U.S. NUCLEAR REGULATORY COMMISSION

DESIGN-SPECIFIC REVIEW STANDARD for NuScale SMR DESIGN

3.11 ENVIRONMENTAL QUALIFICATION OF MECHANICAL AND ELECTRICAL EQUIPMENT

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of environmental qualification of electrical equipment

Secondary - Organization responsible for the review of instrumentation and control systems

Organization responsible for the review of environmental qualification of mechanical equipment

I. AREAS OF REVIEW

The information presented in Section 3.11 of the final safety analysis report (FSAR) should be sufficient to support the conclusion that all items of equipment that are important to safety (mechanical, electrical, and instrumentation and control (I&C), including digital I&C) are capable of performing their design safety functions under all normal environmental conditions, anticipated operational occurrences, and accident and postaccident environmental conditions. The information included in Section 3.11 of the FSAR also includes all environmental conditions that may result from any normal mode of plant operation, anticipated operational occurrences, design-basis events (as defined in Title 10 of the *Code of Federal Regulations* (10 CFR) 50.49(b)(1)(ii)), post-design-basis events, and containment tests.

The review will be performed to assure conformance with the environmental design-basis requirements of 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," Appendix A, "General Design Criteria for Nuclear power Plants," General Design Criterion (GDC) 4, "Environmental and Dynamic Effects Design Bases," which states, in part, that "Structures, systems, and components 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." The review will assure conformance with the applicable portions of other relevant regulations, including 10 CFR Part 50, Appendix A, GDC 1, "Quality Standards and Records"; GDC 2, "Design Bases for Protection Against Natural Phenomena"; and GDC 23, "Protection System Failure Modes"; and 10 CFR Part 50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," Quality Assurance Criteria III, "Design Contol"; XI, "Test Control"; and XVII, "Quality Assurance Records."

In 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants," the U.S. Nuclear Regulatory Commission (NRC) established specific requirements for the environmental qualification (EQ) of certain electric equipment important to safety located in a "harsh" environment. The NRC stated in 10 CFR 50.49 that EQ of electric equipment located in a "mild" environment was not included within the scope of 10 CFR 50.49. The regulation defined a "mild" environment as an environment that would at no time be significantly more severe than the environment that would occur during normal plant operation, including anticipated operational occurrences. The review under this design-specific review

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standard (DSRS) section assures conformance to 10 CFR 50.49 for the EQ of electrical equipment important to safety that is located in a harsh environment.

For mechanical equipment located in a harsh environment, compliance with the environmental design provisions of GDC 4 are generally achieved by demonstrating that the nonmetallic parts and components of the equipment are suitable for the postulated design-basis environmental conditions.

For electrical and mechanical devices located in mild environments, compliance with the environmental design provisions of GDC 4 are generally achieved and demonstrated by proper incorporation of all relevant environmental conditions into the design process, including the equipment specification. The NRC regulations in Appendix A to 10 CFR Part 50 require that structures, systems, and components (SSCs) important to safety be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed. Appendix A to 10 CFR Part 50 also requires that a quality assurance (QA) program be established and implemented to provide adequate assurance that these SSCs will satisfactorily perform their safety functions. Appendix B to 10 CFR Part 50 specifies criteria for the QA program to provide adequate confidence that SSCs will perform their safety-related functions satisfactorily in service.

In SECY-02-0067, "Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) for Operational Programs (Programmatic ITAAC)," the NRC staff recommended that combined license (COL) applications for nuclear power plants submitted in accordance with the requirements of 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," contain ITAAC for operational programs required by regulations to the extent that such ITAAC are necessary and sufficient to support the finding that the facility has been constructed and will be operated in conformity with the license, the provisions of the Atomic Energy Act (AEA), and the Commission's rules and regulations.

In SECY-04-0032, "Programmatic Information Needed for Approval of a Combined License Without Inspections, Tests, Analyses, and Acceptance Criteria," the NRC staff provided recommendations to the Commission regarding the level of programmatic information needed for approval of a COL without ITAAC for operational programs. In the staff requirements memorandum (SRM) to SECY-04-0032, dated May 14, 2004, the Commission stated that " fully described' [for an operational program] should be understood to mean that the program is clearly and sufficiently described in terms of the scope and level of detail to allow a reasonable assurance finding of acceptability." The Commission noted that "required [operational] programs should always be described at a functional level and at an increased level of detail where implementation choices could materially and negatively affect the program effectiveness and acceptability." The Commission also stated that the staff should continue the practice of inspecting relevant licensee procedures and programs in a similar manner as was done in the past and consistent with applicable inspection programs. The staff should also continue to ensure, consistent with the inspection and enforcement processes, that licensees address pertinent issues before fuel loading.

The NRC staff discussed the Commission's position on operational programs for COL applications in SECY-05-0197, "Review of Operational Programs in a Combined License Application and General Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria." In SECY-05-0197, the NRC staff describes operational programs for new nuclear power plants as programs that are required by regulation, are reviewed by the NRC staff for acceptability with the results documented in the safety evaluation report (SER), and will be verified for implementation by NRC inspectors. For example, SECY-05-0197 specifies the EQ program as an operational program. The description of the program should contain the

information necessary for the staff to make a reasonable assurance finding on the acceptability of the operational program in the review of a COL application. The staff proposed license conditions to provide certainty as to when the operational programs are scheduled to be implemented, which are described in SECY-05-0197.

As discussed, COL applicants are responsible for providing a full description of the EQ operational program. The design certification (DC) applicant may include information in its design control document (DCD) or FSAR on the EQ operational program for use by the COL applicant in developing the operational program. The NRC reviews the information provided by the DC applicant in its DCD or FSAR for acceptability for reference by COL applicants. In that operational program, descriptions are the responsibility of the COL applicant; the operational program information in the DCD or FSAR provided by the DC applicant will not receive finality per 10 CFR 52.63, “Finality of Standard Design Certifications.”

In their FSARs, COL applicants may incorporate by reference the description of the EQ program provided in the DCD or FSAR submitted by the DC applicant with supplemental information or departures. The NRC reviews the program description provided in the DC DCD/FSAR for acceptability for reference by COL applicants in preparing the SER on the DC application. The NRC then reviews the program description provided in the COL FSAR in preparing its SER on the COL application. Therefore, the full description of the EQ program is provided by the combination of the DC DCD/FSAR and the COL FSAR,

Other sections of the DSRS or NUREG–0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants” (SRP), such as SRP Section 3.10, contain reviews to determine compliance with related requirements for (1) dynamic and seismic qualification of electrical and mechanical equipment, (2) protection of electric and mechanical equipment against other natural phenomena and external events, (3) functional qualification of mechanical equipment, (4) equipment survivability for the length of time for which its function is required, and (5) qualification of I&C equipment located in mild environments.

The specific areas of review are as follows:

1. Mechanical, electrical, and I&C equipment associated with systems described in this paragraph are reviewed to determine whether they are designed to meet the acceptance criteria described in this DSRS section. Mechanical, electrical, and I&C equipment covered by this DSRS section include the following:

    A. equipment associated with systems that are essential for emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or otherwise are essential in preventing significant release of radioactive material to the environment

    B. equipment that initiates the above functions automatically

    C. equipment that is used by the operators to initiate the above functions manually

    D. equipment the failure of which can prevent the satisfactory accomplishment of one or more of the above safety functions

    E. other electrical equipment important to safety, as described in 10 CFR 50.49(b)(1) and (2)

F. postaccident monitoring equipment, as described in 10 CFR 50.49(b)(3) and Regulatory Guide 1.97, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants."

2. Section 3.11 of the SAR or the DCD is reviewed to determine whether the required environmental design and qualification of all equipment important to safety will be, or has been, adequately demonstrated. The term "environmental qualification" means verification of design, limited to demonstrating that electrical, mechanical, or I&C equipment is capable of performing its safety functions under significant environmental stresses (i.e., harsh environments) resulting from design-basis events to avoid common-cause failure. Environmental design requirements apply to all equipment important to safety (i.e., in both mild and harsh environments).

3. The staff's DC review consists of evaluating the description of the applicant's EQ program (i.e., approach and methodology) for selecting and identifying mechanical, electrical, and I&C equipment important to safety (i.e., providing the equipment list) required to be environmentally qualified for the certified design for compliance with 10 CFR Part 50, Appendices A and B, and 10 CFR 50.49, as applicable, and specifying how long its function will be required. For a COL applicant, the staff reviews the incorporation by reference of the EQ provisions for mechanical, electrical, and I&C equipment important to safety in the DC DCD and FSAR. The staff also reviews the description of the COL program for the site-specific EQ for electrical, mechanical, and I&C equipment important to safety.

4. The NRC regulations in 10 CFR 52.47, "Contents of Applications; Technical Information," state that the Commission will require, before DC, that information normally contained in certain procurement specifications and construction and installation specifications be completed and available for audit, if the information is necessary for the Commission to make its safety determination. Based on its experience with the review of other DC applications, the staff has determined that an audit of design and procurement specifications is necessary to make its safety determination. Therefore, the staff will conduct an audit of the procurement specifications, as discussed in the introductory paragraph of 10 CFR 52.47 for the EQ of mechanical and electrical equipment. This audit could be conducted as part of the review of the COL application, if the NRC staff's reviews of the DC application and initial COL application are underway at the same time.

5. Operational Program Description and Implementation. The staff reviews the full description of the equipment qualification operational program consistent with the guidance in SECY-05-0197. The staff also reviews FSAR Section 13.4, "Operational Program Implementation," to ensure that the EQ program and associated implementation milestones are included.

6. Inspections, Tests, Analyses, and Acceptance Criteria. For DC and COL applications, the staff reviews the applicant's proposed ITAAC associated with the 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.

7. COL Action Items and Certification Requirements and Restrictions. For a DC application, the review will address COL action items (referred to as COL license

information in certain DCs) and additional certification requirements and restrictions (e.g., interface and site-specific information).

For a COL application referencing a DC, a COL applicant must address COL action items included in the referenced DC. Additionally, a COL applicant must address additional requirements (i.e., interface and site-specific information) identified in the referenced DC.

8. Application of Risk Insights. The NRC regulations in 10 CFR 52.47(a)(27) and 10 CFR 52.79(a)(46) require DC and COL applicants, respectively, to submit a description of the plant-specific probabilistic risk assessment and its results in their applications. The NRC staff may incorporate risk insights into the review of DC and COL applications. When applying risk insights in its application review, the applicable technical branch of the NRC's Office of New Reactors will focus its review on components important to safety categorized as having high risk significance. For components categorized as having low risk significance, the staff will rely on the applicant's certification of component qualification (provided by the manufacturer) and programmatic requirements to provide reasonable confidence that the components satisfy their environmental design requirements, with confirmation of compliance with those regulatory requirements through ITAAC verification and inspection activities.

Review Interfaces

Other DSRS sections interface with this section as follows:

1. Review of the adequacy of the design, installation, inspection, and testing of containment systems is performed under DSRS Sections 6.2.1, 6.2.2, 6.2.4, 6.2.5,6.2.6, and SRP Section 6.2.3.

2. Review of the adequacy of the design, installation, inspection, and testing of the decay heat removal system, the emergency core cooling system, and the accident analysis is performed under DSRS Sections 5.4.7 and 6.3, and the applicable sections of Chapter 15, respectively.

3. Review of the adequacy of the design, installation, inspection, and testing of I&C equipment is performed under DSRS Chapter 7.

4. Review of the adequacy of the design, installation, inspection, and testing of electric power systems is performed under DSRS Chapter 8.

5. Review of the applicant's QA program to verify that it satisfies the requirements of 10 CFR Part 50, Appendix B, Criteria III, XI, and XVII, is performed under SRP Chapter 17.

6. Review of design-basis radiological consequence analyses associated with design-basis accidents is performed under DSRS Section 15.0.3.

7. The functional design and qualification of mechanical, electrical, and I&C equipment are addressed in several sections of DSRS and SRP Chapter 3:

   A. SRP Section 3.9.5 includes an evaluation of potential adverse flow effects on mechanical and electrical equipment from pressure fluctuations and vibration caused by acoustic resonances and hydrodynamic forces.

B. SRP Section 3.9.6 includes the functional design and qualification of pumps, valves, and dynamic restraints at a nuclear power plant. The review includes the potential impact of adverse environmental conditions on active mechanical and electrical equipment. For example, electric motors might produce less torque under high temperature conditions than under ambient conditions, which could affect their capability to operate their individual pumps or valves.

C. The design bases for the protection of mechanical and electrical equipment against natural phenomena and external events are reviewed under appropriate sections of SRP Chapter 3 (e.g., 3.3.1, 3.3.2, 3.4.1, 3.5.1.1, 3.5.1.4, 3.5.1.5, and 3.5.2). SRP Section 3.10 includes the seismic and dynamic qualification of mechanical and electrical equipment.

8. Review of the adequacy of equipment functional performance during and after being exposed to the environmental conditions resulting from the release of hydrogen generated by the equivalent of a 100 percent fuel-clad metal-water reaction, as stated in 10 CFR 50.44(c), is performed under DSRS Section 6.2.5.

9. For COL reviews of operational programs, the applicant's implementation plan is performed under SRP Section 13.4, "Operational Program Implementation."

10. Review of the types of radiation and the radiation environment used to determine the total dose expected during normal operation over the installed life of the equipment, consistent with 10 CFR 50.49(e)(4), and identification of the kinds and quantities of radioactive materials expected to be produced in the operation, consistent with 10 CFR 50.34(b)(3), 10 CFR 52.47(a)(5), 10 CFR 52.79(a)(3), and 10 CFR 52.157(e), are performed under DSRS and SRP Chapter 12.

II. ACCEPTANCE CRITERIA

Requirements

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

1. 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants."

2. 10 CFR Part 50, Appendix A, General Design Criterion (GDC) 1

3. 10 CFR Part 50, Appendix A, GDC 2, "Design Bases for Protection Against Natural Phenomena."

4. 10 CFR Part 50, Appendix A, GDC 2

5. GDC 4, "Environmental and Dynamic Effects Design Bases."

6. 10 CFR Part 50, Appendix A, GDC 23, "Protection System Failure Modes."

7. 10 CFR Part 50, Appendix B, Criterion (Criterion) III"Design Control"

8. 10 CFR Part 50, Appendix B, Criterion XI, "Test Control."

9. 10 CFR Part 50, Appendix B, Criterion XVII, "Quality Assurance Records."

10. 10 CFR 52.47, which states that "the Commission will require, before design certification, that information normally contained in certain procurement specifications and construction and installation specifications be completed and available for audit if the information is necessary for the Commission to make its safety determination."

11. 10 CFR 52.79(a)(10), which references establishing a program for qualifying the electrical equipment per 10 CFR 50.49(a) for COL applicants

12. 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 AEA, and the NRC's regulations

13. 10 CFR 50.34(b)(3), 10 CFR 52.47(a)(5), 10 CFR 52.79(a)(3), and 10 CFR 52.157(e), which require the applicant to describe the types and quantities of radiation used to determine the total dose expected during normal operation over the installed life of the equipment, and the radiation environment associated with the most severe design-basis accident during or following which, the equipment is required to remain functional, including the radiation resulting from recirculating fluids for equipment located near the recirculating lines and including dose-rate effects

14. The general requirement for environmental design and qualification of mechanical, electrical, and I&C equipment important to safety can be summarized as follows: Appendix A to 10 CFR Part 50 provides an overall requirement that mechanical, electrical, and I&C equipment important to safety shall be designed to have the capability of performing its design safety functions under all anticipated operational occurrences and normal, accident, and postaccident environments, and for the length of time for which its function is required. The NRC regulations in 10 CFR 50.49 provide specific requirements that the EQ of certain electric equipment located in a harsh environment be demonstrated by appropriate testing, or a combination of testing and analyses, and by maintaining all qualification records for the operational life of the plant. Appendix B to 10 CFR Part 50 requires that a QA program be established and implemented to provide assurance that the applicable requirements for environmental design and qualification of all safety-related mechanical, electrical, and I&C equipment have been satisfactorily accomplished. The environmental design and qualification of mechanical, electrical, and I&C equipment is acceptable when it can be ascertained that these requirements have been met.

DSRS Acceptance Criteria

Specific DSRS acceptance criteria that 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.

If the NRC staff has endorsed a referenced standard in a regulatory guide, that standard constitutes an acceptable method for use in meeting the related regulatory requirement, as

described in the regulatory guide. If a referenced standard has not been endorsed in a regulatory guide, licensees and applicants may consider and use the information in the referenced standard, if appropriately justified, consistent with current regulatory practice.

1. Regulatory Guide 1.89 provides the principal guidance for implementing the requirements and criteria of 10 CFR 50.49 for the EQ of electrical equipment that is important to safety and located in a harsh environment. However, certain NUREG-0588 Category I guidance may be used if relevant guidance is not provided in Regulatory Guide 1.89. NUREG–0588 includes two sets of qualification criteria, Category I and Category II. Category I refers to IEEE Std. 323-1974, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations." Category II refers to IEEE Std. 323-1971 and is not applicable to any future plants.

2. IEEE Std. 323-1974 contains the principles and criteria that are generic to the EQ process. The following clarification related to the criteria in IEEE Std. 323 should be considered. IEEE Std. 323 requires that the service environment, including the installed configuration of the equipment, be considered as part of the qualification process. In meeting this requirement, the potential for flooding of electrical equipment installed above the flood level but subject to water and moisture intrusion, should be considered as part of EQ. Operating experience (e.g., Information Notice 89-63) shows that electrical enclosures that are located above the flood level and are subject to water and moisture intrusion could result in the submergence of electrical components inside the enclosures, if the enclosures do not have drainage holes. The reviewer should confirm that equipment in such locations, the design of which could allow water accumulation, should have measures to preclude such accumulation (e.g., enclosure drain holes), or the affected equipment should be qualified for the anticipated submergence.

3. Regulatory Guide 1.63, "Electrical Penetration Assemblies in Containment Structures for Nuclear Power Plants," endorses IEEE Std. 317-1983, "IEEE Standard for Electric Penetration Assemblies in Containment Structures for Nuclear Power Generating Stations." These documents contain general guidance that is acceptable to the staff for the environmental design and qualification of electrical penetration assemblies and should be used in conjunction with NUREG-0588 and Regulatory Guide 1.89, as appropriate, for evaluating the environmental design and qualification of electrical penetration assemblies.

4. Regulatory Guide 1.73, "Qualification Tests for Safety-Related Actuators in Nuclear Power Plants," endorses IEEE Std. 382-2006, "Standard for Qualification of Safety-Related Actuators for Nuclear Power Generating Stations." These documents contain guidance acceptable to the staff for the environmental design and qualification of Class 1E electric valve operators and should be used in conjunction with NUREG-0588 and Regulatory Guide 1.89, as appropriate, for evaluating the environmental design and qualification of Class 1E electric valve operators.

5. Regulatory Guide 1.89, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants," provides guidance for implementing the requirements and criteria of 10 CFR 50.49 for the EQ of electrical equipment that is important to safety and located in a harsh environment. Regulatory Guide 1.89 endorses the provisions of IEEE Std. 323 as being acceptable to the staff and provides guidance for satisfying the Commission's regulations regarding the EQ of electrical equipment located in a harsh environment.

6. Regulatory Guide 1.97 provides guidance acceptable to the staff for the EQ of the postaccident monitoring equipment described in Subsection I, Item 1(F), of this DSRS

section, as well as instruments and controls for the equipment described in Subsection I, Items 1(A) to 1(E), of this DSRS section. These criteria, as supplemented by those of RG 1.89, should be used to evaluate the EQ of the I&C equipment.

7. RG 1.152, "Criteria for Use of Computers in Safety Systems of Nuclear Power Plants," endorses IEEE Std. 7-4.3.2-2003, "Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations," with the exception of Annexes B–F. These documents contain guidance acceptable to the staff for the environmental design and qualification of computer-specific requirements and should be used in conjunction with NUREG-0588 and Regulatory Guide 1.89, as appropriate, for evaluating computer-specific requirements.

8. RG 1.153, "Criteria for Safety Systems," endorses IEEE Std. 603-1991, "Criteria for Safety Systems for Nuclear Power Generating Stations." These documents contain guidance acceptable to the staff for the environmental design and qualification of power, instrumentation, and control portions of the safety systems and should be used in conjunction with NUREG-0588 and Regulatory Guide 1.89, as appropriate, for evaluating power, instrumentation, and control portions of the safety systems.

9. RG 1.209, "Guidelines for Environmental Qualification of Safety-Related Computer-Based Instrumentation and Control Systems in Nuclear Power Plants," endorses, with some exceptions, IEEE Std. 323-2003, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations." These documents contain guidance acceptable to the staff for the environmental design and qualification of safety-related computer-based I&C systems in mild environments and should be used in conjunction with NUREG-0588 and Regulatory Guide 1.89, as appropriate, for satisfying the EQ of safety-related, computer-based I&C systems.

10. RG 1.211, "Qualification of Safety-Related Cables and Field Splices for Nuclear Power Plants" replaces RG 1.131, "Qualification Tests of Electric Cables and Field Splices for Light-Water-Cooled Nuclear Power Plants." RG 1.211 endorses, with some exceptions, IEEE Std. 383-2003, "IEEE Standard for Qualifying Class 1E Electric Cables and Field Splices for Nuclear Power Generating Stations." These documents contain guidance acceptable to the staff for the EQ of Class 1E electric cables and field splices and should be used in conjunction with NUREG-0588 and Regulatory Guide 1.89, as appropriate, for evaluating the EQ of Class 1E electric cables and field splices.

11. Regulatory Guide 1.156, "Qualification of Connection Assemblies for Nuclear Power Plants," endorses IEEE Std 572-2006, "IEEE Standard for Qualification of Class 1E Connection Assemblies for Nuclear Power Generating Stations." These documents contain guidance acceptable to the staff for the EQ of Class 1E connection assemblies and should be used in conjunction with NUREG-0588 and Regulatory Guide 1.89, as appropriate, for evaluating the EQ of Class 1E connection assemblies.

12. Regulatory Guide 1.158, "Qualification of Safety-Related Lead Storage Batteries for Nuclear Power Plants," endorses IEEE Std 535-1986, "IEEE Standard for Qualification of Class 1E Lead Storage Batteries for Nuclear Power Generating Stations." These documents contain guidance acceptable to the staff for the EQ of Class 1E lead storage batteries and should be used in conjunction with NUREG-0588 and Regulatory Guide 1.89, as appropriate, for evaluating the EQ of lead storage batteries.

13. Regulatory Guide 1.180, "Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems," provides guidance acceptable to the staff for determining electromagnetic compatibility

for I&C equipment during service. These criteria, as supplemented by those of Regulatory Guide 1.89, should be used to evaluate the environmental design and qualification of safety-related I&C equipment. New digital systems and new advanced analog systems may require susceptibility testing for electromagnetic interference/radio-frequency interference (EMI/RFI) and power surges, if the environments are significant to the equipment being qualified. DSRS Chapter 7 contains the functional descriptions of I&C equipment.

14. Regulatory Guide 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," provides guidance acceptable to the staff for determining the radiation dose and dose rate for equipment during normal operation and postulated accident conditions. These criteria, as supplemented by those of Regulatory Guide 1.89, should be used to evaluate the accident source term used in the environmental design and qualification of equipment important to safety.

    Radiation dose and dose rate used to determine the radiation environment for qualification of electrical and mechanical equipment must be based on an NRC staff-approved source term and methodology. This is discussed in NUREG-0588 and as supplemented by Section II.B.2 of NUREG-0737, "Clarification of TMI Action Plan Requirements," and NUREG-0718, "Licensing Requirements for Pending Applications for Construction Permits and Manufacturing License," or as discussed in NUREG-1465, "Accident Source Terms for Light-Water Nuclear Power Plants." The radiation environment should be based on the integrated effects of the normally expected radiation environment over the equipment's installed life, plus the effects associated with the most severe design-basis event during or following which the equipment is required to remain functional. The effects of beta radiation should be considered in the qualification process. The effects of radiation exposure due to recirculatory fluid must be considered for equipment located outside the containment.

    The staff's definition of what constitutes a mild radiation environment for electronic components, such as semiconductors or electronic components containing organic material, differs from that for other equipment. The staff's position, as stated in NUREG-1503, "Final Safety Evaluation Report Related to the Certification of the Advanced Boiling Water Reactor Design," and NUREG–1793, "Final Safety Evaluation Report Related to Certification of the AP1000 Standard Design," is that a mild radiation environment for electronic equipment is a total integrated dose less than 10 gray (Gy) (1E3 rad), and a mild radiation environment for other equipment is less than 100 Gy (1E4 rad).

    EQ for electrical equipment located in a "radiation-harsh" environment (i.e., locations where radiation is the only harsh environmental condition) can be accomplished in accordance with 10 CFR 50.49(f)(4) using an analysis of test data (from identical materials) combined with radiation test information (i.e., partial test data), and appropriate consideration of margin and aging effects for nonmetallic components and materials when sufficient documentation is available to preclude the need for a type test. Equipment subject to being submerged is identified, consistent with the requirements of 10 CFR 50.49(e)(6). Consistent with 10 CFR 50.49(e)(7), synergistic effects must be considered when these effects are believed to have a significant effect on equipment performance.

15. RG 1.100, Revision 3, "Seismic Qualification of Electrical and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants," endorses, with some exceptions and clarifications, American Association of Mechanical Engineers (ASME) Standard QME-1-2007, "Qualification of Active

Mechanical Equipment Used in Nuclear Power Plants," which includes provisions for the functional design and qualification of active mechanical equipment in nuclear power plants. QME-1-2007, Appendix QR-B, "Guide for Qualification of Nonmetallic Parts," recommends a methodology and describes the documentation that should be available to demonstrate the qualification of nonmetallic parts, materials, or lubricants. It addresses the steps for the user of active mechanical equipment to follow to qualify and maintain the qualification of nonmetallic material that is part of active mechanical equipment. The NRC staff considers Nonmandatory Appendix QR-B to provide a reasonable approach to the qualification of nonmetallic material in active mechanical equipment. As stated in RG 1.100, "when a licensee commits to the use of non-mandatory appendices in ASME QME-1-2007 [such as Appendix QR-B] for its qualification of active mechanical equipment in NPPs, then the criteria and procedures delineated in [Appendix QR-B] become part of the basis for its qualification program, unless specific deviations are requested and justified."

16. RG 1.204, "Guidelines for Lightning Protection of Nuclear Power Plants," provides guidance acceptable to the staff for determining the environmental design and qualification of the lightning protection system.

17. Environmental design means that components shall be designed to accommodate the effects of environmental conditions for all equipment important to safety located in both mild and harsh environments, in accordance with 10 CFR Part 50, Appendix A. In that a mild environment is defined in 10 CFR 50.49 as an environment that would at no time be significantly more severe than the environment that would occur during normal plant operation, including anticipated operational occurrences, equipment located in a "mild" environment might be subjected to significant environmental conditions during normal plant operation that must be addressed in meeting the environmental design criteria in 10 CFR Part 50, Appendix A. The NRC regulations in 10 CFR 50.49 specify EQ requirements to verify the design by test or a combination of test and analysis for certain electric equipment important to safety located in harsh environments.

18. Mechanical components important to safety must be designed to be compatible with postulated environmental conditions, including those associated with loss-of-coolant accidents (LOCAs) in compliance with 10 CFR Part 50, Appendix A. Under Appendix B to 10 CFR Part 50, a process must be established to determine the suitability of materials, parts, and equipment that are essential to safety-related functions. Also, environmental design records for safety-related mechanical equipment must be maintained in accordance with 10 CFR Part 50, Appendix B, and these records must include the results of tests and material analyses used as part of the environmental design process for each mechanical component.

    For mechanical equipment, the staff concentrates its review on materials that are sensitive to environmental effects (e.g., seals, gaskets, lubricants, fluids for hydraulic systems, and diaphragms). The reviewer confirms that the applicant has (1) identified safety-related mechanical equipment located in harsh or mild environment areas and the operation time for equipment located in harsh environment areas, (2) identified nonmetallic subcomponents of such equipment, (3) identified the environmental conditions and process parameters for which this equipment must be qualified, (4) identified nonmetallic material capabilities, and (5) evaluated environmental effects.

19. Appendix QR-B, "Guide for Qualification of Nonmetallic Parts," of ASME QME-1-2007 as accepted in RG 1.100 (Revision 3) provides a methodology and documentation of records that the staff finds acceptable to demonstrate that nonmetallic parts of mechanical equipment are designed to accommodate the effects of environmental

conditions. The environmental design of nonmetallic parts for mechanical equipment shall consider both the external and internal service conditions of the component. The applicant should apply ASME QME-1-2007, Appendix QR-B, as accepted in RG 1.100 (Revision 3), or describe a suitable alternative in its application for NRC staff review.

20. For electrical and mechanical equipment important to safety located in a mild environment, the applicant might describe a process in its DCD/FSAR for environmental design through "design/purchase" specifications that demonstrate the capability of the equipment to perform under its applicable environmental conditions in compliance with 10 CFR Part 50, Appendix A. The specifications must contain a description of the functional requirements for a specific environmental zone during normal environmental conditions and anticipated operational occurrences. A certificate of compliance from the manufacturer provides documentation that the equipment is capable of performing its design function under the applicable environmental conditions.

21. The applicable documentation for the environmental design and qualification of safety-related mechanical, electrical, and I&C equipment must be in accordance with the QA program per 10 CFR Part 50, Appendix B, and 10 CFR 50.49(j).

22. A well-supported maintenance/surveillance program, in conjunction with a good preventive maintenance program, is needed to provide assurance that the environmental design and qualification status of equipment in both mild and harsh environments will be maintained during the operational life of the plant.

    The applicant should specify in its DCD/FSAR that the EQ operational program shall contain the following aspects specific to the EQ of mechanical and electrical equipment: (1) evaluation of EQ results to establish activities to support continued EQ for the entire time an item is installed in the plant, (2) determination of surveillance and preventive maintenance activities based on EQ results, (3) consideration of EQ maintenance recommendations from equipment vendors, (4) evaluation of operating experience in developing surveillance and preventive maintenance activities for specific equipment, (5) development of plant procedures that specify individual equipment identification, appropriate references, installation requirements, surveillance and maintenance requirements, postmaintenance testing requirements, condition monitoring requirements, replacement part identification, and applicable design changes and modifications, (6) development of plant procedures for reviewing equipment performance and EQ operational activities, and for trending the results to incorporate lessons learned through appropriate modifications to the EQ operational program, and (7) development of plant procedures for the control and maintenance of EQ records.

23. For COL reviews, Section 13.4 of the FSAR, "Operational Program Implementation," describes the operational program and proposed implementation milestone(s) for the EQ program, which is reviewed in accordance with 10 CFR 50.49. The implementation milestone for the EQ program is to have all qualification requirements met before the loading of fuel. Implementation is required by a license condition.

24. Consistent with the guidance contained within RG 1.206subsection C.I.3.11.5, the applicant should identify the radiation dose and dose rate used to determine the radiation environment and indicate the extent to which estimates of radiation exposures are based on a radiation source term that is consistent with NRC staff-approved source terms and methodology. For exposure of organic components on engineered safety feature (ESF) systems, the applicant should tabulate beta and gamma exposures separately for each item of equipment and list the average energy of each type of

radiation. For ESF systems outside containment, the applicant should indicate whether the radiation estimates account for factors affecting the source term, such as containment leak rate, meteorological dispersion (if appropriate), and operation of other ESF systems. The applicant should list all assumptions used in the calculation.

25. Where the NRC staff plans to conduct an audit of the design and procurement specifications, the applicant should make available procurement specifications as discussed in the introductory paragraph of 10 CFR 52.47.

Technical Rationale

The technical rationale for applying these acceptance criteria to reviewing this DSRS section are discussed in the following paragraphs:

1. Compliance with 10 CFR 50.49 requires that the applicant identify a list of electrical equipment important to safety and establish a program, as described therein, for qualifying electrical equipment important to safety located in a harsh environment.

   Consistent with 10 CFR 50.49(e)(4), 10 CFR 50.49(e)(6), and 10 CFR 50.49(e)(7), which apply to CP, OL, and COL applicants; 10 CFR 50.34(b)(3), which applies to CP and OL applicants only; and 10 CFR 52.47(a)(5), 10 CFR 52.79(a)(3), and 10 CFR 52.157(e), which apply to COL applicants, the applicant should identify the radiation dose and dose rate used to determine the radiation environment and indicate the extent to which estimates of radiation exposures are based on a radiation source term that is consistent with NRC staff-approved source terms and methodology. The radiation environment must be based on the type of radiation, the total dose expected during normal operation over the installed life of the equipment, and the radiation environment associated with the most severe design-basis accident during or following which the equipment is required to remain functional. The applicant should list all assumptions used in the calculation.

   In addition to the design requirements in Appendix A to 10 CFR Part 50, the NRC regulations in 10 CFR 50.49 provide specific requirements related to the EQ of electrical and I&C equipment located in a harsh environment. The EQ process described by this regulation provides requirements to ensure that equipment will be able to perform acceptably during all anticipated operating conditions, even after being degraded due to exposure to service conditions during its qualified life.

   Meeting the requirements of 10 CFR 50.49, 10 CFR 52.47(a)(5), 10 CFR 52.79(a)(3), and 10 CFR 52.157(e) provides assurance that electrical and I&C equipment important to safety that are located in a harsh environment are environmentally qualified and are capable of performing their intended safety function.

2. Compliance with GDC 1 requires that components important to safety be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety function to be performed.

   GDC 1 is applicable to this section, since it includes requirements for quality standards that must be met, and records that must be kept, concerning the quality standards for design, fabrication, erection, and testing of components important to safety. Components in the scope of this DSRS section that are subject to environmental design and qualification must have auditable records to document that environmental design and qualification requirements have been met.

Meeting GDC 1 provides assurance that the equipment is of sufficiently high quality to be capable of performing its design safety functions acceptably during all anticipated operating conditions and that appropriate records are maintained to document meeting these requirements.

3. GDC 2 requires that components important to safety be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions.

   GDC 2 is applicable to this section, since the design bases for components important to safety must consider the effects of the most severe natural phenomena anticipated for the site, together with normal and accident plant operating conditions and the importance of the safety function to be performed. Components in the scope of this section that are subject to environmental design and qualification must consider environmental conditions and stressors resulting from natural phenomena as part of the environmental conditions evaluated.

   Meeting GDC 2 provides assurance that appropriate combinations of the effects of normal and accident conditions resulting from the effects of the natural phenomena are considered in meeting the environmental design and qualification requirements.

4. Compliance with GDC 4 requires that components important to safety be designed to accommodate the effects of, and be compatible with, the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including LOCAs. Components must be protected against dynamic effects, including those of missiles, pipe whipping, and discharging fluids, that may result from equipment failures and from events and conditions outside the nuclear power unit.

   GDC 4 is applicable to this section, since it provides the requirement for components important to safety to be designed to accommodate the effects of, and be compatible with, the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including LOCAs.

   Meeting GDC 4 ensures that equipment important to safety is environmentally designed and qualified and provides assurance that the equipment will be able to accommodate the effects of, and be compatible with, the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including LOCAs.

5. Compliance with GDC 23 requires that protection systems be designed to fail in a safe state, or in a state demonstrated to be acceptable on some other defined basis, if conditions such as postulated adverse environments (e.g., extreme heat or cold, pressure, steam, water, or radiation) are experienced.

   GDC 23 is applicable to this section, since the environmental design and qualification of protection systems must ensure that the protection systems will fail in a safe state, or in a state demonstrated to be acceptable on some other defined basis, if they are subjected to harsh conditions, such as postulated adverse environments. The failure mode of the components in the scope of this section that are subject to environmental design and qualification requirements must be considered.

   Meeting GDC 23 provides assurance that the failure mode of protection system components is considered in the environmental design and qualification process.

6. Compliance with 10 CFR Part 50, Appendix B, Criterion III, requires that measures be established to ensure that applicable regulatory requirements and the design basis are correctly translated into specifications, drawings, procedures, and instructions. These measures should include provisions to ensure that appropriate quality standards are included in design documents and that deviations from established standards are controlled. A process should also be established to determine the suitability of equipment that is essential to the safety-related functions of the SSCs and to identify, control, and coordinate design interfaces among participating design organizations. Where a test program is used to verify the adequacy of a specific design feature, it shall include suitable qualification testing of a prototype unit under the most adverse design conditions.

   Criterion III is applicable to this section, since it includes requirements for test programs that are used to verify the adequacy of a specific design feature. Such test programs must include suitable qualification testing of a prototype unit under the most adverse design conditions. For components within the scope of this section that are subject to EQ testing, the test program must address these requirements.

   Meeting 10 CFR Part 50, Appendix B, Criterion III, provides assurance that the EQ process includes suitable qualification testing of a prototype unit under the most adverse design conditions.

7. Compliance with 10 CFR Part 50, Appendix B, Criterion XI, requires that a test control plan be established to ensure that all tests needed to demonstrate a component's capability to perform satisfactorily in service be identified and performed in accordance with written procedures that incorporate the requirements and acceptance limits contained in applicable design documents.

   Criterion XI is applicable to this section, since it includes requirements for developing a test control plan to ensure that all tests needed to demonstrate a component's capability to perform satisfactorily in service be identified and performed in accordance with written procedures that incorporate the requirements and acceptance limits contained in applicable design documents. Components within the scope of this DSRS section that are subject to testing to verify conformance to environmental design and qualification requirements must include such a test control plan.

   Meeting 10 CFR Part 50, Appendix B, Criterion XI, provides assurance that a test control plan is established for components subject to testing for environmental design and qualification that will ensure that all tests needed to demonstrate a component's capability to perform satisfactorily in service are identified and performed in accordance with written procedures that incorporate the requirements and acceptance limits contained in applicable design documents.

8. Compliance with 10 CFR Part 50, Appendix B, Criterion XVII requires that sufficient records be maintained to furnish evidence of activities affecting quality. The records must include inspections, tests, audits, monitoring of work performance, and materials analysis. Records must be identifiable and retrievable.

   Criterion XVII is applicable to this section, since it includes requirements for records that must be maintained to furnish evidence of activities affecting quality. Environmental design and qualification are activities that can affect quality; therefore, components within the scope of this section that are subject to environmental design and qualification must have identifiable and retrievable records that document the fact that they meet these requirements.

Meeting 10 CFR Part 50, Appendix B, Criterion XVII, provides assurance that identifiable and retrievable records are maintained to furnish evidence of activities affecting quality, which includes environmental design and qualification.

9. In SRM-SECY-05-0197, the Commission approved the use of a license condition for operational program implementation milestones that are fully described or referenced in the FSAR. The 10 CFR 50.49 EQ regulation for electrical and I&C equipment located in a harsh environment was identified as an operational program in that memorandum.

III. REVIEW PROCEDURES

For each area of review specified in subsection I of this DSRS section, the review procedure is identified below. These review procedures are based on the identified DSRS acceptance criteria. For deviations from these specific acceptance criteria, the staff should review the applicant's evaluation of how the proposed alternatives to the DSRS criteria 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: Light-Water Small Modular 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 small modular reactor (SMR) framework. Using the graded approach described in NUREG-0800, Intro Part 2, the NRC staff may determine that, for certain 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 completing the applicable ITAAC. The use of the selected programs to augment or replace traditional review procedures is shown in Figure 1 of NUREG-0800, Intro Part 2. Examples of such programs that may be relevant to the graded approach for these SSCs include:

   - 10 CFR Part 50, Appendix A, GDC, Overall Requirements, Criteria 1–5
   - 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 Nonsafety 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 DC or COL applications submitted under 10 CFR 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, "Resolution of Generic Safety Issues," 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. For new applications, the 10 CFR 50.49(b)(3) requirement to qualify certain types of postaccident monitoring equipment located in a harsh environment applies to those instruments identified as requiring such qualification based on the applicant's submittal and the NRC review thereof, including the review conducted under DSRS Chapter 7. The regulatory requirements in 10 CFR 50.49(b)(3) reference the guidance in Revision 4 to Regulatory Guide 1.97. Applicants and licensees may use later revisions of Regulatory Guide 1.97 when appropriate.

4. For review of a DC application, the reviewer should follow the above procedures to verify that the design, including additional requirements (i.e., interface and site-specific information), specified in the DC DCD/FSAR meets the acceptance criteria described in this DSRS section. 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).

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

   Together with the review of SRP Section 3.9.6, the staff will conduct an audit of the procurement specifications for the EQ of mechanical, electrical, and I&C equipment important to safety for compliance with 10 CFR 52.47.

5. For review of a COL application, the NRC staff confirms whether the COL applicant has incorporated, by reference in its FSAR, the provisions in the DC DCD/FSAR for the capability of mechanical, electrical, and I&C equipment important to safety to perform the design functions under applicable environmental conditions in compliance with the design criteria in 10 CFR Part 50, Appendix A. In addition, the staff reviews the requirements of the 10 CFR 50.49 EQ program for certain electrical and I&C equipment important to safety located in harsh environments and the proposed implementation milestones. The staff also reviews environmental design and qualification provisions for nonmetallic parts of mechanical equipment for consistency with ASME QME-1-2007, Appendix QR-B, as accepted in Revision 3 to RG 1.100 or the applicant's proposed alternative to satisfy the regulatory requirement. The staff also confirms that the COL application describes the EQ operational program consistent with this DSRS section.

6. The reviewer verifies that the EQ program is fully described, as specified in SECY-05-0197, and that implementation milestones have been identified. The reviewer verifies that the program and implementation milestones are included in FSAR Table 13.4-[x] and will be identified as a license condition.

   Implementation of this program will be inspected in accordance with NRC Inspection Manual Chapter IMC-2504, "Construction Inspection Program: Inspection of Construction and Operational Programs."

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.

The staff concludes that the environmental design and qualification of mechanical, electrical, and I&C equipment important to safety are acceptable and meet the relevant requirements of 10 CFR 50.49; 10 CFR Part 50, Appendix A, General Design Criteria 1, 2, 4, and 23; and 10 CFR Part 50, Appendix B, Quality Assurance Criteria III, XI, and XVII; with respect to systems and components being designed to withstand the effects of, and being capable of performing their safety function in, the environmental conditions associated with normal operation, maintenance, testing, and accident conditions.

This conclusion is based on the finding that the applicant has implemented an environmental design and qualification program that provides adequate assurance that mechanical, electrical, and I&C equipment important to safety will function as intended in the event of anticipated operational occurrences, as well as in the normal, accident, and postaccident environmental conditions. The applicant's environmental design and qualification program is in accordance with the requirements and guidance described in the regulations, regulatory guides, and industry standards identified in Subsection II of DSRS Section 3.11.

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.

The applicant described the EQ program and its implementation in conformance with the relevant requirements of 10 CFR 50.49; 10 CFR Part 50, Appendix A, General Design Criteria 1, 2, 4, and 23; and 10 CFR Part 50, Appendix B, Quality Assurance Criteria III, XI, and XVII. Implementation milestones are contained in FSAR Table 13.4-x and will be addressed as a license condition.

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 SRP revision in effect 6 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 SMR designs, however, differ significantly from large light-water nuclear 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 Staff Requirements Memorandum (SRM)-COMGBJ-10-0004/COMGEA-10-0001, "Use of Risk Insights To Enhance Safety Focus of Small Modular Reactor Reviews," dated August 31, 2010. 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 preapplication activities. Accordingly, the staff has developed the content of the DSRS as an alternative method for evaluating 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 to address new design or siting assumptions.

VI. REFERENCES

1. 10 CFR 50.44, "Combustible Gas Control for Nuclear Power Reactors."

2. 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants."

3. 10 CFR 50.65, “Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants.”

4. 10 CFR Part 50, Appendix A, General Design Criterion 1, “Quality Standards and Records;” General Design Criterion 2, “Design Bases for Protection Against Natural Phenomena;” General Design Criterion 4, “Environmental and Dynamic Effects Design Bases;” and General Design Criterion 23, “Protection System Failure Modes.”

5. 10 CFR Part 50, Appendix B, Criterion III, “Design Control”; Criterion XI, “Test Control”; and Criterion XVII, “Quality Assurance Records.”

6. 10 CFR 52.47, “Contents of Applications; Technical Information.”

7. 10 CFR 52.80, “Contents of Applications; Additional Technical Information.”

8. IEEE Std. 317-1983 , “IEEE Standard for Electric Penetration Assemblies in Containment Structures for Nuclear Power Generation Stations,” Institute of Electrical and Electronics Engineers IEEE Std. 323-1974 and 2003, “IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations,” Institute of Electrical and Electronics Engineers.

9. IEEE Std. 382-2006, “IEEE Standard for Qualification of Safety-Related Actuators for Nuclear Power Generating Stations,” Institute of Electrical and Electronics Engineers.

10. IEEE Std. 383-2003, “IEEE Standard for Qualifying Class 1E Electric Cables and Field Splices for Nuclear Power Generating Stations,” Institute of Electrical and Electronics Engineers.

11. IEEE Std. 535-1986, “IEEE Standard for Qualification of Class 1E Lead Storage Batteries for Nuclear Power Generating Stations,” Institute of Electrical and Electronics Engineers.

12. IEEE Std. 572-1985, “IEEE Standard for Qualification of Class 1E Connection Assemblies for Nuclear Power Generating Stations,” Institute of Electrical and Electronics Engineers.

13. NUREG–0588, “Interim Staff Position on Environmental Qualification of Safety Related Electrical Equipment.”

14. NUREG–0718, “Licensing Requirements for Pending Applications for Construction Permits and Manufacturing License.”

15. NUREG–0737, “Clarification of TMI Action Plan Requirements.”

16. NUREG–1465, “Accident Source Terms for Light-Water Nuclear Power Plants.”

17. NUREG–1503, “Final Safety Evaluation Report Related to the Certification of the Advanced Boiling Water Reactor Design.”

18. NUREG-–1793, “Final Safety Evaluation Report Related to Certification of the AP1000 Standard Design.”

19. Regulatory Guide 1.63, “Electric Penetration Assemblies in Containment Structures for Light Water Cooled Nuclear Power Plants” (this guide endorses IEEE Std. 317-1983, et. al.).

20. Regulatory Guide 1.73, “Qualification Tests of Electric Valve Operators Installed Inside the Containment of Nuclear Power Plants” (this guide endorses IEEE Std. 382-2006).

21. Regulatory Guide 1.89, “Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants” (this guide endorses IEEE Std. 323-1974).

22. Regulatory Guide 1.97, Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants Demonstrating Control Room Envelope Integrity at Nuclear Power Reactors,” Revision 4.

23. Regulatory Guide 1.100 (Revision 3), “Seismic Qualification of Electrical and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants.”

24. Regulatory Guide 1.152, “Criteria for Use of Computers in Safety Systems of Nuclear Power Plants.”

25. Regulatory Guide 1.153, “Criteria for Safety Systems.”

26. Regulatory Guide 1.156, “Environmental Qualification of Connection Assemblies for Nuclear Power Plants” (endorses IEEE Std. 572-2006).

27. Regulatory Guide 1.158, “Qualification of Safety-Related Lead Storage Batteries for Nuclear Power Plants” (endorses IEEE Std. 535-1986).

28. Regulatory Guide 1.160, “Monitoring the Effectiveness of Maintenance at Nuclear Power Plants,” Revision 2, March 1997 (Revision 2, ML003761662).

29. Regulatory Guide 1.180, “Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems.”

30. Regulatory Guide 1.183, “Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors.”

31. Regulatory Guide 1.204, “Guidelines for Lightning Protection of Nuclear Power Plants.”

32. Regulatory Guide 1.209, “Guidelines for Environmental Qualification of Safety-Related Computer-Based Instrumentation and Control Systems in Nuclear Power Plants.”

33. Regulatory Guide 1.211, “Qualification of Safety-Related Cables and Field Splices for Nuclear Power Plants (this guide endorses IEEE Std. 383-2003).

34. SECY 02 0067, “Inspections, Tests, Analysis, and Acceptance Criteria (ITAAC) for Operational Programs (Programmatic ITAAC).” ADAMS Accession Number ML020700641.

35. SECY 04 0032, “Programmatic Information Needed for Approval of a Combined License Without Inspections, Tests, Analyses and Accptance Criteria.” ADAMS Accession Number ML040230079.

36. SRM-SECY 02 0032, “Staff Requirements – SECY-04-0032 – Programmatic Information Needed for Approval of a Combined License Without Inspections, Tests, Analyses and Accptance Criteria.” ADAMS Accession Number ML041350440.

37. SECY-05-0197, “Review of Operational Programs in a Combined License Application and Generic Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria.” ADAMS Accession Number ML052770257.

38. NRC Inspection Manual Chapter IMC-2504, “Construction Inspection Program: Inspection of Construction and Operational Programs.”