U.S. NUCLEAR REGULATORY COMMISSION

DESIGN-SPECIFIC REVIEW STANDARD FOR mPOWER™ iPWR DESIGN

3.13 THREADED FASTENERS - ASME CODE CLASS 1, 2, AND 3

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of materials engineering issues related to flaw evaluation and welding

Secondary - None

I. AREAS OF REVIEW

This Design-Specific Review Standard (DSRS) section provides guidance for reviewing and evaluating the adequacy of an applicant's criteria in regard to selection of materials, design, inspection and testing of its threaded fasteners (i.e., threaded bolts, studs, etc.) prior to initial service and during service. The scope of this chapter is limited to the review of threaded fasteners in American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) Class 1, 2 or 3 systems. The staff's review in this DSRS chapter focuses on the information provided in Section 3.13 of the technical submittal or application.

The specific areas of review are as follows:

1. Design Aspects

A. Materials Selection

The staff reviews information pertaining to the selection of materials and material testing of threaded fasteners that are categorized as ASME Code Class 1, 2, or 3. The scope of the review includes material selection considerations and conformance with applicable codes or standards.

B. Mechanical Testing, Special Process and Controls

The staff reviews information in the safety analysis report (SAR) pertaining to the fabrication of threaded fasteners that have been selected for ASME Code Class 1, 2, and 3 systems. The scope of the review includes fabrication practices or special processes used to mitigate the occurrence of stress corrosion cracking (SCC) or other forms of material degradation in the fasteners during service.

The staff reviews information pertaining to the environmental considerations that should be accounted for when selecting materials of fabrication for threaded fasteners. The scope of the review includes any information in the SAR or submitted by the applicant that pertains to the use of lubricants and/or surface treatments in mechanical connections secured by threaded fasteners and the compatibility of these materials with the threaded fasteners.

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C. Fracture Toughness Requirements for Ferritic Materials

The staff reviews information pertaining to fracture toughness tests that are necessary for and performed on threaded fasteners that are made from ferritic steel materials (i.e., from carbon steel grades or low-alloy steel grades).

D. Fabrication Inspection

The staff reviews information to confirm that the appropriate Section III inspections for bolting, studs and nuts used in ASME Code Class 1, 2, or 3 applications are conducted.

E. Quality Records

The staff reviews information to confirm that the SAR indicates that the applicant is complying with the criteria of Section III of the ASME Code, Division 1 (henceforth Section III) regarding preparation of certified material test reports (CMTRs).

2. Preservice and Inservice Inspection Requirements

The staff reviews information to determine whether the applicant is complying with the preservice and inservice inspection requirements of Title 10 of the *Code of Federal Regulations* (CFR), 50.55a and conforming to the criteria of Section XI of the ASME Code, Division 1 (henceforth Section XI) for threaded-fastener assemblies (i.e., mechanical joints) in ASME Code Class 1, 2, and 3 systems.

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 DSRS section in accordance with 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.

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).

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 SRP and DSRS sections interface with this section as follows:

1. Review of the quality assurance program for ASME Code Class 1, 2, and 3 threaded fasteners is performed under SRP Section 17.5.

2. Review of the programs and procedures for material selection, fabrication, design, installation, testing, and inspection of structural bolting is performed under SRP Section 3.8.

3. Review of the programs for maintaining threaded fastener assemblies used in ASME Code Class 1, 2, and 3 systems and component supports and in core support structures is performed under SRP Section 13.5.2.2.

4. Review of the probabilistic risk assessment is performed under SRP Section 19.0.

II. ACCEPTANCE CRITERIA

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

1. 10 CFR Part 50, Appendix A, General Design Criteria (GDC) 1 and 30, as they relate to the requirement that SSCs important to safety be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety function to be performed;

2. GDC 4, as it relates to the compatibility of components with environmental conditions;

3. GDC 14, as it relates to the requirement that the reactor coolant pressure boundary (RCPB) be designed, fabricated, erected, and tested in a manner that provides assurance of an extremely low probability of abnormal leakage, rapidly propagating failure, or gross rupture;

4. GDC 31, as it relates to the requirement that the RCPB be designed with sufficient margin to ensure that when stressed under operating, maintenance, testing, and postulated accident conditions the boundary behaves in a nonbrittle manner and the probability of rapidly propagating fracture is minimized;

5. 10 CFR Part 50, Appendix B, as it relates to controlling the cleaning of material and equipment to prevent damage or deterioration;

6. 10 CFR Part 50, Appendix G, as it relates to materials testing and acceptance criteria for fracture toughness of reactor pressure boundary components;

7. 10 CFR 50.55a incorporates by reference the design criteria of ASME Code, Section III, Class 1, 2, and 3 components. The selection of materials, design, testing, fabrication, installation and inspection of threaded fasteners and mechanical joints are acceptable if they meet the criteria of the ASME Code, Section III, Class 1, 2, and 3 components. However, 10 CFR 50.55a(b)(4) permits use of code cases that have been adopted by the staff in Regulatory Guide (RG) 1.84 in lieu of applicable criteria of ASME Code, Section III, Class 1, 2, and 3 components;

8. 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 DC has been constructed and will be operated in conformity with the DC, the provisions of the Atomic Energy Act (AEA), and the U.S. Nuclear Regulatory Commission’s (NRC's) regulations;

9. 10 CFR 52.79(a)(11), which references 50.55a for COL applicants; and

10. 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 COL, the provisions of the AEA, and the NRC's 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. 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. Design Aspects

A. Materials Selection

The selection of materials used for the design of threaded fasteners is acceptable if the ASME Code, Section III criteria shown in Table 3.13-1 of this DSRS section are appropriately specified by the applicant for ASME Code Class 1, 2, and 3 systems.

B. Mechanical Testing, Special Process and Controls

The criteria for mechanical property testing of threaded fastener materials are provided in the particular ASME Code Section II, Part A, specification under which the material was procured. The material heat treatment and tensile test coupon preparation criteria for threaded fasteners that are fabricated from ferritic materials (i.e., carbon steel, low-alloy steel, quenched and tempered steel) are acceptable if the ASME Code, Section III criteria shown in Table 3.13-1 are appropriately specified by the applicant for ASME Code Class 1, 2, and 3 systems. The applicant should apply criteria of ASME Code Section III Subparagraphs NB-2200, NC-2200, ND-2200 rather than the criteria of the material specification applicable to the mechanical testing if there is a conflict between the two sets of criteria.

Lubricants and sealants in mechanical connections secured by threaded fasteners should be specified to ensure they are compatible with the threaded fasteners. Any mechanical joint using threaded fasteners should be designed to preclude galvanic corrosion.

C. Fracture Toughness Requirements for Ferritic Materials

The fracture toughness of ferritic bolts, studs, and nuts (i.e., made from either low-alloy steel or carbon steel materials) is acceptable if the ASME Code, Section III criteria shown in Table 3.13-1 are appropriately specified by the applicant for ASME Code Class 1, 2, and 3 systems. Ferritic bolts, studs, and nuts (i.e., bolts, studs, and nuts made from either low-alloy steel or carbon steel

materials) used in RCPB applications must also meet the fracture toughness requirements of 10 CFR Part 50, Appendix G.

D. Fabrication Inspection

The examination criteria for threaded fasteners are acceptable if the ASME Code, Section III criteria shown in Table 3.13-1 are appropriately specified by the applicant for ASME Code Class 1, 2, and 3 systems.

E. Quality Records

The applicant should provide assurance that the CMTRs will be retained in accordance with the requirements of 10 CFR 50.71. The CMTR should identify the material specification for which the material was procured along with the associated material properties tests (including fracture toughness tests) and inspections that apply to the particular material specification.

Table 3.13-1

ASME Section III Criteria for Selection and Testing of Bolting Materials [1]

Code Category		ASME Class 1 Criteria	ASME Class 2 Criteria	ASME Class 3 Criteria
Material Selection		NCA-1220 and NB-2128	NCA-1220 and NC-2128	NCA-1220 and ND-2128
Material Test Coupons and Specimens for Ferritic Steel Material (Tensile Test Criteria)	Heat Treatment Criteria	NB-2210	NC-2210	ND-2210
	Test Coupons Requirements Bolting/Stud Materials	NB-2221 NB-2224	NC-2221 NC-2224.3	ND-2221 ND-2224.3
Fracture Toughness Requirements	Material to be Impact Tested	NB-2311	NC-2311	ND-2311
	Types of Impact Test	NB-2321	NC-2321	ND-2321
	Test Coupons	NB-2322	NC-2322	ND-2322
	Acceptance Standards	NB-2333	NC-2332.3	ND-2333
	Number of Impact Tests Necessary	NB-2345	NC-2345	ND-2345
	Retesting	NB-2350	NC-2352	ND-2352
	Calibration of Test	NB-2360	NC-2360	ND-2360

Equipment			
Examination Criteria for Bolts, Studs, and Nuts	NB-2580	NC-2580	ND-2580
Certified Material Test Report Criteria	NCA-3860	NCA-3860	NCA-3860

Note 1: Section III paragraphs listed in this table represent those specified in the 2001 Edition of Section III. Corresponding paragraphs may vary in other Editions or Addenda of Section III.

Table 3.13-2

ASME Section XI Examination Categories for Inservice Inspections of Mechanical Joints in ASME Code Class 1, 2, and 3 Systems that Are Secured by Threaded Fastners [1]

Examination Type	ASME Class 1 Criteria	ASME Class 2 Criteria	ASME Class 3 Criteria
Specific Bolting Inspections	Table IWB-2500-1, Exam. Cat. B-G-1 for bolting greater than 2 inches in diameter	Table IWC-2500-1, Exam. Cat. C-D for bolting greater than 2 inches in diameter	Not Applicable - Currently there are no examination categories that correspond to those that exist for ASME Class 1 and 2 bolting.
	Table IWB-2500-1, Exam. Cat. B-G-2 for bolting less than or equal to 2 inches in diameter		
System Pressure Tests	Table IWB-2500-1, Exam. Cat. B-P	Table IWC-2500-1, Exam. Cat. C-H	Table IWD-2500-1, Exam. Cat. D-B

Note 1: Section XI paragraphs listed in this table represent those specified in the 2001 Edition of Section XI. Corresponding paragraphs may vary in other Editions or Addenda of ASME Section XI.

2. Preservice and Inservice Inspection Requirements

The preservice and inservice inspection provisions for mechanical joints are acceptable if the ASME Code, Section XI criteria shown in Table 3.13-2 are appropriately specified by the applicant for ASME Code Class 1, 2, and 3 systems.

For system pressure testing, the requirements of 10 CFR 50.55a(b)(2)(xxvii) for visual examination of certain insulated bolting or studs during system pressure testing should also be identified.

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. GDCs 1 and 30 require that SSCs important to safety be designed, fabricated, erected, tested and inspected to quality standards commensurate with the importance of the safety functions to be performed. GDC 14 requires that the RCPB be designed, fabricated, erected, and tested in a manner that provides assurance of an extremely low probability of abnormal leakage, rapidly propagating failure, or gross rupture. The RCPB provides a barrier to fission products, a confined volume for the inventory of reactor coolant, and flow paths to facilitate core cooling. Threaded fasteners and mechanical joints form an integral part of maintaining pressure boundary integrity and are essential for withstanding normal loading and any transient load created during abnormal or accident conditions. The failure of fasteners in a system could result in loss of fluid in the system and jeopardize safe operation of the plant. Conformance with criteria of the ASME Code, Section III and the regulatory positions of RG 1.65 satisfies, in part, the requirements of GDCs 1, 14, and 30 by providing assurance that threaded fasteners will be designed, fabricated, and tested to established and proven standards and, thereby, minimizing the likelihood of failure of the pressure boundary.

2. GDC 4 requires that SSC important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents. Therefore, mechanical connections using threaded fasteners should be protected against the detrimental effects of certain lubricants/sealants that promote corrosion and its vulnerability to boric acid corrosion.

3. GDC 31 requires that the RCPB be designed with sufficient margin to ensure that when stressed under operating, maintenance, testing, and postulated accident conditions the boundary behaves in a nonbrittle manner and the probability of rapidly propagating fracture is minimized. Appendix G to 10 CFR Part 50 establishes fracture toughness requirements for ferritic materials of pressure-retaining components of the reactor coolant pressure boundary to ensure that there are adequate margins of safety during any condition of normal operation, including anticipated operational occurrences and system hydrostatic tests, to which the pressure boundary may be subjected over its service lifetime. Threaded fasteners and mechanical joints are integral to the design of the RCPB. Application of the requirements of Appendix G ensures that threaded fasteners in the RCPB will behave in a nonbrittle manner, minimizing the probability of rapidly propagating fracture and thereby satisfying the requirements of GDC 31.

4. 10 CFR Part 50, Appendix B, Criterion XIII, requires that measures be established to control the cleaning of material and equipment to prevent damage or deterioration. RG 1.37 provides quality assurance criteria for cleaning fluid systems and associated components that ensure compliance with Appendix B. Application of the cleaning criteria in RG 1.37 to threaded fasteners provides assurance that contaminants to which they could be exposed will not damage or deteriorate the materials, alter their properties, accelerate effects associated with aging, or increase the susceptibility to failure mechanisms such as stress corrosion cracking. Application of these criteria reduces the likelihood that degradation of threaded fasteners could lead to loss of pressure boundary integrity.

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. In accordance with 10 CFR 52.47(a)(8),(21), and (22), for new reactor 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 that are identified in the version of NUREG-0933 current on the date 6 months before application and that 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). 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.

2. Design Aspects

   A. Materials Selection

      ASME Code, Section III provides acceptable standards for selecting threaded fastener materials identified in Section II of the ASME Code. Section II provided the material properties for threaded fasteners used in mechanical joints for ASME Code, Class 1, 2 and 3 applications. Table 3.13-1 lists the applicable criteria in ASME Code, Section III that pertain to the material selection for threaded fasteners in Class 1, 2, and 3 systems. In accordance with NB-2128, the use of washers is optional. If washers are used, they should be fabricated from wrought materials with mechanical properties that are compatible with the associated nuts.

      Class 1 Applications: ASME Code, Section III, Paragraphs NCA-1220 and NB-2128, provide the material selection criteria for threaded fasteners used in Class 1 applications. Paragraph NB-2128 provides that materials for Class 1 bolts and studs should conform to one of the specifications listed in Table 4 of ASME Section II, Part D, Subpart 1. The materials for nuts should conform to either SA-194 or to one of the specifications listed in Table 4 of ASME Code, Section II, Part D, Subpart 1. The applicant should, prior to determining the acceptability of proposed alternatives to the materials permitted in Table 4 of Subpart 1, perform a study of the suitability of the alternative materials selected for the threaded fasteners and compare with any precedents set forth and accepted in prior staff reviews. The reviewer should provide a rationale for accepting or rejecting any material that has been proposed as an alternative to the mandated material selection criteria.

      RG 1.65 provides an acceptable NRC position with respect to criteria for selecting materials for reactor vessel (RV) closure studs. The criteria of Position C.1 are consistent with, but more limited in scope, than the corresponding material specifications that are presented under ASME Section III, NB-2128.

      Class 2 and 3 Applications: ASME Code, Section III, Paragraphs NCA-1220 and NC-2128, provide the material selection criteria for threaded fasteners used in Class 2 applications. The criteria for selecting bolt materials for ASME Code Class 3 applications are specified in Paragraphs NCA-1220 and ND-2128. Paragraphs NC-2128 and ND-2128 provide that the bolting materials should conform to one of the specifications listed in Table 3 of ASME Section II, Part D, Subpart 1. The materials used for nuts should conform to either SA-194 or to one of the specifications listed in Table 3 of Subpart 1.

B. Mechanical Testing, Special Process and Controls

The criteria for mechanical property testing of threaded fastener materials are identified in the specification of ASME Code, Section II, Part A. The reviewer should verify that the applicant has specified the appropriate mechanical tests in accordance with Part A for each type of threaded fastener. Table 3.13-1 identifies the appropriate section of the ASME Code relative to material heat treatment and tensile test coupon preparation criteria for ferritic materials (i.e., carbon steel, low-alloy steel, quenched and tempered steel). The applicant should apply criteria of ASME Code, Section III, Subparagraphs NB-2200, NC-2200, ND-2200 rather than the criteria of the material specification applicable to the mechanical testing if there is a conflict between the two sets of criteria.

The reviewer should ensure that the applicant conforms to the recommendations in RG 1.65 for RV studs. The reviewer should also assess whether the applicant has implemented any special controls to ensure that the surface treats, plating applications, or use of lubricants on RV closure studs are compatible with the stud material at the anticipated operating temperature for the RCPB.

Lubricants and sealants in mechanical connections secured by threaded fasteners should be specified by the applicant to ensure maximum compatibility with the threaded fasteners. For example, molybdenum disulfide lubricant is known to promote corrosion in low alloy steel and should not be used. The applicant should provide the technical basis for the acceptability of lubricants or sealants, with reference to accepted industry practice, experience, and supporting data. The guidance for selection of lubricants is provided in NUREG-1339.

Any mechanical connection using threaded fasteners should be designed to preclude galvanic corrosion. The application should identify any differences in materials used in mechanical connections and include the technical basis for the compatibility of the materials used, with reference to accepted industry practice, experience, and supporting data.

The reviewer should ensure that the applicant conforms to the RG 1.37 quality assurance criteria for cleaning fluid systems and associated components. The reviewer should also confirm conformance to the practices noted in the RG 1.37 that are intended to minimize the probability that SCC will occur in components that are fabricated from either austenitic stainless steel or nickel-based alloys.

Additional information summarizing the initiatives of the NRC staff and the industry to address bolting degradation and failure issues in the United States can be found in References 4 through 9.

C. Fracture Toughness Requirements for Ferritic Materials

The reviewer should ensure that the fracture toughness properties of ferritic bolts, studs, and nuts (i.e., made from either low-alloy steel or carbon steel materials) will be attained in accordance with the ASME Code, Section III criteria for threaded fasteners used in ASME Code Class 1, 2, and 3 systems.

Class 1 Applications: The reviewer should verify that ferritic bolts, studs, and nuts (i.e., bolts, studs, and nuts made from either low-alloy steel or carbon steel materials) used in RCPB applications meet the fracture toughness requirements of 10 CFR Part 50, Appendix G. Section IV.A of Appendix G requires (in part)

that the fracture toughness values for these materials comply with the fracture toughness criteria for ferritic materials that are specified in Subarticle NB of ASME Code Section III (refer to column 2 of Table 3.13-1).

Class 2 and 3 applications: The fracture toughness requirements that are specified in 10 CFR Part 50, Appendix G, do not apply to ferritic bolts and studs used in Class 2 or 3 applications. However, since 10 CFR 50.55a invokes fracture toughness requirements in ASME Code, Section III, Subarticles NC and ND for ferritic bolting used in Class 2 and 3 applications, the reviewer should ensure that applicant specifies the appropriate Section III criteria (refer to Columns 3 and 4 of Table 3.13-1).

D. Fabrication Inspection

The reviewer should verify that the applicant has specified the appropriate ASME Code, Section III examination criteria for threaded fasteners used in ASME Code Class 1, 2, and 3 systems. Table 3.13-1 identifies the appropriate inspection criteria for bolts, studs and nuts. Under Section III, Paragraph NB-2580, the following fabrication inspections should be performed: (1) visual examinations of the threads, shanks, and heads in all bolts, nuts, and studs used in ASME Code Class 1 applications, (2) surface examinations (i.e., either liquid penetration examinations or, if the materials of fabrication are ferritic, magnetic particle examinations) of all Class 1 bolts, studs, and nuts that are larger than 1 inch in diameter, and (3) ultrasonic (UT) examinations for Class 1 bolts, studs, and nuts are larger than 2 inches in diameter and more comprehensive UT criteria if the bolts, studs, and nuts are larger than 4 inches in diameter.

E. Quality Records

The reviewer should ensure that the applicant commits to retaining the CMTRs in accordance with the requirements of 10 CFR 50.71. The reviewer should also confirm that the applicant commits to recording the results of its material chemistry tests (i.e., alloying elements) and physical property tests in applicable CMTRs, as provided in ASME Code, Section III.

3. Preservice and Inservice Inspection Requirements

The reviewer should ensure the applicant commits to complying with the preservice and inservice inspection requirements of 10 CFR 50.55a and the criteria of ASME Code, Section XI for threaded fasteners and mechanical joints used in ASME Code, Class 1, 2, and 3 systems.

The reviewer should verify that applicants for COLs commit to complying with the requirements of ASME Code, Section XI, IWA-5000 and the requirements of 10 CFR 50.55a(b)(2)(xxvi), “Pressure Testing Class 1, 2, and 3 Mechanical Joints” and Paragraph (xxvii), “Removal of Insulation.”

4. 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 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.

IV. EVALUATION FINDINGS

The reviewer verifies that the applicant has provided sufficient information and that the review and calculations (if applicable) support conclusions of the following type to be included in the staff's SER. The reviewer also states the bases for those conclusions.

1. The staff concludes that the selection of materials, design, inspection, testing and recording is in accordance with the ASME Code, Section II and III criteria for Code Class 1, 2 and 3 threaded fasteners and ensures application of quality standards commensurate with the importance of the safety functions to be performed. Application of these ASME Code criteria also provides assurance of an extremely low probability of abnormal leakage, rapidly propagating failure, or gross rupture. The applicant has conformed to these ASME Code criteria and the guidance in RG 1.65, and, therefore, meets the requirements of 10 CFR Part 50, Appendix A, as well as GDCs 1, 14, and 30.

2. The fracture toughness tests provided for in the ASME Code, as augmented by the requirements of Appendix G of 10 CFR Part 50, provide reasonable assurance that adequate safety margins against nonductile behavior or rapidly propagating fracture will be provided for threaded fastener materials used in ASME Code Class 1, 2 and 3 systems. The applicant has conformed to these criteria and, therefore, meets the requirements of 10 CFR 50.55a and GDC 31.

3. The applicant has identified special processes used for threaded fasteners. Since the applicant has certified that the materials and fabrication criteria of Section III of the ASME Code have been complied with, the staff considers the special processes used to be acceptable.

4. The threaded fastener materials are compatible with the materials of the components being joined. Lubricants and sealants are compatible with the materials of the components being joined and with the piping system fluids. Following the criteria of the ASME Code, Section III ensures that the level of general corrosion of threaded fasteners will be acceptable. The applicant has provided evidence of compatibility of threaded fasteners with the materials being joined and with the piping system fluids, as well as compliance with ASME Code criteria. Therefore, the applicant meets the requirements of GDC 4 relative to compatibility of components with environmental conditions.

5. The applicant’s controls to avoid contamination that could lead to SCC conform to the recommendations of RG 1.37. These controls satisfy the requirements of 10 CFR Part 50, Appendix B, Criterion XIII with respect to controls for cleaning of materials and components.

6. The staff concludes that the applicant’s preservice and inservice program for threaded fasteners is acceptable and meets the criteria of ASME Code, Section XI and the requirements of 10 CFR 50.55a.

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 DC, or 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 (Agencywide Documents Access and Management System Accession No. ML102510405), to develop risk-informed licensing review plans for each of the small modular reactor 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, or COL submitted pursuant to 10 CFR Part 52 to comply with 10 CFR 52.47(a)(9), "Contents of applications; technical information."

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^{TM} 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 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. ASME Boiler and Pressure Vessel Code, Sections II, III, and XI, 2001 Edition, American Society of Mechanical Engineers.

2. RG 1.37, "Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants," March 1973.

3. RG 1.65, "Materials and Inspections for Reactor Vessel Closure Studs," October 1973.

4. RG 1.84, "Design, Fabrication, and Materials Code Case Acceptability, ASME Section III."

5. Generic Letter No. 91-17, “Generic Safety Issue 29, Bolting Degradation or Failure in Nuclear Power Plants,” October 17, 1991.

6. NUREG-1339, “Resolution of Generic Safety Issue 29: Bolting Degradation or Failure in Nuclear Power Plants,” June 1990.

7. EPRI NP-5067, Volume I (Large Bolt Manual), “Good Bolting Practices - A Reference Manual for Nuclear Power Plant Maintenance Personnel,” 1987.

8. EPRI NP-5067, Volume II (Small Bolt Manual), “Good Bolting Practices - A Reference Manual for Nuclear Power Plant Maintenance Personnel,” 1990.

9. EPRI NP-5769, Volumes 1 and 2, “Degradation and Failure of Bolting in Nuclear Power Plants, Volumes 1 and 2,” April 1988.

10. 10 CFR Part 50, Section 50.55a, "Codes and Standards."

11. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Plants."

12. 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants."

13. 10 CFR Part 50, Appendix G, "Fracture Toughness Requirements."