periodic inservice testing (such as pressure, hydrostatic and leak tests) are addressed in the ASME Code requirements for Class 2 and 3 components at ASME Section XI, Articles IWC-5000 and IWD-5000; testing is also an alternative acceptance option for Code Class supports (excluding dynamic restraints) under ASME Section XI, Article IWF-1200. Inservice testing of Class 2 and 3 pumps, valves and dynamic restraints are addressed in the ASME OM Code and are reviewed under DSRS Section 3.9.6.
2. General Design Criteria 36, 37, 39, 40, 42, 43, 45, and 46 require that the respective safety-related or risk significant systems addressed by these criteria be designed such that they permit periodic inspection, pressure testing, and functional testing of system components and piping. Specific functional classes of components for each of the safety systems addressed are identified in the GDC. The ISI programs for Class 2 and Class 3 components rely upon these design provisions to allow performance of ISI and, where required, inservice testing. Compliance with these General Design Criteria ensures that the design of the safety systems will allow accessibility of important components so that periodic inspections can be performed that detect degradation, leakage, signs of mechanical or structural distress caused by aging, and fatigue or corrosion, prior to jeopardizing the ability of the systems to perform their intended safety-related or risk significant functions.

### 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 (SER) section.

3. Components Subject to Inspection. The applicant's component and system classifications, the corresponding proposed inspection or test requirements for each classification, and the proposed exceptions are reviewed for agreement with the acceptance criteria of Subsection II.1 of the DSRS Acceptance Criteria in this DSRS section as the basis for determining the acceptability of component inclusion in the ISI programs.
4. Accessibility. The design and arrangement of Class 2 and 3 systems are reviewed in terms of accessibility for ISI to establish that the design is in conformance with the acceptance criteria of Subsection II.2 of the DSRS Acceptance Criteria in this DSRS section. No remote inspection program is required for Code Class 2 or 3 components. Limitations due to design, materials of construction and geometry are to be eliminated to enable the performance of inservice examinations.
5. Examination Categories and Methods. The reviewer verifies that the examination categories and methods as described by the applicant's technical submittal are in conformance with the acceptance criteria in Subsection II.3 of the DSRS Acceptance Criteria in this DSRS section.

The reviewer verifies that the training and requalification requirements of the applicant's ISI programs are in conformance with applicable portions of ASME Section XI and/or the ASME OM Code, where the latter is applicable to the plant's Expert Panel for inservice testing. Qualification of personnel performing ultrasonic examinations should contain the elements of Appendix VII to ASME Section XI.

The reviewer verifies that the ultrasonic examination systems required by the applicant's ISI program meet the requirements of Appendix VIII to Division 1 of ASME Section XI in accordance with the implementation requirements of 10 CFR 50.55a.

The reviewer also verifies that an appropriate long-term monitoring program for potential wall-thinning of high-energy piping by erosion/corrosion, pursuant to Generic Letter 89-08 and NUREG-1344 has been incorporated into the ISI program.

6. Inspection Intervals. The ISI program for Class 2 and 3 components in the inservice testing program in the administrative controls of the plant technical specifications is reviewed to establish that each area and component in the program is inspected on a schedule in conformance with the acceptance criteria in Subsection II.4 of the DSRS Acceptance Criteria in this DSRS section.

7. Evaluation of Examination Results. The reviewer verifies that the applicant's technical submittal describes methods for evaluation of examination results in accordance with the acceptance criteria in Subsection II.5 of the DSRS Acceptance Criteria in this DSRS section.
8. System Pressure Test. The reviewer verifies that the applicant's technical submittal describes the system pressure test program in accordance with the acceptance criteria in Subsection II.6 of the DSRS Acceptance Criteria in this DSRS section.
9. Structural Supports: The reviewer verifies that the applicant's technical submittal describes the examinations or alternative tests for fixed structural supports of Class 2 and 3 SSCs in accordance with the acceptance criteria in Subsection II.7 of the DSRS Acceptance Criteria in this DSRS section. Dynamic restraints are reviewed under SRP Section 3.9.6.
10. Augmented ISI to Protect Against Postulated Piping Failures. The reviewer verifies that the applicant's technical submittal describes an augmented ISI program that meets the acceptance criteria identified in Subsection II.8 of the DSRS Acceptance Criteria in this DSRS section.
11. Code Exemptions. The reviewer verifies that the exemptions from Code examinations identified by the applicant or licensee are in accordance with the acceptance criteria identified in Subsection II.9 of the DSRS Acceptance Criteria in this DSRS section.
12. Relief Requests. There should not be a need for a DC or COL applicant to request relief from an ASME Section XI requirement based on limitations of the design, geometry, or materials of construction because any deficiencies should be addressed during the design stages. 10 CFR 50.55a requires that Class 2 and 3 components (including their supports) shall be designed and provided with access to perform preservice and inservice examinations in accordance with the ASME Code.
13. Operational Programs. The reviewer verifies that the Preservice Inspection and Inservice Inspection and testing programs are fully described and that implementation milestones have been identified. The reviewer verifies that the programs and implementation milestones are included in applicant's technical submittal Table 13.4-x.

Implementation of this program will be inspected in accordance with NRC Inspection Manual Chapter IMC-2504, "Construction Inspection Program - Non-ITAAC Inspections."

14. The reviewer verifies 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. 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 design control document (DCD).

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 or other NRC approvals (e.g., manufacturing license, site suitability report or topical report).

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

15. The reviewer assures that inspection of the containment in accordance with IWE/IWL is part of the operational program and is discussed either in this section or Section 3.8.
16. Risk informed ISI. The ISI program reviewer verifies that the applicant's (or licensee's) technical submittal describes a risk-informed ISI program that meets the acceptance criteria identified in Subsection II.13 of the DSRS Acceptance Criteria in this DSRS section. The PRA reviewer verifies the suitability of the probabilistic risk analyses and that risk insights have been appropriately implemented.

#### 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, 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. To ensure that no deleterious defects develop during service in ASME Code Class 2 and 3 system components, the reactor containment, selected welds and weld heat-affected zones are inspected prior to reactor startup and periodically throughout the life of the plant. In addition, Code Class 2 and 3 systems receive visual inspections while the systems are pressurized in order to detect leakage, signs of mechanical or structural distress, and corrosion.

The applicant (licensee) has stated that the inservice inspection and test (ISI) program will comply (complies) with the rules published in 10 CFR 50.55a, and ASME Section XI, ( ) Edition, including addenda through the ( ) Addenda. The ISI program will consist of a preservice inspection and test plan and an inservice inspection and test plan.

The staff concludes that the inservice inspection and test program is acceptable and meets the inspection and pressure/leak testing requirements of GDCs 36, 37, 39, 40, 42, 43, 45, and 46 and 10 CFR 50.55a. This conclusion is based on the applicant or licensee meeting the requirements of the ASME Boiler and Pressure Vessel Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," as reviewed, by the staff and determined to be appropriate for this application.

The applicant-described Preservice Inspection and Inservice Inspection and testing programs for Class 2 and 3 components and containment and implementation milestones in the applicant's technical submittal Table 13.4-x are in conformance with 10 CFR 50.55a, "Codes and Standards".

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 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 50.36, "Technical Specifications."
2. 10 CFR 50.55a, "Codes and Standards."
3. 10 CFR 50.65. " Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants. "

4. 10 CFR Part 50, Appendix A, GDC 1, "Quality Standards and Records."
5. 10 CFR Part 50, Appendix A, GDC 36, "Inspection of Emergency Core Cooling System"
6. 10 CFR Part 50, Appendix A, GDC 37, "Testing of Emergency Core Cooling System."
7. 10 CFR Part 50, Appendix A, GDC 39, "Inspection of Containment Heat Removal System."
8. 10 CFR Part 50, Appendix A, GDC 40, "Testing of Containment Heat Removal System."
9. 10 CFR Part 50, Appendix A, GDC 42, "Inspection of Containment Atmosphere Cleanup Systems."
10. 10 CFR Part 50, Appendix A, GDC 43, "Testing of Containment Atmosphere Cleanup Systems."
11. 10 CFR Part 50, Appendix A, GDC 45, "Inspection of Cooling Water Systems."
12. 10 CFR Part 50, Appendix A, GDC 46, "Testing of Cooling Water System."
13. 10 CFR Part 50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants."
14. 10 CFR 52.47, " Contents of applications; technical information."
15. 10 CFR 52.80, " Contents of applications; additional technical information."
16. RG 1.68, "Initial Test Programs for Water-Cooled Nuclear Power Plants."
17. RG 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants."
19. RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)."
20. RG 1.215, "Guidance for ITAAC Closure under 10 CFR Part 52."
21. NUREG-1344, "Erosion/Corrosion Induced Pipe Wall Thinning in U.S. Nuclear Power Plants."
22. NUREG-1430, Volume 1, "Standard Technical Specifications--Babcock and Wilcox Plants."
23. NRC Letter to All Holders of Operating Licenses or Construction Permits for Nuclear Power Plants, "Erosion/Corrosion-Induced Pipe Wall Thinning" (Generic Letter No. 89-08).
24. ASME Boiler and Pressure Vessel Code, Section III, "Rules for Construction of Nuclear Facility Components," Article NCA-2000, "Classification of Components," American Society of Mechanical Engineers.



- 25 ASME Boiler and Pressure Vessel Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," Division 1, "Rules for Inspection and Testing of Components of Light-Water Cooled Plants," American Society of Mechanical Engineers.
26. ASME Code for Operation and Maintenance of Nuclear Power Plants, Division 1, "Section IST: Rules for Inservice Testing of Light-Water Reactor Power Plants," American Society of Mechanical Engineers.
27. NRC Inspection Manual Chapter IMC-2504, "Construction Inspection Program - Inspection of Construction and Operational Programs," issued October 15, 2009.