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14 VERIFICATION PROGRAMS

This chapter of the Safety Evaluation Report (SER) provides the staff's review of the U.S. EPR verification programs, including the Initial Test Program (ITP), and Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC). The staff has prepared Sections 14.1 through 14.3 of this report in accordance with the review procedures described in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," (hereafter referred to as NUREG-0800 or the Standard Review Plan (SRP)), using information presented in the U.S. EPR Final Safety Analysis Report (FSAR), and responses to staff requests for additional information (RAIs).

14.1 Specific Information to be addressed for the Initial Plant Test Program

The applicable regulatory requirements and key features of the ITP are given in FSAR Tier 2, Section 14.1, "Specific Information to be addressed for the Initial Plant Test Program." FSAR Tier 2, Section 14.2, "Initial Plant Test Program," discusses how these regulatory requirements and features are implemented.

Regulatory Guide (RG) 1.206, "Combined License Applications for Nuclear Power Plants," June 2007, states that the Combined License (COL) applicant should describe the technical aspects of the initial test program in sufficient detail to show that (1) the test program adequately verifies the functional requirements of plant structures, systems, and components (SSCs) and (2) the sequence of testing is such that the safety of the plant does not depend on untested SSCs. In addition, the COL applicant should describe measures to ensure that (1) the initial test program is accomplished with adequate numbers of qualified personnel, (2) adequate administrative controls will be established to govern the initial test program, (3) the test program is used, to the extent practicable, to train and familiarize the plant's operating and technical staff in the operation of the facility, and (4) the adequacy of plant operating and emergency procedures is verified, to the extent practicable, during the period of the initial test program. FSAR Tier 2, Section 14.0 did not state that the COL applicant is responsible for this description. In RAI 16, Question 14.02-1, the staff requested that the applicant provide information regarding the description of the verification programs consistent with the COL responsibilities addressed in RG 1.206.

In an August 4, 2008, response to RAI 16, Question 14.02-1, the applicant stated that although the wording used in FSAR Tier 2, Section 14.2 to identify COL applicant responsibilities was different from the wording used in RG 1.206, the information requested in this question is either addressed in the FSAR or by COL Information Items 14.2-1 through 14.2-7. The staff finds the applicant's response acceptable and, therefore, considers RAI 16, Question 14.02-1 resolved.

In RAI 68, Question 14.02-28, the staff requested that the applicant revise FSAR Tier 2, Section 14.1 to add Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52.47(b)(1) to the regulations applicable to design certifications in accordance with SRP Section 14.2.II.5. In an October 24, 2008, response to RAI 68, Question 14.02-28, the applicant stated that the 10 CFR 52.47(b)(1) requirement for inspection, test, analysis and acceptance criteria is specifically addressed in FSAR Tier 1. Additionally, the applicant further stated that the relationship between FSAR Tier 1, FSAR Tier 2 (specifically Section 14.3), and 10 CFR 52.47(b)(1) is described in FSAR Tier 2, Section 14.3. The staff finds that the subject information in the FSAR conforms to the guidance contained in RG 1.68, "Initial Test Programs

for Water-Cooled Nuclear Power Plants." Therefore, the staff considers RAI 68, Question 14.02-28 resolved.

14.2 Initial Plant Test Program

14.2.1 Introduction

The U.S. EPR initial plant test program is intended to verify that the as-built facility configuration and operation complies with the approved plant design and applicable regulations. The initial plant test program consists of preoperational and initial startup testing. Major phases of testing include:

- Preoperational Tests – The preoperational tests are conducted following the completion of construction but before fuel loading.
- Initial Fuel Loading – Initial fuel loading starts after completion of the preoperational testing.
- Initial Criticality and Low-Power Tests – The initial criticality phase of the startup test program confirms that criticality is achieved in a safe and controlled manner. Following initial criticality, a series of low-power physics tests are performed to verify selected core design parameters.
- Power-Ascension Tests – A series of power ascension tests is conducted to bring the reactor to full power.

The scope of the initial test program, as well as its general plans for accomplishing the test program, is described to demonstrate that due consideration has been given to matters that normally require advance planning.

The technical aspects of the initial test program are described to show that: (1) the test program adequately verifies the functional requirements of plant SSCs; and (2) the sequence of testing is such that the safety of the plant does not depend on untested SSCs. In addition, the measures are described to ensure that: (1) The initial test program is accomplished with adequate numbers of qualified personnel; (2) adequate administrative controls will be established to govern the initial test program; (3) the test program is used, to the extent practicable, to train and familiarize the plant's operating and technical staff in the operation of the facility; and (4) the adequacy of plant operating and emergency procedures is verified, to the extent practicable, during the period of the initial test program. In addition, this section provides information on the COL information items that have been addressed by the applicant.

14.2.2 Summary of Application

FSAR Tier 1: The FSAR Tier 1 information associated with this section is found in FSAR Tier 1, Section 3.3, "Initial Test Program." FSAR Tier 1, Section 3.3.1, "Description," describes an initial plant test program and includes a provision that COL applicants who reference the certified design will commit to implementing such an ITP. FSAR Tier 1, Section 3.3.2, "Design Features," describes tests to evaluate the integrated response of multiple systems to achieve a desired function. These are given in FSAR Tier 1, Table 3.3.1-1, "Integrated Tests, Analyses, and Acceptance Criteria."

FSAR Tier 2: The applicant has provided a description of the initial plant test program in Sections 14.1 and 14.2, summarized here, in part, as follows:

FSAR Tier 2, Section 14.1 summarizes the relevant requirements of regulations applicable to the initial plant test program and lists the initial plant test program topics that are addressed in FSAR Tier 2, Section 14.2.

The important elements of the initial plant test program described in FSAR Tier 2, Section 14.2 are as follows:

- Organization and staffing
- Test procedures
- Conduct of test program
- Review, evaluation, and approval of test results
- Test records
- Conformance of test programs to Regulatory Guides
- Utilization of reactor operating and testing experience in the development of the test program
- Trial use of plant operating and emergency procedures
- Initial fuel loading and initial criticality
- Test program schedule
- Individual test descriptions

ITAAC: There are no ITAAC associated with this area of review.

Technical Specifications: There are no Technical Specifications for this area of review.

U.S. EPR Plant Interfaces: There are no U.S. EPR plant interfaces for this area of review.

14.2.3 Regulatory Basis

The relevant requirements of U.S. Nuclear Regulatory Commission (NRC) regulations for the initial plant test program, and the associated acceptance criteria, are specified in NUREG-0800, Section 14.2, “Initial Plant Test Program - Design Certification and New License Applicants,” and are summarized below. Review interfaces with other SRP sections can also be found in NUREG-0800, Section 14.2.

1. 10 CFR 50.34(b)(6)(iii), “Contents of applications; technical information,” as it relates to the requirement that the applicant provide plans for preoperational testing and initial operations.

2. 10 CFR 30.53(c), “Tests,” as it relates to testing radiation detection and monitoring instruments.

3. 10 CFR Part 50, Appendix B, Criterion XI, “Test Control,” as it relates to test programs established to assure that SSCs will perform satisfactorily in service.

4. 10 CFR Part 50, Appendix J, “Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors,” Section III.A.4, “Preoperational Leakage Rate Tests,” as it relates to the preoperational leakage rate testing of the primary reactor containment and related systems and components penetrating the primary containment pressure boundary.

5. 10 CFR 52.47(b)(1), “Contents of applications; technical information,” as it relates to the requirement that a design certification 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 plant that incorporates the design certification is built and will operate in conformity with the design certification, the provisions of the Atomic Energy Act of 1954, and NRC regulations.

Acceptance criteria adequate to meet the above requirements include:

1. RG 1.68, Revision 3, as it relates to the Initial Test Program.

2. RG 1.68.3, “Preoperational Testing of Instrument and Control Air Systems,” as it relates to testing guidance for instrumentation and control air systems.

14.2.4 Technical Evaluation

FSAR Tier 1

In RAI 330, Question 14.02-143, the staff requested that the applicant remove FSAR Tier 1, Section 3.3.2 and Table 3.3-1, “ITP ITAAC,” after the inclusion of the integrated test ITAAC into appropriate sections of FSAR Tier 1, Chapter 2, “System Based Design Descriptions and ITAAC.” In a March 17, 2010, response to RAI 330, Question 14.02-143, the applicant provided the proposed markup to the FSAR. The staff found the proposed changes to the FSAR conformed to the guidance contained in RG 1.68. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 330, Question 14.02-143 resolved.

14.2.4.1 *Summary of Test Program and Objectives*

Introduction

In FSAR Tier 2, Section 14.2.1, “Summary of Test Program and Objectives,” the applicant described the following phases of the initial test program: (1) Construction activities; (2) preoperational testing; (3) initial fuel loading and precritical testing; (4) initial criticality and low power physics testing; and (5) power ascension testing. General prerequisites and specific objectives for each phase are identified.

Evaluation

The staff reviewed conformance of FSAR Tier 2, Section 14.2.1 to the guidance in NUREG-0800, Section 14.2.II.1, "Summary of Test Program and Objectives," and the general guidelines and applicable regulatory positions in RG 1.68. SRP Section 14.2.II.1 states, in part, that the applicant should describe the objectives, including a description of the objectives for each of the major phases of the test program, and describe the criteria for selection of plant features to be tested by the applicant.

The applicant described the summary of the startup testing and included a description of the objectives of each of the appropriate major phases of the test program in FSAR Tier 2, Section 14.2.1.

RG 1.68, Regulatory Position C.1, "Criteria for Selection of Plant Features to be Tested," describes the criteria for identifying SSCs that must be tested to verify that the component or system can operate in accordance with design requirements. The applicant defined the criteria for identifying SSCs to conduct suitable tests to verify performance capabilities in FSAR Tier 2, Section 14.2.1.1, "Summary of the Startup Test Program." The staff reviewed the criteria given in FSAR Tier 2, Section 14.2.1 against the criteria given in the RG 1.68 and determined that the FSAR included the appropriate selection criteria for SSCs to be tested in the initial test program.

The staff noted that the applicant's proposed test program provided the following phases and objectives:

- Construction Activities

  Confirm that construction is complete and systems are ready for preoperational testing, through testing such as: (1) Weld inspections; (2) hydro lazing and flushing; and (3) circuit integrity and separation checks.

- Phase I – Preoperational Testing

  (1) Demonstrate the capability of SSCs to operate in accordance with design bases; (2) Demonstrate that appropriate acceptance criteria for SSCs are met, including alarms and indications; (3) Provide baseline data; (4) Provide the permanent plant operating staff with maximum opportunity to obtain practical experience in the operation of equipment and systems and their procedures; (5) Demonstrate plant systems operate on an integrated basis to the extent possible; and (6) Demonstrate that plant systems are operational in order to continue to fuel loading and initial startup testing.

- Phase II – Initial Fuel Loading and Precritical Testing

  Confirm that plant systems function as expected and conduct orderly loading of fuel. Provide additional confirmation that plant systems function as expected and obtain performance data on core-related systems and components.

- Phase III – Initial Criticality and Low Power Physics Testing

  Confirm that criticality is achieved in a safe and controlled manner. Low power physics tests verify selected core design parameters to substantiate the safety analysis assumptions and Technical Specifications.

- Phase IV – Power Ascension Testing

  Confirm that the facility operates in accordance with its design bases during steady state conditions and, to the extent practical, during anticipated transients.

Upon review of FSAR Tier 2, Section 14.2.1.1, the staff identified the following areas where additional information is needed. A description of the specific issues identified by the staff is as follows:

In RAI 16, Question 14.02-4, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.1.1.1, "Construction Activities," to include initial instrument calibration and functional test of components as recommended by RG 1.68, Appendix A, Section 1, "Preoperational Testing." In an August 4, 2008, response to RAI 16, Question 14.02-4, the applicant stated that the initial instrument calibrations and functional tests of components will occur during preoperational testing and revised this section to include instrument calibrations and functional tests as objectives of preoperational testing. The staff determined that the applicant's response did not conform to the existing guidance. Therefore, in follow-up RAI 68, Question 14.02-20, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.1.1.1, "Construction Activities." The staff requested that the applicant confirm that initial instrument calibration and functional test of components are completed in construction activities and revise FSAR Tier 2, Section 14.2.1.1.1, accordingly. In an October 24, 2008, response to RAI 68, Question 14.02-20, the applicant proposed a revision to FSAR Tier 2, Section 14.2.1.1.1 to specifically mention functional testing and instrument calibrations as part of the requirements to the list of construction activities. The staff finds the proposed revisions conform to the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 68, Question 14.02-20 resolved.

In RAI 68, Question 14.02-19, the staff requested that the applicant add a statement to clarify that the verification of Technical Specification (TS) surveillance requirement (SR) 3.1.2.1 is the transition point from initial criticality to low power physics testing. Additionally, the staff requested that the applicant remove the reference to American National Standards Institute (ANSI) 19.6.1, "Reload Startup Physics Tests for Pressurized Water Reactors," from FSAR Tier 2, Section 14.2.1.1.4, "Phase III - Initial Criticality and Low Power Physics Testing," since the scope of the ANSI standard is limited and does not cover all of the needed areas for the administrative controls of the initial criticality and low power physics testing. In an October 24, 2008, response to RAI 68, Question 14.02-19, the applicant proposed changing FSAR Tier 2, Section 14.2.1.1.4 to state that the transition from initial criticality to low power physics testing is completed after verifying that the Technical Specification SR 3.1.2.1 requirement of 1,000 percent millirho (pcm) is met. Additionally, the applicant proposed removing all references to ANSI 19.6.1 from FSAR Tier 2, Sections 14.2.1.1.4 (Step 7); 14.2.12, "Individual Test Descriptions," (Test Nos. 190, 191, 192, and 218); and 14.2.13, "References." The staff finds the proposed revisions consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 68, Question 14.02-19 resolved.

In RAI 68, Question 14.02-21, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.1.1.4 to meet all of the initial criticality and low power physics testing objectives

described in RG 1.68, Appendix A, Section 3, "Initial Criticality," and RG 1.68, Appendix A, Section 4, "Low Power Testing." In an October 24, 2008, response to RAI 68, Question 14.02-21, the applicant proposed a revision to FSAR Tier 2, Section 14.2.1.1.4 to include the objectives of RG 1.68, Appendix A, Section 4: (1) Confirm the design and, to the extent practical, validate the analytical models and verify the correctness or conservatism of assumptions used in the safety analyses for the facility; and (2) confirm the operability of plant systems and design features that could not be completely tested during the preoperational test phase due to the lack of an adequate heat source for the reactor coolant and main steam systems. The applicant also proposed a revision to FSAR Tier 2, Section 14.2.1.1.4 to contain separate bullets with respect to control rod and poison removal information. The staff finds the proposed revisions conform to the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, considers RAI 68, Question 14.02-21 resolved.

In RAI 68, Question 14.02-22, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.1.1.5, "Phase IV – Power Ascension Testing," to add all the objectives of RG 1.68, Appendix A.5. Specifically, the staff requested that the applicant include the following objectives: (1) Tests and acceptance criteria should be prescribed to demonstrate the ability of major or principal plant control systems to automatically control process variables within design limits. Such tests are expected to provide assurance that the facility's integrated dynamic response is in accordance with design for plant events such as reactor scram, turbine trip, reactor coolant pump trip, and loss of feedwater heaters or pumps. (2) Testing should be sufficiently comprehensive to establish that the facility can operate in all operating modes for which it has been designed; however, tests should not be conducted, or operating modes or plant configurations established, if they have not been analyzed or if they fall outside the range of assumptions used in analyzing postulated accidents in the facility's FSAR. (3) Appropriate consideration should be given to testing at the extremes of possible operating modes for facility systems. Testing under simulated conditions of maximum and minimum equipment availability within systems should be accomplished if the facility is intended to be operated in these modes. In an October 24, 2008, response to RAI 68, Question 14.02-22, the applicant proposed a revision to FSAR Tier 2, Section 14.2.1.1.5 to include the objectives of RG 1.68, Appendix A.5. The staff finds the proposed revisions conform to the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, considers RAI 68, Question 14.02-22 resolved.

Conclusions

The staff finds that the information provided in FSAR Tier 2, Section 14.2.1 adequately describes the activities related to the phases of the initial test program: (1) Construction activities; (2) preoperational testing; (3) initial fuel loading and precritical testing; (4) initial criticality and low power physics testing; and (5) power ascension testing, and is therefore acceptable. All issues relating to this section of the initial test program have been resolved.

14.2.4.2 *Organization and Staffing*

Introduction

In FSAR Tier 2, Section 14.2.2, "Organization and Staffing," the applicant stated that the COL applicant that references the U.S. EPR certified design is responsible for the following:

(1) Providing site-specific information that describes the organizational units that manage, supervise, or execute any phase of the test program; (2) describing how, and to what extent, the plant's operating and technical staff participates in each major test phase; and (3) developing a training program for each fundamental group in the organization of the U.S. EPR plant.

Evaluation

The staff reviewed conformance of FSAR Tier 2, Section 14.2.2 to the guidance in NUREG-0800 and the general guidelines and applicable regulatory positions in RG 1.68. In FSAR Tier 2, Section 14.2.2, the applicant stated that the site-specific organization, the participation of staff in the test program, and the training program are all the responsibility of the COL applicant that references the U.S. EPR FSAR to describe in the COL application. The applicant stated that these descriptions should address the organizational authorities and responsibilities, the degree of participation of each identified organizational unit, and include information pertaining to the experience and qualification of supervisory personnel and other principal participants who are responsible for managing, developing, or conducting each test phase. The staff finds that because staffing will be determined by the COL applicant and is, thus, outside the scope of design certification, it is acceptable to defer responsibility for the site-specific organization to the COL applicant. This is identified as COL Information Item 14.2-1 in FSAR Tier 2, Table 1.8-2, "U.S. EPR Combined License Information Items."

Upon review of FSAR Tier 2, Section 14.2.2, the staff identified the following area where additional information is needed. A description of the specific issue identified by the staff is as follows:

In RAI 16, Question 14.02-5, the staff requested that in FSAR Tier 2, Section 14.2, "Organization and Staffing," the applicant provided a greater level of detail into the administrative control sections of FSAR Tier 2, Section 14.2 of the initial test program as described in SRP Section 14.2 and RG 1.68. In an August 4, 2008, response to RAI 16, Question 14.02-5, the applicant stated that FSAR Tier 2, Section 14.2 provides a sufficient level of detail into the administrative control of the initial test program consistent with the requirements of SRP Section 14.2 and RG 1.68 for design certifications. The staff concluded that, because the development of the requested information will depend upon detailed plant-specific design information, it is acceptable to defer responsibility for the development of detailed initial test administrative control information to the COL applicant. The staff finds that the FSAR is consistent with the guidance contained in RG 1.68, and therefore, considers RAI 16, Question 14.02-5 resolved.

Conclusions

The staff concludes that the information provided in FSAR Tier 2, Section 14.2.2 adequately describes the activities related to the organization and staffing for the initial test program, and is thus acceptable. All issues relating to this section of the initial test program have been resolved.

The staff also concludes that because staffing will be determined by the COL applicant and is, thus, outside the scope of design certification, it is acceptable to defer responsibility for the site-specific organization to the COL applicant. This is identified as COL Information Item 14.2-1.

14.2.4.3 *Test Procedures*

Introduction

In FSAR Tier 2, Section 14.2.3, "Test Procedures," the applicant provided guidelines for the development of test procedures, including format requirements, adherence to applicable RGs, and provisions for review and approval by responsible personnel.

Test specifications and test procedures address the process used to develop, review, and approve individual test procedures, including the organizational units or personnel that are involved in performing these activities and their respective responsibilities. In general, testing during all phases of the initial test program is conducted using detailed, step-by-step written procedures to control the conduct of each test. Such test procedures specify testing prerequisites, describe desired initial conditions, include appropriate methods to direct and control test performance (including the sequencing of testing), specify acceptance criteria by which the test is to be evaluated, and provide for or specify the format by which data or observations are to be recorded.

Evaluation

The staff reviewed conformance of FSAR Tier 2, Section 14.2.3 to the guidance in NUREG-0800 and the general guidelines and applicable regulatory positions in RG 1.68. The staff notes that the applicant followed the guidance of the SRP and provided the controls to develop test procedures. The applicant provided for detailed procedure guidelines and procedures used to develop the test procedures, a minimum set of topic areas to be included in each procedure, and the reference materials to be used in the preparation of each test procedure. FSAR Tier 2, Section 14.2.3 indicates that a COL applicant is responsible for providing site-specific controls for the review and approval of test procedures for preoperational and startup tests. Additionally, the applicant stated that the submittal by the COL applicant of applicable procedures and guidelines to the staff for review will be conducted as described in FSAR Tier 2, Section 14.2.11, "Test Program Schedule."

Upon review of FSAR Tier 2, Section 14.2.3, the staff identified the following area where additional information is needed. A description of the specific issue identified by the staff is as follows:

In RAI 68, Question 14.02-27, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.3 to clarify how test acceptance criteria will account for measurement errors and uncertainties used in the transient and accident analyses described in RG 1.68, Regulatory Position C.4 and Appendix C.1.f. In an October 24, 2008, response to RAI 68, Question 14.02-27, the applicant proposed adding acceptance criteria that accounts for measurement errors and uncertainties used in transient and accident analysis to FSAR Tier 2, Section 14.2.3. The staff finds the proposed revisions consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 68, Question 14.02-27 resolved.

Conclusions

The staff concludes that the information provided in FSAR Tier 2, Section 14.2.3 adequately describes the activities related to the process used to develop, review, and approve individual

test procedures, including the organizational units or personnel that are involved in performing these activities and their respective responsibilities, and is thus acceptable. All issues relating to this section of the initial test program have been resolved.

The staff also concludes that, because development of test specifications and test procedures will depend upon detailed plant-specific design information, it is acceptable to defer responsibility for the development of detailed initial test procedures to the COL applicant. This is identified as COL Information Item 14.2-3.

14.2.4.4 *Conduct of Test Program*

Introduction

In FSAR Tier 2, Section 14.2.4, "Conduct of Test Program," the applicant stated that the COL applicant is responsible for planning and conducting the plant startup test program. The applicant also provided the format of the administrative procedures that will be used to conduct the initial test program.

This section describes the administrative controls that govern the conduct of the test program. This description includes the administrative controls used to ensure that necessary prerequisites are satisfied for each major phase and for individual tests. The methods to be followed in initiating plant modifications or maintenance tasks that are determined necessary to conduct the test program are also described, as well as are the methods used to ensure retesting following such modifications or maintenance. In addition, the description discusses the involvement of design organizations and the applicant in reviewing and approving proposed plant modifications. The administrative controls pertaining to adherence to approved test procedures during the conduct of the test program, as well as the methods for effecting changes to approved test procedures, are described.

Evaluation

The staff reviewed conformance of FSAR Tier 2, Section 14.2.4 to the guidance in NUREG-0800 and the general guidelines and applicable regulatory positions in RG 1.68. The staff notes that the applicant followed the guidance of the SRP section, and in FSAR Tier 2, Section 14.2.4, the applicant states that the COL applicant is responsible for the planning and the conduct of the initial test programs. The applicant stated that the startup test group will conduct the initial test program in accordance with administrative procedures and requirements. These procedures, provided by the COL licensee, will (1) define the format and content of startup test procedures, (2) define the review and approval process for both initial procedures and subsequent revisions or changes, (3) specify the process for review and approval of test results and for resolution of failures, (4) describe the phases of the test program and establish the requirements for progressing from one phase to the next and beyond hold-points within a phase, (5) describe the controls for tracking retest requirements and testing completion, and (6) delineate the qualifications and responsibilities of the different positions within the startup group.

Conclusions

The staff concludes that the information provided in FSAR Tier 2, Section 14.2.4 adequately describes the activities related to review, evaluation, and approval of test results for the initial

test program, and is thus acceptable. The staff finds that all issues relating to this section of the initial test program have been resolved.

The staff also concludes that, because conduct of the test program will be completed by the COL applicant, it is acceptable to defer responsibility for the development of detailed administrative procedures to the COL applicant. This is identified as COL Information Item 14.2-10.

14.2.4.5 *Review, Evaluation, and Approval of Test Results*

Introduction

In FSAR Tier 2, Section 14.2.5, "Review, Evaluation, and Approval of Test Results," the applicant stated that the COL applicant is responsible for the site-specific administration procedures for review and approval of test results.

This section describes the specific controls to be established for the review, evaluation, and approval of test results for each major phase of the program by appropriate personnel and/or organizations. This description includes specific controls to be established to ensure notification of affected and responsible organizations or personnel when test acceptance criteria are not met, as well as the controls established to resolve such matters. A discussion of plans pertaining to (1) approval of test data for each major test phase before proceeding to the next test phase and (2) approval of test data at each power test plateau (during the power-ascension phase) before increasing the power level is also provided.

Evaluation

The staff reviewed conformance of FSAR Tier 2, Section 14.2.5 to the guidance in NUREG-0800 and the general guidelines and applicable regulatory positions in RG 1.68. The applicant followed the guidance of the SRP and in FSAR Tier 2, Section 14.2.5 states that the COL applicant is responsible for providing the administrative controls for the review, evaluation, and approval of test results. The applicant states that final review and approval of test phase results for selected milestones or hold-points within test phases shall be completed before beginning the next phase of start-up. In addition, the COL applicant commits to route completed procedures and test reports included in the ITAAC to the NRC resident inspector for NRC review.

Conclusions

The staff concludes that the information provided in FSAR Tier 2, Section 14.2.5 adequately describes the activities related to review, evaluation, and approval of test results for the initial test program, and is thus acceptable. The staff finds that all issues relating to this section of the initial test program have been resolved.

Also, the staff concludes that, because review and approval of the test results will be completed by the COL applicant, it is acceptable to defer responsibility for the development of detailed administrative procedures for the review and approval of test results to the COL applicant. This is identified as COL Information Item 14.2-4.

14.2.4.6 *Test Records*

Introduction

In FSAR Tier 2, Section 14.2.6, "Test Records," the applicant provided a description of the controls that will be implemented to compile and maintain initial test program records.

This section describes the protocols pertaining to the disposition of test procedures and test data following completion of the test program. Initial test program results are compiled and maintained according to the plant administrative procedures and applicable regulatory requirements. Test records that demonstrate the adequacy of safety-related components, systems, and structures are retained for the life of the plant. Retention periods for other test records are based on consideration of their usefulness in documenting initial plant performance characteristics.

Evaluation

The staff reviewed conformance of FSAR Tier 2, Section 14.2.6 to the guidance in NUREG-0800 and the general guidelines and applicable regulatory positions in RG 1.68. The applicant stated that initial test program results will be compiled and maintained in compliance with administrative procedures which will incorporate regulatory requirements. In addition, the applicant stated that documents will be retained in accordance with RG 1.28, "Quality Assurance Program Requirements – Design and Construction." The applicant follows SRP Section 14.2.II.3.F.v and established that test reports will be prepared consistent with the guidance contained in RG 1.16, "Reporting of Operating Information – Appendix A Technical Specifications."

Conclusions

The staff concludes that the information provided in FSAR Tier 2, Section 14.2.6 adequately describes protocols pertaining to the disposition of test procedures and test data following completion of the test program, and is thus acceptable. The staff finds that all issues relating to this section of the initial test program have been resolved.

14.2.4.7 *Conformance of Test Program with Regulatory Guides*

Introduction

In FSAR Tier 2, Section 14.2.7, "Conformance of Test Programs with Regulatory Guides," the applicant provided a list of specific RGs related to testing and testing programs. In addition, FSAR Tier 2, Table 1.9-2, "U.S. EPR Conformance with Regulatory Guides," lists RGs which are applicable to the initial test program.

The initial test program for a plant is conducted in conformance with the regulatory positions in RG 1.68. This section provides a list of applicable RGs. In presenting the conformance of the initial test program with RG 1.68, additional information is provided in FSAR Tier 2, Section 1.9, "Conformance with Regulatory Criteria," which provides a guide to U.S. EPR conformance with regulatory criteria, and FSAR Tier 2, Table 1.9-2 which provides a listing of the regulatory positions of RGs as they apply to the U.S. EPR design certification.

Evaluation

The staff reviewed conformance of FSAR Tier 2, Section 14.2.7 to the guidance in NUREG-0800, Section 14.2.II.2, "Test Program's Conformance with Regulatory Guides," and the general guidelines and applicable regulatory positions in RG 1.68. SRP Section 14.2 states, in part, that the applicant should establish and describe an initial test program that is consistent with the regulatory positions outlined in RG 1.68. SRP Section 14.2 also includes a list of RGs that provide more detailed information pertaining to the testing. RG 1.68, Appendix A, "Initial Test Program," references a set of supplemental regulatory guides that provide guidance to particular tests during the preoperational and initial startup phases. The supplemental RGs contain additional information to help determine if performance of the tests in the proposed manner will likely accomplish the objectives of certain plant tests.

In FSAR Tier 2, Section 14.2.7, the applicant provided a list of RGs utilized for the development of the U.S. EPR initial test program. In addition, FSAR Tier 2, Table 1.9-2 provided a list of RGs applicable to the U.S. EPR design. The staff reviewed the tables mentioned above to ensure that the applicable RGs were included in the development of the initial test program. For those instances in which the applicant determined that RGs were not applicable to the U.S. EPR design or where exception to RGs were proposed, the staff reviewed the applicant's justification for the exception to ensure that the test program scope remained sufficient.

Upon review of FSAR Tier 2, Section 14.2.7, the staff identified the following areas where additional information was needed. Descriptions of the specific issues identified by the staff are as follows:

In RAI 68, Question 14.02-30, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.7 to correct the title of RG 1.9 from, "Selection, Design, and Qualification of Diesel-Generator Units Used as Onsite Electric Power Systems at Nuclear Power Plants," to the correct title of, "Application and Testing of Safety-Related Diesel Generators in Nuclear Power Plants." In an October 24, 2008, response to RAI 68, Question 14.02-30, the applicant proposed a revision to FSAR Tier 2, Section 14.2.7 to correct the title of RG 1.9. The proposed revisions are consistent with the guidance contained in RG 1.68 and are, therefore, acceptable to the staff. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, considers RAI 68, Question 14.02-30 resolved.

In RAI 143, Question 14.02-65, the staff noted that FSAR Tier 2, Section 14.2.10.8.10, "Main Control Room Air Conditioning System (Test #082)," includes testing of the toxic chemical detection system. Therefore, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.7 and FSAR Tier 2, Table 1.9-2 to state that RG 1.78, "Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release" is applicable to the testing conducted in FSAR Tier 2, Section 14.2. In a December 18, 2008, response to RAI 143, Question 14.02-65, the applicant proposed a revision to FSAR Tier 2, Section 14.2.7 and FSAR Tier 2, Table 1.9-2 to include RG 1.78. The staff finds the proposed revisions conform to the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, considers RAI 143, Question 14.02-65 resolved.

In RAI 143, Question 14.02-64, the staff noted that the applicant stated in FSAR Tier 2, Table 1.9-2 that the FSAR takes exception to RG 1.20, "Comprehensive Vibration Assessment

Program for Reactor Internals During Preoperational and Initial Startup Testing," for FSAR Tier 2, Section 14.2.12, "Individual Test Descriptions." The staff requested that the applicant revise FSAR Tier 2, Table 1.9-2, to include the use of RG 1.20 during startup vibration tests as described in RG 1.68, Appendix A, Section 1, Paragraph 3 or provide justification for the exception. In a February 13, 2008, response to RAI 143, Question 14.02-64, the applicant proposed a revision to FSAR Tier 2, Section 3.9.2.4.1, "Exceptions to Regulatory Guide 1.20," which explains their exceptions to RG 1.20 that affect the steam generator internals and the condensate system instrumentation. The staff notes that these exceptions were also added to FSAR Tier 2, Section 14.2.7 with additional details added to FSAR Tier 2, Sections 14.2.12.7.8, "Condensate System (Test #066)" and 14.2.12.13.4 "Pre-Core Reactor Internals Vibration Measurements (Test #164)," and FSAR Tier 2, Revision 3, Table 1.9-2. Additionally, the applicant reviewed and added RG 1.136, "Design Limits, Loading Combinations, Materials, Construction, and Testing of Concrete Containments," to FSAR Tier 2, Sections 14.2.7 and 14.2.12.3.6, "Containment Integrated Leak Rate and Structural Integrity Tests (Test #029)." The applicant also revised FSAR Tier 2, Table 1.8-2, Item 14.2-2 so that the wording of this item is consistent with the FSAR Tier 2, Section 14.2.11 "Test Program Schedule." The staff noted some inconsistencies, with the existing guidance, in the objectives of the test abstract in FSAR Tier 2, Section 14.2.12.13.4. Therefore, in follow-up RAI 260, Question 14.02-102, the staff requested that the applicant clarify the objective for Test #164 so that the test objective demonstrates that the reactor internal vibration is within design limits. In an October 21, 2009, response to RAI 260, Question 14.02-102, the applicant proposed a revision to the objectives of Test #164 regarding acceptable vibration amplitude and frequency. Additionally, the applicant revised all sections of the test abstract to address details from RG 1.20. In this manner, the applicant addressed the exceptions to start up vibrations tests for the steam generator internals and the condensate system instrumentation in FSAR Tier 2, Section 3.9.2.4.1. The staff finds the two exceptions acceptable based on the operational experience of steam generators and that RG 1.20 addresses instrumentation of steam dryers and steam systems in boiling water reactors and the U.S. EPR design is a pressurized water reactor (PWR). The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 143, Question 14.02-64 and RAI 260, Question 14.02-102 resolved.

Conclusions

The staff concludes that the information provided in FSAR Tier 2, Section 14.2.7 adequately describes U.S. EPR initial test program's conformance with RG 1.68. Additionally, information is provided in FSAR Tier 2, Section 1.9 which provides a guide to U.S. EPR conformance with regulatory criteria and FSAR Tier 2, Table 1.9-2 which provides a listing of the regulatory positions of RGs as they apply to the U.S. EPR design certification. The staff finds that all issues relating to this section of the initial test program have been resolved.

14.2.4.8 *Utilization of Reactor Operating and Testing Experiences in Development of Initial Test Program*

Introduction

In FSAR Tier 2, Section 14.2.8, "Utilization of Reactor Operating and Testing Experience in Development of Initial Test Program," the applicant provided measures for the review of relevant operating and testing experiences gained from previous successful startups. In addition, the

applicant provided a list of operating experience reports that will be used by plant personnel to collect relevant operating and testing experience.

Evaluation

The staff reviewed conformance of FSAR Tier 2, Section 14.2.8 to the guidance in NUREG-0800, Section 14.2.II.3.G, "Utilization of Reactor Operating and Testing Experiences in Development of Test Program," and the general guidelines and applicable regulatory positions in RG 1.68. In FSAR Tier 2, Section 14.2.8, the applicant described how it will use operating and testing experiences of other facilitates in the development of the initial test program. The staff noted that the applicant considers the use of experience gained from successful startups from previous U.S. EPR plant designs, as well as operating and testing experience obtained from NRC Licensee Event Reports (LERs), from Institute of Nuclear Power Operations (INPO) correspondence, and through other industry wide pressurized water reactor information sources. The applicant also stated that these experiences have been factored into the initial test program.

Upon review of FSAR Tier 2, Section 14.2.8, the staff identified the following areas where additional information is needed. A description of the specific issues identified by the staff is as follows:

In RAI 98, Question 14.02-51, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.8 to add the statement that the review of operating and test experiences should recognize reportable occurrences of repeatedly experienced safety concerns and other operating experiences that could potentially impact the performance of the test program as described in the SRP Section 14.2.II.3.B. In a November 14, 2008, response to RAI 98, Question 14.02-51, the applicant proposed a revision to FSAR Tier 2, Section 14.2.8 to include reviewing reportable occurrences of repeatedly experienced safety concerns and other operating experiences that could potentially impact the performance of the test program. The staff finds the proposed revisions consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, considers RAI 98, Question 14.02-51 resolved.

In FSAR Tier 2, Section 14.2.8.1, "First-of-a-Kind Testing," the applicant discussed first-of-a-kind (FOAK) testing as it applies to the U.S. EPR design. The applicant stated that the U.S. EPR plant is not a FOAK plant, and testing of plant SSCs that may be novel in the U.S. EPR will be conducted in European plants prior to any U.S. unit, providing operational and testing data that will be used in U.S. plants. In addition, the applicant provided a list of features that "may be novel in the U.S." that will be tested during the initial test program at all U.S. EPR plants. The staff concurs with the applicant that the U.S. EPR is not a FOAK plant, because the U.S. EPR design does not have new passive features that have not been implemented in previous commercial nuclear plants. Additionally, the staff noted that operational and testing experience will be available and will be factored into the development of the initial test program for U.S. facilities. The staff finds that such provisions will ensure adequate consideration of existing and testing and operational data.

In RAI 98, Question 14.02-45, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.8.1 to remove the statement, "The first COL applicant that references the U.S. EPR certified design will commit to review results from European predecessors concerning new, unique, or novel EPR features such as those previously noted and propose supplemental

testing if necessary." This statement to commit only the first COL applicant to review the operating experience is a redundant COL information item, as this action item is already contained in the commitment in FSAR Tier 2, Section 14.2.8 which states that all plants will review all operating and test experiences. In a November 14, 2008, response to RAI 98, Question 14.02-45, the applicant proposed a revision to FSAR Tier 2, Section 14.2.8.1 and FSAR Tier 2, Table 1.8-2 to delete the statement to commit to reviews of testing results from European predecessors concerning new, unique or novel U.S. EPR features. The staff finds the proposed revisions are consistent with existing guidance, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, considers RAI 98, Question 14.02-45 resolved.

Conclusions

The staff finds that the information provided in FSAR Tier 2, Section 14.2.8 adequately describes the activities related to the review of relevant operating and testing experiences gained from previous successful startups, and is therefore acceptable. The staff finds all issues relating to this section of the initial test program have been resolved.

14.2.4.9 *Trial Use of Plant Operating and Emergency Procedures*

Introduction

In FSAR Tier 2, Section 14.2.9, "Trial Use of Plant Operating and Emergency Procedures," the applicant stated that the schedule for the development of the plant operating and emergency procedures will allow sufficient time for trial use of these procedures during the initial test program as appropriate and to the extent possible. Emergency procedures will be performed on the plant simulator for procedure validation and operator training.

To the extent practicable throughout the preoperational and initial startup test program, test procedures utilize operating, emergency, and abnormal procedures where applicable in the performance of tests. The use of these procedures is intended to (1) prove the specific procedure or illustrate changes which may be required, (2) provide training of plant personnel in the use of these procedures, and (3) increase the level of knowledge of plant personnel on the systems being tested.

Evaluation

The staff reviewed conformance of FSAR Tier 2, Section 14.2.9 to the guidance in NUREG-0800, Section 14.2.II.3.H, "Trial Use of Plant Operating and Emergency Procedures," and the general guidelines and applicable regulatory positions in RG 1.68. SRP Section 14.2 indicates that the applicant should incorporate, to the extent practicable, plant operating, emergency, and surveillance procedures into the test program, or otherwise verify these procedures through use during the test program. The staff reviewed the methodology submitted by the applicant that will be used to verify plant operating and emergency procedures during the conduct of the initial test program.

The staff noted that the applicant included provisions in FSAR Tier 2, Section 14.2.9 to allow for sufficient time for development and trial use of the plant operating and emergency procedures so that they can be used, to the extent practical, during the initial test program. The staff also noted that FSAR Tier 2, Section 14.2.9 states that the COL applicant is responsible for

identifying the specific operator training to be conducted as part of the low-power test program related to the resolution of the Three Mile Island (TMI) Action Plan, Item I.G.1. The applicant stated that the COL applicant should conduct this training as described in the following reports: NUREG-0660, "NRC Action Plans Developed as a Result of the TMI-2 Accident," Revision 1, August 1980; NUREG-0694, "TMI-Related Requirements for New Operating Licenses," June 1980; and NUREG-0737, "Clarification of TMI Action Plan Requirements," November 1980. Also, the applicant stated that emergency procedures will be performed on the plant simulator to accomplish the requirements for procedure validation and operator training.

Upon review of FSAR Tier 2, Section 14.2.9, the staff identified the following areas where additional information is needed. Descriptions of the specific issues identified by the staff are as follows:

In RAI 85, Question 14.02-36, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.9 and FSAR Tier 2, Table 1.8-2 to address all COL information items assigned to the COL applicant or justify their omission as described in SRP Section 14.2.I.3. In a January 14, 2008, response to RAI 85, Question 14.02-36, the applicant proposed a revision to FSAR Tier 2, Section 14.2.9 and FSAR Tier 2, Table 1.8-2 to include these COL applicant information items. The staff finds the proposed revisions are consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 85, Question 14.02-36 resolved.

In RAI 127, Question 14.02-57, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.9 to (1) include guidance on use of surveillance procedures during the initial test program, (2) include guidance on the incorporation of operating and surveillance procedures into the test program for verification, and (3) provide for correction of operating and emergency procedures after trial-testing as described in SRP Sections 14.2.II.3.C and 14.2.II.3.H.i. In a December 12, 2008, response to RAI 127, Question 14.02-57, the applicant proposed a revision to FSAR Tier 2, Section 14.2.9 to provide: (1) Guidance on using surveillance procedures during the initial test program; (2) guidance on incorporating operating and surveillance procedures in the test program for verification; and (3) provisions for correcting operating and emergency procedures after trial-testing. The staff finds the proposed revisions are consistent with existing guidance, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 127, Question 14.02-57 resolved.

In RAI 127, Question 14.02-58, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.9 to include the performance of operator training for all procedures which include plant changes (such as operating and surveillance) and off-normal events in addition to emergency procedures as described in SRP Sections 14.2.II.3.H.i and 14.2.II.3.H.ii. In a December 12, 2008, response to RAI 127, Question 14.02-58, the applicant proposed a revision to FSAR Tier 2, Section 14.2.9 to include hands-on training for plant evaluation and off-normal events in addition to emergency procedures. Additionally, the applicant stated that each operating shift will have training for normal operating and surveillance procedures. The staff finds the proposed revisions are consistent with existing guidance, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 127, Question 14.02-58 resolved.

In RAI 127, Question 14.02-59, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.9 to include provisions for "hands-on" operator training and participation based on the performance and evaluation of the test results of certain initial tests to fulfill the criteria of TMI Action Plan Item 1.G.1 or justify the use of the simulator for operator training in lieu of "hands-on" training and participation. In a December 12, 2008, response to RAI 127, Question 14.02-59, the applicant proposed a revision to FSAR Tier 2, Section 14.2.9 to include hands-on training for plant evaluation and off-normal events in addition to emergency procedures. Additionally, the applicant stated that each operating shift will have training for normal operating and surveillance procedures. The staff finds the proposed revisions consistent with existing guidance, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 127, Question 14.02-59 resolved.

Conclusions

The staff finds that the information provided in FSAR Tier 2, Section 14.2.9 adequately describes that the schedule for the development of the plant operating and emergency procedures will allow sufficient time for trial use of these procedures during the initial test program as appropriate and to the extent possible, and is thus acceptable. All issues relating to this section of the initial test program have been resolved.

The staff also concludes that it is acceptable to defer the review of the trial use of operating and emergency procedures to the COL phase, because the development of operating and emergency procedures will depend upon detailed plant-specific design information. This is identified as COL Information Item 14.2-9.

14.2.4.10 *Initial Fuel Loading and Initial Criticality*

Introduction

In FSAR Tier 2, Section 14.2.10, "Initial Fuel Loading and Initial Criticality," the applicant stated that initial fuel loading and initial criticality will be performed in a controlled manner during the startup test program. The minimum initial conditions for the core and the criteria for the safe loading of fuel are specified. Criteria are also specified for a safe and controlled approach to criticality.

Evaluation

The staff reviewed conformance of FSAR Tier 2, Section 14.2.10 to the guidance in NUREG-0800, Section 14.2.II.4.A, "Initial Fuel Loading/Initial Criticality/Low Power /Power Ascension Testing," and the general guidelines and applicable regulatory positions in RG 1.68. As stated in the regulatory guidance, initial fuel loading and pre-critical tests (1) ensure safe initial core loading, (2) ensure that provisions are in place to maintain shutdown margin, and (3) ensure that the facility is in a final state of readiness to achieve criticality and perform low-power testing.

Initial Fuel Loading

The applicant included provisions for initial fuel loading prerequisites in accordance with RG 1.68 and SRP Section 14.2. The staff noted that these provisions included Technical

Specifications compliance, use of approved plant procedures, proper verification of water level and chemistry, and calibration and response of nuclear instrumentation. In addition, to ensure safe fuel loading, the applicant provides criteria for immediately stopping fuel loading operations, and requires that procedures shall have criteria for emergency boron injection, containment evacuation and actions to be followed in the event of fuel failures.

Upon review of FSAR Tier 2, Section 14.2.10.1, "Initial Fuel Loading," the staff identified the following areas where additional information is needed. Descriptions of the specific issues identified by the staff are as follows:

In RAI 68, Question 14.02-24, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.10.1 to include, or justify the exclusion of, the additional prerequisites given in RG 1.68, Appendix C.2.a. Additionally, the staff requested, that the applicant clarify why the statement, "All ITAAC have been closed," from FSAR Tier 2, Section 14.2.10.1 was edited out of their response. In an October 24, 2008, response to RAI 68, Question 14.02-24, the applicant stated, "All ITAAC have been closed," from FSAR Tier 2, Section 14.2.10.1 was removed from the FSAR, because it is not specific to the initial test program. Additionally, the applicant proposed a revision to FSAR Tier 2, Section 14.2.10.1 to include the missing prerequisites given in RG 1.68, Appendix C.2.a. The staff finds the proposed revisions consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 68, Question 14.02-24 resolved.

In RAI 16, Question 14.02-13, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.10.1 to include the criteria for the safe loading of fuel and the guidance to stop fuel loading operations in RG 1.68, Appendix C.2.c. In an August 4, 2008, response to RAI 16, Question 14.02-13, the applicant proposed a revision to FSAR Tier 2, Section 14.2.10.1 which included all of the safe fuel loading criteria and the guidance to stop fuel loading operations of RG 1.68, Appendix C.2.c. The staff finds the proposed revisions are consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 16, Question 14.02-13 resolved.

Initial Criticality

In FSAR Tier 2, Section 14.2.10, the applicant described the controls to be used for controlled approach to criticality. These controls include the use of approved plant procedures, use of an orderly combination of control rod withdrawal and boron concentration reduction, and monitoring of the core response. The applicant included provisions for initial criticality prerequisites in the Technical Specifications in accordance with RG 1.68 and SRP Section 14.2. The staff noted that these provisions for a safe and controlled approach to criticality included that the following conditions are met: Technical Specifications; a minimum count rate of one half counts per second; and a sustained startup rate of one decade per minute is not exceeded. In addition, to ensure safe approach to criticality, the applicant provided controls for requiring rod control withdrawal and boron dilution to be stopped if unexplainable changes occur in the neutron count rates.

Upon review of FSAR Tier 2, Section 14.2.10.2, "Initial Criticality," the staff identified the following areas where additional information is needed. Descriptions of the specific issues identified by the staff are as follows:

In RAI 68, Question 14.02-23, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.10.2 to clarify the use of two counts per second versus the one-half counts per second recommended in RG 1.68, Appendix C.2.a. Additionally, the staff requested that the applicant clarify the process the applicant will use to perform a statistical reliability test on each operable source range instrument. In a December 5, 2008, response to RAI 68, Question 14.02-23, the applicant proposed a revision to FSAR Tier 2, Section 14.2.10.2 to include a neutron count rate of a minimum of one-half counts per second and a description of the statistical reliability test on each operable source range instrument. The staff finds the proposed revisions are consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 68, Question 14.02-23 resolved.

In RAI 68, Question 14.02-25, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.10.2 to clarify the use of the same rod withdrawal sequences and patterns in subsequent plant startups as specified in RG 1.68, Appendix A.3. In an October 24, 2008, response to RAI 68, Question 14.02-25, the applicant proposed a revision to FSAR Tier 2, Section 14.2.10.2 to provide a statement that the approach to initial criticality will be in a deliberate and orderly manner using the same rod withdrawal sequences and patterns that will be used during subsequent startups. The staff finds the proposed revisions are consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 68, Question 14.02-25 resolved.

Conclusions

The staff concludes that the information provided in FSAR Tier 2, Section 14.2.10 adequately describes the minimum initial conditions for the core and the criteria for the safe loading of fuel and the criteria for providing a safe and controlled approach to criticality. Additionally, the applicant stated that initial fuel loading and initial criticality will be performed in a controlled manner during the startup test program. The staff finds that all issues relating to this section of the initial test program have been resolved.

14.2.4.11 *Test Program Schedule*

Introduction

In FSAR Tier 2, Section 14.2.11, the applicant stated that the scheduling of individual tests or test sequences will be established so that systems and components that are required to prevent or mitigate the consequences of postulated accidents are tested prior to fuel loading. Tests that require a substantial core power level for proper performance will be performed at the lowest power level commensurate with obtaining acceptable test data. Guidance for developing a test program is provided for COL applicants referencing the U.S. EPR design.

Evaluation

The staff reviewed conformance of FSAR Tier 2, Section 14.2.11 to the guidance in NUREG-0800, Section 14.2.II.3.C, "Test Program Schedule and Sequence," and the general guidelines and applicable regulatory positions in RG 1.68. RG 1.68 states that sufficient time should be scheduled to perform an orderly and comprehensive testing, providing for a minimum time of approximately 9 months for conducting the preoperational testing phase, and a minimum time of approximately 3 months for conducting the initial startup testing phase. In addition, SRP Section 14.2 states, in part, that the safety of the plant will not depend entirely on the performance of untested systems, components, or features.

The staff reviewed the applicant's methodology, which will be utilized to develop the initial test program schedule and sequence. The applicant provided general controls to ensure that systems and components that are required to prevent or mitigate the consequences of postulated accidents are tested prior to fuel loading and that tests that require a substantial core power level for proper performance are performed at the lowest power level commensurate with obtaining acceptable test data.

In FSAR Tier 2, Section 14.2.11, the applicant states that it is the responsibility of the COL applicant that references the U.S. EPR FSAR to develop a test program that considers the following components:

- The applicant should allow at least 9 months for conducting preoperational testing.
- The applicant should allow at least 3 months to conduct startup testing, including fuel loading, low-power tests, and power-ascension tests.
- Plant safety will not be dependent on the performance of untested SSCs during any phase of the startup test program.
- Surveillance test requirements will be completed in accordance with plant Technical Specification requirements for SSC operability before changing plant modes.
- Overlapping test program schedules (for multi-unit sites) should not result in significant divisions of responsibilities or dilutions of the staff provided to implement the test program.
- The sequential schedule for individual startup tests should establish, insofar as practicable, that test requirements should be completed prior to exceeding 25 percent power for SSCs that are relied on to prevent, limit, or mitigate the consequences of postulated accidents.
- Approved test procedures should be in a form suitable for review by regulatory inspectors at least 60 days prior to their intended use or at least 60 days prior to fuel loading for fuel loading and startup test procedures.

Upon review of FSAR Tier 2, Section 14.2.1, the staff identified the following area where additional information is needed. A description of the specific issue identified by the staff is as follows:

In RAI 189, Question 14.02-95, the staff requested that the applicant revise the COL information item in FSAR Tier 2, Section 14.2.11 to include the COL applicant's responsibility to identify and cross-reference each test (or portion thereof) required to be completed before initial fuel loading and that is designed to satisfy the requirements for completing ITAAC in accordance with 10 CFR 52.99(a). In a March 30, 2009, response to RAI 189, Question 14.02-95, the applicant proposed a revision to FSAR Tier 2, Section 14.2.11 and Table 1.8-2 to include the COL information item to identify and cross-reference each test (or portion thereof) required to be completed before initial fuel loading and that is designed to satisfy the requirements for completing ITAAC. The staff finds the proposed revisions are consistent with existing guidance, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 189, Question 14.02-95 resolved.

Conclusions

The staff concludes that the information provided in FSAR Tier 2, Section 14.2.11 adequately describes that tests are to be scheduled, so that systems and components that are required to prevent or mitigate the consequences of postulated accidents are tested prior to fuel loading. Additionally, the test schedule and sequence of testing ensures that tests that require a substantial core power level for proper performance will be performed at the lowest power level commensurate with obtaining acceptable test data. For the reasons discussed above, the staff finds that all issues relating to this section of the initial test program have been resolved.

Also, since the schedule will be implemented by the COL applicant; the staff concluded that it is acceptable to defer responsibility for the development of a detailed test program schedule to the COL applicant. This is identified as COL Information Item 14.2-2.

14.2.4.12 *Individual Test Descriptions*

Introduction

FSAR Tier 2, Section 14.2.12 contains individual preoperational and startup test abstracts. Each abstract identifies test objectives, prerequisites, test methods, data required, and acceptance criteria. The minimum test requirements are generally based on system or component functional design requirements that were used in the safety analysis. Detailed preoperational and startup test procedures will be developed using these test abstracts.

Evaluation

The staff reviewed conformance of FSAR Tier 2, Section 14.2.12 to the guidance in NUREG-0800, Section 14.2.II.5, "Individual Test Descriptions/Abstracts," and the general guidelines and applicable regulatory positions in RG 1.68. RG 1.68, Appendix A addresses the specific tests required for each of the five phases of the initial test program, which are: (1) Preoperational testing; (2) initial fuel loading and pre-criticality testing; (3) initial criticality testing; (4) low-power testing; and (5) power ascension testing.

In FSAR Tier 2, Section 14.2.12, the applicant provided 217 test abstracts for the preoperational and startup testing program. For each of the test abstracts, the staff reviewed the test objective, prerequisites, test method, data required, and acceptance criteria to verify conformance with NRC regulatory guidance.

Upon review of FSAR Tier 2, Section 14.2.12, the staff identified the following areas where additional information is needed. Descriptions of the specific issues identified by the staff are as follows:

In RAI 255, Question 14.02-97, the staff requested that the applicant indicate which test abstract in FSAR Tier 2, Section 14.2.12 will include testing of the cold water interlocks requirements described in RG 1.68, Appendix A, Section 1, Paragraph h.5, or justify the exclusion of this test. In a July 22, 2009, response to RAI 255, Question 14.02-97, the applicant stated that the U.S. EPR does not have "cold water interlocks" systems or functions. The U.S. EPR does have a low temperature overpressure interlock (LTOP) as part of its protection system (PS) and the applicant proposed a revision to FSAR Tier 2, Section 14.2.12.11.22, "Protection System (Test #146)," to clarify that PS interlocks are to be tested. The staff finds the proposed revisions are consistent with the guidance contained in RG 1.68, and therefore, acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, the staff considers RAI 255, Question 14.02-97 resolved.

Phase I: Preoperational Testing

The following is a list of "Phase I: Preoperational Testing" abstracts described in FSAR Tier 2, Sections 14.2.12.1 through 14.2.12.13:

NSSS Support Systems

14.2.12.1.1, "Fuel Pool Cooling and Purification System (Test #001)"

14.2.12.1.2, "CVCS Volume Control Tank (Test #002)"

14.2.12.1.3, "CVCS Charging and Seal Injection (Test #003)"

14.2.12.1.4, "CVCS Letdown (Test #004)"

14.2.12.1.5, "CVCS Chemical Addition (Test #005)"

14.2.12.1.6, "Coolant Supply & Storage System (Test #006)"

14.2.12.1.7, "Reactor Boron & Water Makeup System (Test #007)"

14.2.14.1.8, "Boric Acid Mixing Tank (Test #008)"

14.2.12.1.9, "Boric Acid Storage Tank (Test #009)"

14.2.12.1.10, "Coolant Degasification System (Test #010)"

14.2.12.1.11, "Coolant Purification System (Test #011)"

14.2.12.1.12, "Reactor Coolant System (Test #012)"

Front Lines Safety Systems

14.2.12.2.1, "Combustible Gas Control System (Test #013)"

14.2.12.2.2, “Medium Head Safety Injection (Test #014)”

14.2.12.2.3, “Safety Injection Accumulator (Test #015)”

14.2.12.2.4, “Residual Heat Removal (Test #016)”

14.2.12.2.5, “Mid-Loop Operations Verification (Test #017)”

14.2.12.2.6, “Severe Accident Heat Removal System (Test #018)”

14.2.12.2.7, “Extra Borating System (Test #019)”

14.2.12.2.8, “Emergency Feedwater System (Test #020)”

14.2.12.2.9, “Emergency Feedwater Storage Pool (Test #021)”

14.2.12.2.10, “In-Containment Refueling Water Storage Tank System (Test #022)”

14.2.12.2.11, “Core Melt Stabilization System (Test #023)”

Engineered Components

14.2.12.3.1, “Containment Equipment Hatch Functional and Leak Test (Test #024)”

14.2.12.3.2, “Containment Personnel Airlock Functional and Leak Test (Test #025)”

14.2.12.3.3, “Containment Electrical Penetration Assemblies (Test #026)”

14.2.12.3.4, “Containment Isolation Valves (Test #027)”

14.2.12.3.5, “Containment Isolation Valves Leakage Rate (Test #028)”

14.2.12.3.6, “Containment Integrated Leak Rate and Structural Integrity Tests (Test #029)”

14.2.12.3.7, “Reactor Coolant System Hydrostatic Test (Test #030)”

14.2.12.3.8, “Reactor Coolant Pump Motor Initial Operation (Test #031)”

14.2.12.3.9, “Steam Generator Hydrostatic (Test #032)”

14.2.12.3.10, “Steam Generator Downcomer Feedwater System Water Hammer (Test #033)”

14.2.12.3.11, “Balance of Plant Piping Thermal Expansion Measurement (Test #034)”

14.2.12.3.12, “Balance of Plant Piping Vibration Measurement (Test #035)”

14.2.12.3.13, “Control Rod Drive Mechanism Control (Test #036)”

14.2.12.3.14, “Pressurizer Safety Relief Valves (Test #037)”

14.2.12.3.15, “Fuel Handling System (Test #038)”

14.2.12.3.16, “Fuel Transfer System Operation and Leak Test (Test #039)”

Civil Components and Systems

14.2.12.4.1, “Containment Polar Crane (Test #040)”

14.2.12.4.2, “Fuel Building Cranes (Test #041)”

14.2.12.4.3, “Turbine Building Crane (Test #042)”

Distributed Utilities

14.2.12.5.1, “Raw Water Supply System (Test #043)”

14.2.12.5.2, “Reactor Containment Building Doors (Test #044)

14.2.12.5.3, “Seal Water Supply System (Test #045)”

14.2.12.5.4, “Potable and Sanitary Water System (Test #225)”

14.2.12.5.5, “Component Cooling Water System (Test #046)”

14.2.12.5.6, Reserved (Test #047)

14.2.12.5.7, “Essential Service Water System (Test #048)”

14.2.12.5.8, “Ultimate Heat Sink (Test #049)”

14.2.12.5.9, Reserved (Test #050)

General Supply Systems

14.2.12.6.1, Reserved (Test #051)

14.2.12.6.2, “Safety Chilled Water (Test #052)”

14.2.12.6.3, Reserved (Test #053)

14.2.12.6.4, “Fire Water Distribution System (Test #054)”

14.2.12.6.5, “Spray Deluge Systems (Test #055)”

14.2.12.6.6, “Sprinkler Systems (Test #056)”

14.2.12.6.7, “Gaseous Fire Extinguishing Systems (Test #057)”

14.2.12.6.8, Reserved (Test #058)

Power Conversion Systems

14.2.12.7.1, “Feedwater System (Test #059)”

14.2.12.7.2, “Feedwater Heating System (Test #060)”

14.2.12.7.3, “Main Steam - Turbine Bypass Systems (Test #061)”

14.2.12.7.4, “Main Steam Safety Valve (Test #062)”

14.2.12.7.5, “Main Steam Isolation Valves, and MSIV Bypass Valves (Test #063)”

14.2.12.7.6, “Turbine Gland Sealing System (Test #064)”

14.2.12.7.7, “Main Condenser and Main Condenser Evacuation System (Test #065)”

14.2.12.7.8, “Condensate System (Test #066)”

14.2.12.7.9, “Steam Generator Blowdown System (Test #067)”

14.2.12.7.10, “Steam Turbine (Test #068)”

14.2.12.7.11, “Circulating Water Supply System (Test #069)”

14.2.12.7.12, “Reheater Drains System (Test #070)”

14.2.12.7.13, “Secondary Sampling System (Test #071)”

14.2.12.7.14, “Steam Generator Blowdown Demineralizing System (Test #072)”

Heating Ventilation and Air Conditioning (HVAC) Systems

14.2.12.8.1, “Containment Building Cooling (Test #073)”

14.2.12.8.2, “Containment Building Cooling Subsystem (Test #074)”

14.2.12.8.3, “Containment Building Ventilation System (Test #075)”

14.2.12.8.4, “Containment Purge (Test #076)”

14.2.12.8.5, “Annulus Ventilation System (Test #077)”

14.2.12.8.6, “Electrical Division of Safeguard Building Ventilation System (Test #078)”

14.2.12.8.7, “Nuclear Auxiliary Building Ventilation System (Test #079)”

14.2.12.8.8, “Radioactive Waste Building Ventilation System (Test #080)”

14.2.12.8.9, “Fuel Building Ventilation System (Test #081)”

14.2.12.8.10, “Main Control Room Air Conditioning System (Test #082)”

14.2.12.8.11, “Safeguard Building Controlled Area Ventilation System (Test #083)”

14.2.12.8.12, “Emergency Power Generating Building Ventilation (Test #084)”

14.2.12.8.13, “Smoke Confinement System (Test #085)”

14.2.12.8.14, “Station Blackout Room Ventilation System (Test #086)”

14.2.12.8.15, “Turbine Island Ventilation Systems (Test #087)”

14.2.12.8.16, “Essential Service Water Pump Building Ventilation System (Test #088)”

14.2.12.8.17, “Main Steam and Feedwater Valve Room System (Test #089)”

14.2.12.8.18, “Plant Laboratory Equipment (Test #090)”

14.2.12.8.19, “Access Building Ventilation System (Test #224)”

Auxiliary Systems

14.2.12.9.1, “Leak-off System (Test #091)”

14.2.12.9.2, “Sampling Activity Monitoring System (Test #092)”

14.2.12.9.3, “Solid Waste Storage (Test #093)”

14.2.12.9.4, “Radioactive Concentrates Processing - Solid Waste (Test #094)”

14.2.12.9.5, “Liquid Waste Processing (Test #095)”

14.2.12.9.6, “Reactor Coolant Drain Tank (Test #096)”

14.2.12.9.7, “Process Drain Tank (Test #097)”

14.2.12.9.8, “Equipment and Floor Drainage System (Test #098)”

14.2.12.9.9, “Gaseous Waste Processing System (Test #099)”

14.2.12.9.10, “Nuclear Sampling System (Test #100)”

14.2.12.9.11, “Station Blackout Diesel Generator Mechanical (Test #101)”

14.2.12.9.12, “Station Blackout Diesel Generator Electrical (Test #102)”

14.2.12.9.13, “Station Blackout Diesel Generator Auxiliaries (Test #103)”

14.2.12.9.14, “Emergency Diesel Generator Mechanical (Test #104)”

14.2.12.9.15, “Emergency Diesel Generator Electrical (Test #105)”

14.2.12.9.16, “Emergency Diesel Generator Auxiliaries (Test #106)”

14.2.12.9.17, “Auxiliary Steam Generating System (Test #107)”

Electrical Systems

14.2.12.10.1, “Switchyard and Preferred Power (Test #108)”

14.2.12.10.2, “Main Generator (Test #109)”

14.2.12.10.3, “Class 1E Uninterruptible Power Supply (Test #110)”

14.2.12.10.4, “Non-Class 1E Uninterruptible Power Supply (Test #111)”

14.2.12.10.5, “Communication System (Test #112)”

14.2.12.10.6, “Normal Lighting (Test #113)”

14.2.12.10.7, “Heat Tracing (Test #114)”

14.2.12.10.8, “Emergency Lighting (Test #115)”

14.2.12.10.9, “6.9 kV Emergency Power Supply System (Test #116)”

14.2.12.10.10, “480 Volt Emergency Power Supply System (Test #117)”

14.2.12.10.11, “13.8 kV Normal Power Supply System (Test #118)”

14.2.12.10.12, “6.9 kV Normal Power Supply System (Test #119)”

14.2.12.10.13, “480 Volt Normal Power Supply System (Test #120)”

14.2.12.10.14, “12-Hour Uninterruptible Power Supply (Test #121)”

Instrumentation and Control (I&C) Systems

14.2.12.11.1, “Safety Information and Control System (Test #124)”

14.2.12.11.2, “Seismic Monitoring System (Test #125)”

14.2.12.11.3, “Boron Concentration Measurement System (Test #126)”

14.2.12.11.4, “Aeroball Measurement System (Test #127)”

14.2.12.11.5, “Process Automation System (Test #128)”

14.2.12.11.6, “Process Information and Control System (Test #129)”

14.2.12.11.7, “Control Rod Drive Control System (Test #130)”

14.2.12.11.8, “Vibration Monitoring System (Test #131)”

14.2.12.11.9, “Plant Fire Alarm System (Test #132)”

14.2.12.11.10, “Loose Parts Monitoring System (Test #133)”

14.2.12.11.11, “Turbine-Generator Instrumentation and Control (Test #134)”

14.2.12.11.12, “Reactor Pressure Vessel Level Measurement System (Test #135)”

14.2.12.11.13, “Fatigue Monitoring System (Test #136)”

14.2.12.11.14, “Leak Detection System (Test #137)”

14.2.12.11.15, “Safety Automation System (Test #139)”

14.2.12.11.16, “Remote Shutdown Station (Test #140)”

14.2.12.11.17, “Incore Instrumentation System (Test #141)”

14.2.12.11.18, “Excore Instrumentation System (Test #142)”

14.2.12.11.19, “Radiation Monitoring System (Test #143)”

14.2.12.11.20, “Process and Effluent Radiological Monitoring System (Test #144)”

14.2.12.11.21, “Hydrogen Monitoring System (Test #145)”

14.2.12.11.22, “Protection System (Test #146)”

14.2.12.11.23, “Reactor Control, Surveillance and Limitation System (Test #147)”

14.2.12.11.24, “Diverse Actuation System (Test #157)”

14.2.12.11.25, “Rod Position Measurement System (Test #158)”

14.2.12.11.26, “Process Radiation Monitor (Test #159)”

14.2.12.11.27, “Personnel Radiation Monitors (Test #160)”

11.2.12.11.28, “Signal Conditioning and Distribution System (Test #121)”

11.2.12.11.29, “Priority and Actuator Control System (Test #122)”

I&C Functions

14.2.12.12.1, “Accident Monitoring (Test #138)”

14.2.12.12.2, “Main Steam Relief Trains (Test #148)”

14.2.12.12.3, “Steam Generator Level Control System (Test #149)”

14.2.12.12.4, “Partial Trip (Test #150)”

14.2.12.12.5, “Primary Depressurization System (Test #151)”

14.2.12.12.6, “Partial Cooldown (Test #152)”

14.2.12.12.7, “Integrity of Systems Likely to Contain Radioactive Material (Test #153)”

14.2.12.12.8, “Remote Safe Shutdown (Test #154)”

14.2.12.12.9, “Post Accident Monitoring Instrumentation (Test #155)”

14.2.12.12.10, “Pressurizer Pressure and Level Control (Test #156)”

Hot Functional Tests

14.2.12.13.1, “Hot Functional Sequencing Document (Test #161)”

14.2.12.13.2, “Pre-Core Instrument Correlation (Test #162)”

14.2.12.13.3, “Pre-Core Test Data Record (Test #163)”

14.2.12.13.4, “Pre-Core Reactor Internals Vibration Measurements (Test #164)”

14.2.12.13.5, “Pre-Core Reactor Coolant System Expansion Measurements (Test #165)”

14.2.12.13.6, “Pre-Core Primary and Secondary Chemistry Data (Test #166)”

14.2.12.13.7, “Pre-Core Pressurizer Performance (Test #167)”

14.2.12.13.8, “Pre-Core Pressurizer Surge Line Stratification (Test #168)”

14.2.12.13.9, “Pre-Core Control Rod Drive Mechanism Performance (Test #169)”

14.2.12.13.10, “Pre-Core Reactor Coolant System Flow Model Verification (Test #170)”

14.2.12.13.11, “Pre-Core Reactor Coolant System Heat Loss (Test #171)”

14.2.12.13.12, “Pre-Core Primary System Leak Rate Measurement (Test #172)”

14.2.12.13.13, “Pre-Core CVCS Integrated Test (Test #173)”

14.2.12.13.14, “Pre-Core Turbine Overspeed (Test #174)”

14.2.12.13.15, “Pre-Core Safety Injection Check Valve Test (Test #175)”

14.2.12.13.16, “Pre-Core Boration and Dilution Measurements (Test #176)”

14.2.12.13.17, “Pre-Core Safety Injection Initiated at HZP (Test #177)”

14.2.12.13.18, “Pre-Core Loss of Instrument Air (Test #178)”

14.2.12.13.19, “Pre-Core Electrical Distribution System Voltage Verification (Test #226)”

14.2.12.13.20, “Pre-Core Protection System Operation (Test #228)”

In comparing the U.S. EPR preoperational tests to the preoperational testing recommended in RG 1.68, Appendix A, Section 1, the staff identified several areas where additional information was required to complete its review. Descriptions of the specific issues follow:

FSAR Tier 2, Section 14.2.12.1, “NSSS Support Systems”

In RAI 127, Question 14.02-52, the staff requested that the applicant revise Sections 14.2.12.1.2 through 14.2.12.1.11 test abstracts to clarify how the support systems will be considered functional and how the automatic actions of the alarms and interlocks will be verified. In a December 12, 2008, response to RAI 127, Question 14.02-52, the applicant revised FSAR Tier 2, Section 14.2.3 “Test Procedures,” to address the applicant’s philosophy for verifying alarms, permissives and the determination by the test review team as to the acceptability of preoperational tests that have upstream or downstream systems that are not functional. The staff finds that the changes to the FSAR are consistent with the guidance contained in RG 1.68 and, therefore, considers RAI 127, Question 14.02-52 resolved.

In RAI 127, Question 14.02-53, the staff requested that the applicant revise the test abstract in FSAR Tier 2, Section 14.2.12.1.3, "CVCS Charging and Seal Injection (Test #003)," to address verification that the seal injection subsystem is operational, including verification of the operation of the seal injection filters and the differential pressure alarm. In a December 12, 2008, response to RAI 127, Question 14.02-53, the applicant revised FSAR Tier 2, Section 14.2.12.1.3, "CVCS Charging and Seal Injection (Test #003)," to include verification that the seal injection filters and the differential pressure alarm are operational. The staff finds the changes to the FSAR are consistent with the guidance contained in RG 1.68 and, therefore, considers RAI 127, Question 14.02-53 resolved.

FSAR Tier 2, Section 14.2.12.2, "Front Line Safety Systems"

The staff finds the tests for "Front Line Safety Systems" consistent with the guidance contained in RG 1.68.

FSAR Tier 2, Section 14.2.12.3, "Engineered Components"

In RAI 85, Question 14.02-35, the staff requested that the applicant revise the acceptance criteria in FSAR Tier 2, Section 14.2.12.3.6, "Containment Integrated Leak Rate Structural Integrity Tests (Test #029)," to include the references American Society of Mechanical Engineers (ASME) Boiler & Pressure Vessel (B&PV) Code, Article CC-6000 and FSAR Tier 2, Section 3.8.1.7.1, "Structural Integrity Test." In a November 03, 2008, response to RAI 85, Question 14.02-35, the applicant included both references in FSAR Tier 2, Section 14.2.12.3.6. The staff finds the changes to the FSAR are consistent with the guidance contained in RG 1.68 and, therefore, considers RAI 85, Question 14.02-35 resolved.

In RAI 98, Question 14.02-39, the staff requested that the applicant revise the test abstract in FSAR Tier 2, Section 14.2.12.3.14, "Pressurizer Safety Valve (Test #037)," to include provisions to verify the solenoid actuator operation of the pressurizer safety relief valve (PSRV). Additionally, the staff requested that the applicant verify the sections of the FSAR referenced in the acceptance criteria. In a November 14, 2008, response to RAI 98, Question 14.02-39, the applicant revised this test abstract to verify the remote manual function of the PSRV and to reference FSAR Tier 2, Section 5.2.2, "Overpressure Protection," and FSAR Tier 2, Section 5.4.13, "Safety and Relief Valves." Additionally, the staff notes that FSAR Tier 2, Section 14.2.12.3.14 was revised to better match the terminology in FSAR Tier 2, Section 5.4.13. The staff finds that the changes to the FSAR are consistent with the guidance contained in RG 1.68 and, therefore, considers RAI 98, Question 14.02-39 resolved.

In RAI 143, Question 14.02-62, the staff requested that the applicant revise the objectives in the test abstract in FSAR Tier 2, Section 14.2.12.3.13, "Control Rod Drive Mechanism Control (Test #036)," to include a demonstration of control rod withdrawal inhibit features, runback features, rod withdrawal sequence control devices, rod worth minimizers, and proper interaction of control rod drive system with other systems and design features as described RG 1.68, Appendix A, Section 1, Paragraph b.(1). In a December 18, 2008, response to RAI 143, Question 14.02-62, the applicant proposed a revision to FSAR Tier 2, Section 14.2.12.3.13, "Control Rod Drive Mechanism Control (Test #036)," to add the following items to the test method section of the abstract; control rod drive mechanism (CRDM) withdrawal inhibiting features, CRDM withdrawal sequence control devices, partial reactor trip, realignment in proper overlap and sequence following a partial reactor trip, park position, bite position and alarms. The applicant indicated that the U.S. EPR design does not use runback features and rod worth minimizers; therefore, these items from RG 1.68, Appendix A, Section 1, Paragraph b.(1) are

not applicable to Test Abstract Nos. 036 and 169. The staff finds the proposed revisions consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 143, Question 14.02-62 resolved.

In RAI 260, Question 14.02-99, the staff requested that the applicant include its descriptions of the qualitative and quantitative acceptance criteria to FSAR Tier 2, Section 14.2.12.3.10, "Steam Generator Downcomer Feedwater System Water Hammer (Test #033)," Subsection 5.0, "Acceptance Criteria." In an October 21, 2009, response to RAI 260, Question 14.02-99, the applicant proposed to revise FSAR Tier 2, Section 14.2.12.3.10 (Test Abstract No. 033) to include descriptions of both qualitative and quantitative acceptance criteria. The staff finds the proposed revisions are consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 260, Question 14.02-99 resolved.

In RAI 260, Question 14.02-101, the staff noted that the applicant revised FSAR Tier 2, Section 14.2.12.3.4, "Containment Isolation Valves (Test #027)," in a January 15, 2009, response to RAI 77, Question 14.02-32 to include Acceptance Criteria, Item 5.2.2 referencing FSAR Tier 2, Table 14.3-2, "Radiological Analysis (Safety-Significant Features)," Item No. 2-14; however, Item No. 2-14 does not exist in FSAR Tier 2, Table 14.3-2. The staff also requested that the applicant clarify Acceptance Criteria Item 5.2.2 for Test Abstract No. 027, or delete this requirement from FSAR Tier 2, Section 14.2.12.3.4. In a September 4, 2009, response to RAI 260, Question 14.02-101, the applicant stated that Item No. 2-14 was added to FSAR Tier 2, Table 14.3-2 in its December 12, 2008, response to RAI 104, Question 14.03.11-2. The staff finds that Item No. 2-14 is consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the change committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 260, Question 14.02-101 resolved.

In RAI 347, Question 14.02-148, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.12.3.2, "Containment Personnel Airlock Functional Leak Test (Test #025)," to replace the term "portion" with the term "position" in Test Method Items 3.2 and 3.3. In a February 18, 2010, response to RAI 347, Question 14.02-148, the applicant stated that it would revise Test #025 to replace "portion" with "position" in Test Method Items 3.2 and 3.3. The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 347, Question 14.02-148 resolved.

FSAR Tier 2, Section 14.2.12.4, "Civil Components and Systems"

In RAI 260, Question 14.02-100, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.12.4.3, "Turbine Building Crane (Test #042)," Acceptance Criteria Item 5.1 to include a provision that the Turbine Building (TB) crane be rated to handle the heaviest TB component, either the low pressure turbine or the main generator stator. In a September 4, 2009, response to RAI 260, Question 14.02-100, the applicant proposed a revision to FSAR Tier 2, Section 14.2.12.4.3, Acceptance Criteria Item 5.1 to include that the TB crane be

rated to handle the heaviest TB component, either the low pressure turbine or the main generator stator. The staff finds that the proposed change is consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 260, Question 14.02-100 resolved.

FSAR Tier 2, Section 14.2.12.5, "Distributed Utilities"

In RAI 127, Question 14.02-56, the staff requested that the applicant revise the acceptance criteria in the test abstract in FSAR Tier 2, Section 14.2.12.5.7, "Essential Service Water System (Test #048)," to include the information requested in RAI 119, Questions 09.02.01-04 through 09.02.01-08, which requested additional information in FSAR Tier 2, Section 9.2.1 to adequately describe the essential service water system (ESWS) design basis. In an April 28, 2009, response to RAI 127, Question 14.02-56, the applicant referenced its March 27, 2009, responses to RAI 119, Questions 09.02.01-04 (Parts a through h, j, and k), 09.02.01-05, 09.02.01-6, and 09.02.01-7; and its April 27, 2009, responses to RAI 119, Questions 09.02.01-04 (Part i) and 09.02.01-8. The staff evaluated these RAI responses to FSAR Tier 2, Section 9.2.1, "Essential Service Water System," and determined that the design basis information needed to address the acceptance criteria of Test Abstract No. 048 was incomplete. Therefore, in follow-up RAI 345, Questions 09.02.01-26 through 09.02.01-50 for FSAR Tier 2, Section 9.2.1, the staff requested that the applicant address the missing design information needed for the Essential Service Water System test abstract acceptance criteria. **RAI 127, Question 14.02-56,** which relates to RAI 345, Questions 09.02.01-26 through 09.02.01-50, **is being tracked as an open item.**

In RAI 176, Question 14.02-92, the staff requested that the applicant provide the requisite information in FSAR Tier 2, Section 9.2.2, "Component Cooling Water System," to adequately describe the component cooling water system (CCWS) design basis so that the acceptance criteria for FSAR Tier 2, Section 14.2.12.5.5, "Component Cooling Water System (Test #046)," can be adequately established. In a May 15, 2009, response to RAI 176, Question 14.02-92, the applicant stated that the numerical values for the test acceptance criteria will be identified later in the design process, as described in their February 27, 2009, and April 3, 2009, responses to RAI 174, Questions 09.02.02-12 (Part 2) and 09.02.02-18 (Part a), respectively. The applicant stated that details for CCWS equipment sizing and performance are under development and will be identified later in the design process. The staff determined that the applicant's response to this question is inconsistent with existing guidance. Therefore, in follow-up RAI 337, Question 09.02.02-85, the staff identified that many important design parameters remain unavailable in FSAR Tier 2, Section 9.2.2. For example, acceptance criteria in Test Abstract No. 046, Paragraph 5.1.2 require that CCWS flow rates must be within design limits. Design flow rates are not identified in FSAR Tier 2, Section 9.2.2 for many flow paths including some important ones such as: (1) Low head safety injection and residual heat removal (LHSI/RHR) pump coolers (Trains 2 and 3); (2) medium head safety injection (MHSI) pump coolers; (3) CCWS pump motor coolers; (4) emergency surge tank makeup capability; (5) chemical and volume control system (CVCS) high pressure cooler (containment); (6) CVCS pump coolers; (7) reactor coolant pump (RCP) motor bearing coolers; etc. For these reasons, the applicant should provide this information in the FSAR Tier 2, Chapter 9, "Auxiliary Systems." **RAI 337, Question 09.02.02-85 and RAI 176, Question 14.02-92 are being tracked as open items.**

In RAI 176, Question 14.02-93, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.12.5.5, "Component Cooling Water System (Test #046)," to address the following discrepancies:

1. FSAR Tier 1, Section 2.7.1 includes the fuel pool cooling system (FPCS) as one of the safety-related functions of the CCWS. Test Abstract No. 046, Test Method Item 3.4.a states that the non-safety-related headers and the spent fuel pool heat exchangers are isolated on a safety injection actuation signal. However, FSAR Tier 2, Sections 9.2.2.3, "System Operation," and 9.2.2.6, "Instrumentation Requirements," do not discuss the CCWS response to a safety injection signal. Therefore, the staff requested that the applicant revise the FSAR to address this discrepancy.

   In a May 12, 2009, response to RAI 176, Question 14.02-93, the applicant stated that the U.S. EPR design does not isolate the fuel pool cooling system in response to a safety injection signal. The temperature response of the in-containment refueling water storage tank (IRWST) following a loss of coolant accident (LOCA) does not benefit from a brief isolation of fuel pool cooling. In a May 14, 2009, response to RAI 144, Question 14.02-72, the applicant stated that Test Abstract No. 046, Test Method Item 3.4.a would be revised to remove the reference to the spent fuel pool heat exchangers. The staff reviewed the proposed change and finds it acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 144, Question 14.02-72 resolved for this issue.

2. In RAI 176, Question 14.02-93, the staff requested that the applicant clarify the surge tank level terminology used in Test Method Item 3.5 and elsewhere in Test #046 (e.g., low low level) to make it consistent with terminology used in FSAR Tier 2, Section 9.2.2 (e.g., MIN2, MIN3, etc.). Additionally, the staff requested that the applicant clarify the equipment that is automatically isolated at these levels.

   In a May 12, 2009, response to RAI 176, Question 14.02-93, the applicant indicated that in its May 14, 2009, response to RAI 144, Question 14.02-72, it would revise Test Method Item 3.5 to address the surge tank level terminology. However, Test Method Item 3.5 was also modified to remove description of the equipment isolated and to require only verification of switchover valve closure stroke time. Furthermore, the staff noted that the corresponding Acceptance Criteria Item 5.1.5 continued to refer to inaccurate equipment isolation (e.g., RCP header). The staff also noted that while requirements for verification of automatic flow path isolation appear to have been moved to Test Method Item 3.4, clarification is still needed of the flow paths; therefore the staff requesting additional information in follow-up RAI 347, Question 14.02-145, which is discussed later in this section.

3. Test Method Item 3.6 states, to "Verify a low CCW pump differential pressure signal starts the idle pump in each division"; however, as indicated in FSAR Tier 2, Section 9.2.2.3, each CCWS train only contains a single CCWS pump. Therefore, in RAI 176, Question 14.02-93, the staff requested that the applicant clarify the intent of Test Method Item 3.6.

   In a May 12, 2009, response to RAI 176, Question 14.02-93, the applicant indicated in its May 14, 2009, response to RAI 144, Question 14.02-72 that Test Method Item 3.6 would be revised to address the interlock, which automatically starts an ESWS pump

when the corresponding CCWS pump was started. This proposed revision addressed the staff's concern with Test Method Item 3.6; however, the staff noted that the corresponding Acceptance Criteria Item 5.1.6 was not revised to reflect this change. Therefore, applicant's response to this question is inconsistent with existing guidance and resulted in the staff requesting additional information in follow-up RAI 347, Question 14.02-146. In a February 18, 2010, response to RAI 347, Question 14.02-146, the applicant provided the proposed markup to the FSAR. The staff finds the proposed changes to the FSAR conform to the guidance in RG 1.68. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 347, Question 14.02-146 resolved.

4. The Test Method section of Test #046 does not include testing of the automatic common header switchover function and the partial switchover function of the CCWS. Therefore, In RAI 176, Question 14.02-93, the staff requested that the applicant revise the test abstract or justify the exclusion of testing these features of the CCWS.

   In a May 12, 2009, response to RAI 176, Question 14.02-93, the applicant indicated that in its May 14, 2009, response to RAI 144, Question 14.02-72, that the Test Method Item 3.4 would be revised to address the CCWS response to various CCW surge tank levels. The staff evaluated the proposed revision and determined that revised Test Method Item 3.4 partially addressed the staff's concerns and resulted in the staff requesting additional information in follow-up RAI 347, Question 14.02-147. In a February 18, 2010, response to RAI 347, Question 14.02-147, the applicant provided the proposed markup to the FSAR. The staff finds that the proposed changes to the FSAR conform to the guidance in RG 1.68. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 347, Question 14.02-147 resolved.

5. The Test Method section of Test #046 does not include switching of the RCP thermal barrier coolers normally supplied by one common header to the other common header as described in FSAR Tier 2, Chapter 16, Technical Specification 3.7.7 Note A.1. Therefore, in RAI 176, Question 14.02-93, the staff requested that the applicant revise the Test #046 to include the switching of the RCP thermal barrier coolers normally supplied by one common header to the other common header or justify its exclusion.

   In a May 12, 2009, response to RAI 176, Question 14-02-93, the applicant indicated that in its May 14, 2009, response to RAI 144, Question 14.02-72, that the Test Method section would be revised to include Test Method Item 3.12, which verifies the capability of transferring the RCP thermal barrier coolers cooling flow between common headers. The staff reviewed this proposed change and finds it acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 144, Question 14.02-72 resolved for this issue.

6. The Test Method section of Test #046 does not include the verification of adequate flow rates from the fire water distribution supply system to the CCWS surge tank as described in FSAR Tier 2, Section 9.2.2.2.2, "Component Description." Therefore, in RAI 176, Question 14.02-93, the staff requested that the applicant revise Test #046 to

include the verification of adequate flow rates from the fire water distribution supply system to the CCWS surge tank or justify its exclusion.

In a May 12, 2009, response to RAI 176, Question 14-02-93, the applicant indicated that in its May 14, 2009, response to RAI 144, Question 14.02-72, that the Test Method section would be revised to include Test Method Item 3.13, which verifies the design flow rates from the fire protection makeup to the CW surge tank. The staff reviewed this change and finds it acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 144, Question 14.02-72 resolved for this issue. The staff finds that since all the issues associated with this RAI 144, Question 14.02-72 have been adequately addressed, the staff considers all the issues in RAI 144, Question 14.02-72 resolved.

The staff determined that the proposed response did not fully address all of the staff's concerns and subsequently resulted in the staff requesting additional information in RAI 347, Questions 14.02-145, 14.02-146, and 14.02-147. RAI 347, Questions 14.02-146 and 14.02-147 were subsequently resolved as discussed above.

In RAI 347, Question 14.02-145, the staff indicated that it had reviewed the applicant's May 12, 2009, response to RAI 176, Question 14.02-93, Part (b) and requested that the applicant clarify and/or include the following information into FSAR Tier 2, Section 14.2.12.5.5, "Component Cooling Water System (CCWS) (Test #046)":

1. In Test Method Item 3.4, the lead sentence requires verification of flow path isolations in response to "emergency signals." Since the terminology "emergency" is frequently used in reference to design basis accidents, the staff requested that the applicant clarify whether emergency signal applies only to accident conditions (e.g., safety injection) or if it is also intended to apply to individual surge tank level set-points independent of a safety injection signal.

2. In Test Method Item 3.4.a, the applicant's use of the terminology, "non-safety headers outside of the reactor building," is confusing; therefore, the staff requested that the applicant define these headers to avoid confusion with other loads (e.g., fuel handling building) that are not isolated on a safety-injection signal.

3. Test Method Item 3.4.b indicates that non-safety piping will be isolated when the surge tank level is below MIN2 if there is a difference between inlet and outlet flow rate. This also appears to apply to the non-safety loads in the reactor auxiliary and radwaste buildings. Therefore, the staff requested that the applicant revise the description to be consistent and also state whether or not a safety injection signal is required for this action to occur.

4. Test Method Item 3.4.d describes control actions that take place "below" various surge tank level set-points. However, FSAR Tier 2, Section 9.2.2 indicates that control actions take place when the level set-points are reached. Therefore, the staff requested that the applicant clarify Test Method Item 3.4.d to accurately reflect when the control actions occur.

5. The staff requested that the applicant clarify the terminology used in describing the equipment isolation.

In a February 18, 2010, response to RAI 347, Question 14.02-145, the applicant stated that Test #046 would be revised as described in its February 18, 2010, response to RAI 347, Question 14.02-147. In a February 18, 2010, response to RAI 347, Question 14.02-147, the applicant stated that Test #046 would be revised to include the testing of the automatic switchover function and the partial switchover function of the common headers in response to the control signals.

In RAI 347, Question 14.02-146, the staff noted that FSAR Tier 2, Section 14.2.12.5.5, "Component Cooling Water System (CCWS) (Test #046)," Acceptance Criteria Item 5.1.6 states, the "CCW pump differential pressure signal starts the idle pump in each division"; however, FSAR Tier 2, Section 9.2.2 states that the CCWS train contains a single pump per division. Therefore, the staff requested that the applicant clarify the intent of acceptance criteria Item 5.1.6 and update the FSAR accordingly. In a February 18, 2010, response to RAI 347, Question 14.02-146, the applicant stated that Test #046 would be revised to clarify that the response to safety-related simulated signals meets design requirements, which will encompass Acceptance Criteria Item 5.1.6. The applicant stated that Acceptance Criteria Item 5.1.6 would be deleted. The staff reviewed this change and finds the change acceptable pending NRC review and approval of the revised FSAR. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 347, Question 14.02-146 resolved.

In RAI 347, Question 14.02-147, the staff stated that it had reviewed the applicant's May 12, 2009, response to RAI 176, Question 14.02-93, Part (d) and requested that the applicant revise Test #046 to include the testing of the automatic switchover function and the partial switchover function of the common headers in response to the various control signals or justify the exclusion of such testing. In a February 18, 2010, response to RAI 347, Question 14.02-147, the applicant stated that Test #046 would be revised to include the testing of the automatic switchover function and the partial switchover function of the common headers in response to the control signals. The staff reviewed this change and concludes the change is acceptable pending NRC review and approval of the revised FSAR. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 347, Question 14.02-347 resolved for this issue.

In RAI 279, Question 14.02-126, the staff stated that it had reviewed FSAR Tier 2, Section 14.2.12.5.3, "Seal Water Supply System (SWSS) (Test #045)," and requested that the applicant clarify and/or include the following information into FSAR Tier 2, Section 9.2.7, "Seal Water Supply System," or Test #045, as appropriate:

1. In FSAR Tier 2, Section 9.2.7, the applicant designates the Seal Water Supply System by the acronym (SEWSS); however, in FSAR Tier 2, Section 14.2.12.5.3 the applicant designates this system by the acronym (SWSS). The staff requested that the applicant clarify the acronym for the Seal Water Supply System and correctly update FSAR Tier 2, Sections 9.2.7 or 14.2.12.5.3, as appropriate.

   In a September 23, 2009, response to RAI 279, Question 14.02-126, the applicant proposed a revision to FSAR Tier 2, Section 14.2.12.5.3, "Seal Water Supply System (SWSS) (Test #045)," to include editorial changes to remove the use of the acronym "SWSS" and replaced it with "seal water supply system" in FSAR Tier 2,

Section 14.2.12.5.3. The staff reviewed this change and finds the proposed change acceptable.

2. Acceptance Criteria Item 5.1.1 states that the "SWSS pump and system flow meet design specification (refer to FSAR Tier 2, Section 9.2.7)"; however, no design specifications are provided in FSAR Tier 2, Section 9.2.7. Accordingly, the staff requested that the applicant provide the design specifications for the SWSS pump and system flow in FSAR Tier 2, Section 9.2.7.

   In a September 23, 2009, response to RAI 279, Question 14.02-126, the applicant proposed adding FSAR Tier 2, Table 9.2.7-1, "Seal Water Supply System Parameters," which contained detailed seal water supply system technical parameters including flow rates, system pressures, and system temperatures. The staff reviewed these proposed changes and finds the changes acceptable, since Acceptance Criteria Item 5.1.1 references FSAR Tier 2, Section 9.2.7, which now contains the required technical data in FSAR Tier 2, Table 9.2.7-1.

3. Test Method Item 3.3 and Acceptance Criteria Item 5.1.4 state that the "SWSS provides designed rated flow to systems that are supplied by the seal water header"; however, no flow rate specifications are provided in FSAR Tier 2, Section 9.2.7. Therefore, the staff requested that the applicant provide the design specifications for the SWSS flow rates to its supplied components in FSAR Tier 2, Section 9.2.7.

   In a September 23, 2009, response to RAI 279, Question 14.02-126, the applicant indicated that the seal water flow rate would be included in proposed FSAR Tier 2, Table 9.2.7-1. The staff confirmed that the requested information was provided in proposed FSAR Tier 2, Table 9.2.7-1, and the system flow rate was found reasonable at approximately 0.19 L/min (28.7 lb/hr or 0.05 gal/min). Therefore, the staff finds the change acceptable.

4. Test Method Item 3.5 requires confirmation that power operated valves fail in the proper position; however, the failure position of the buffer tank supply solenoid valves is not identified in FSAR Tier 2, Section 9.2.7. Therefore, the staff requested that the applicant identify the failure position of the buffer tank supply valve upon a loss of operating power.

   In a September 23, 2009, response to RAI 279, Question 14.02-126, the applicant indicated that the buffer tank supply valves fail closed on a loss of power. Also, the applicant submitted a proposed revision to FSAR Tier 2, Section 9.2.7 which supplied this information. The staff reviewed the proposed addition of technical data to FSAR Tier 2, Section 9.2.7. Therefore, the staff finds the change acceptable.

5. Test Method Item 3.7 requires verification that the SWSS can meet minimum and maximum design requirements (pressure and temperature); however, the minimum and maximum design pressure and temperature are not identified in FSAR Tier 2, Section 9.2.7. Therefore, the staff requested that the applicant identify the SWSS minimum and maximum design pressure and temperature in FSAR Tier 2, Section 9.2.7.

   In a September 23, 2009, response to RAI 279, Question 14.02-126, the applicant proposed a revision to Test Method Item 3.7 which would remove the term "minimum" from Test #045 and add the design pressure and temperature to FSAR Tier 2,

Table 9.2.7.-1. The staff reviewed this proposed change and finds the change acceptable.

6. The staff requested that the applicant include a test method item in FSAR Tier 2, Section 14.2.12.5.3, that provides verification of the proper operation of the SWSS buffer tank upon a loss of offsite power (LOOP).

   In a September 23, 2009, response to RAI 279, Question 14.02-126, the applicant stated that Test Method Item 3.8 would be added to Test #045 as indicated in its September 4, 2009, response to RAI 260, Question 14.02-101. Proposed Test Method Item 3.8 would verify proper operation of the seal water system buffer tank upon a simulated LOOP. The staff reviewed the proposed change and finds the change acceptable, since the buffer tank will be tested under LOOP conditions.

The staff determined that the proposed changes described above are consistent with the guidance contained in RG 1.68. Therefore, the staff finds that these proposed changes are acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 279, Question 14.02-126 resolved.

FSAR Tier 2, Section 14.2.12.6, "General Supply Systems"

The staff's review of this section did not identify any requests for additional information.

FSAR Tier 2, Section 14.2.12.7, "Power Conversion Systems"

In RAI 313, Question 14.02-128, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.12.7.13, "Secondary Sampling System (Test #071)," as follows:

1. Revise prerequisite Item 2.3 to state: Calibrating gases and solutions are available for radioactive and non-radioactive analyses as referenced in FSAR Tier 2, Table 9.3.2-2, "Secondary Side Sampling Points."

2. Revise the prerequisite section to include an item that requires that all portions of the sampling system be flushed with de-ionized water to ensure that residues of chemical agents used during post-construction cleaning phases have been flushed out.

3. The acceptance criteria section of Test #071 does not define acceptable criteria commensurate with process measurements listed in FSAR Tier 2, Section 9.3.2. Therefore, the staff requested that the applicant identify where such acceptance criteria are located in the FSAR, or otherwise revise FSAR Tier 2, Section 9.3.2 accordingly.

In a January 27, 2010, response to RAI 313, Question 14.02-128, the applicant proposed changes to FSAR Tier 2, Section 14.2.12.7.13 as suggested above. The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff concluded the applicant had adequately addressed this issue and, therefore, considered RAI 313, Question 14.02-128 resolved.

Subsequently, the staff identified a follow-up question to RAI 313, Question 14.02-128. In RAI 386, Question 14.02-151, the staff noted that the response to RAI 313,

Question 14.02-128 refers to the criteria said to be contained in FSAR Tier 2, Table 9.3.2-2. However, the then current version of FSAR Tier 2, Table 9.3.2-2 did not provide this level of detail, and the response to RAI 313, Question 14.02-128 did not commit to update FSAR Tier 2, Table 9.3.2-2 to ensure that the revised acceptance criteria are complemented with supporting FSAR data and a commitment to a parallel revision to FSAR Tier 2, Table 9.3.2-2 to ensure consistency. In an August 10, 2011, response to RAI 313, Question 14.02-151, the applicant stated that FSAR Tier 2, Table 9.3.2-2, "Secondary Side Sampling Points," will be revised to include process instrument parameters and FSAR Tier 2, Section 14.2.12.7.13, Acceptance Criteria 5.1.4 and FSAR Tier 2, Section 14.2.12.18.5, Acceptance Criteria 5.4 will be revised to reflect that laboratory equipment used to measure grab samples is site-specific and is not specified in the FSAR. The staff finds these changes acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 386, Question 14.02-151 resolved.

In RAI 313, Question 14.02-129, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.12.7.14, "Steam Generator Blowdown Demineralizing System (Test #072)," as follows:

1. Revise prerequisite Item 2.3 to state: Calibrating gases and solutions are available for radioactive and non-radioactive analyses as referenced in FSAR Tier 2, Table 9.3.2-2.

2. Revise the prerequisite section to include an item that ensures the Steam Generator Blowdown System's demineralizers and filters have been loaded with and verified to contain the proper types and amounts of ion exchange resins and filter media.

3. Revise Acceptance Criteria Item 5.1 to state, "The SGB demineralizing system meets design requirements (refer to Sections 10.4.8, 11.5.4.3, and 11.2)."

In a January 27, 2010, response to RAI 313, Question 14.02-129, the applicant proposed changes to FSAR Tier 2, Section 14.2.12.7.14 as suggested above. The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff concluded that the applicant had adequately addressed this issue and, therefore, considered RAI 313, Question 14.02-129 resolved.

Subsequently, the staff identified a follow-up question to RAI 313, Question 14.02-129. In RAI 386, Question 14.02-152, the staff noted that the applicant's response to RAI 313, Question 14.02-129 refers to the criteria said to be contained in FSAR Tier 2, Table 9.3.2-2. However, the current version of FSAR Tier 2, Table 9.3.2-2 does not provide this level of detail, and the response to RAI 313, Question 14.02-128 does not commit to update FSAR Tier 2, Table 9.3.2-2 to ensure that the revised acceptance criteria are complemented with supporting FSAR data and a commitment to a parallel revision to FSAR Tier 2, Table 9.3.2-2 to ensure consistency. In an August 10, 2011, response to RAI 386, Question 14.02-152, the applicant refers to its response to RAI 386, Question 14.02-151. The staff finds the changes proposed in the response to RAI 386, Question 14.02-151 acceptable to address RAI 386, Question 14.02-152. The staff confirmed that the FSAR contains the changes committed to in this RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, considers RAI 386, Question 14.02-152 resolved.

FSAR Tier 2, Section 14.2.12.8, "Heating Ventilation and Air Conditioning (HVAC) Systems"

In RAI 313, Question 14.02-130, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.12.8.18, "Plant Laboratory Equipment (Test #090)," as follows:

1. Revise prerequisite Item 2.5 to state: The laboratory equipment area radiological controls (such as postings, shielding, radioactive work permits, operation of ventilated hoods, interim storage of incoming and archived radioactive samples, and the availability of radwaste containers as interim means to store/hold within the laboratory radioactive wastes) have been implemented or are capable of being implemented.

2. Revise prerequisite section to include an item that confirms the availability of proper radioactive standards and check sources. This prerequisite should state: Airborne and liquid radioactivity monitoring and sampling equipment, portable radiation survey equipment and all radio-analytical equipment installed in the laboratory are calibrated in accordance with RG 1.21, "Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste," and RG 4.15, "Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination) – Effluent Streams and the Environment."

3. The acceptance criteria section of Test #090 does not specify the operational programs and regulatory requirements identified in FSAR Tier 2, Sections 11.5, "Process and Effluent Radiological Monitoring and Sampling Systems," and 13.4, "Operational Program Implementation," in analyzing and reporting sample results in demonstrating compliance with NRC regulations. Therefore, the staff requested that the applicant revise the acceptance criteria of Test Abstract No. 090 to include FSAR Tier 2, Sections 11.5 and 13.4.

In a January 27, 2010, response to RAI 313, Question 14.02-130, the applicant provided the proposed changes to FSAR Tier 2, Section 14.2.12.8.18. The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 313, Question 14.02-130 resolved.

FSAR Tier 2, Section 14.2.12.9, "Auxiliary Systems"

In RAI 260, Question 14.02-103, the staff requested that the applicant provide the bounding system criteria or the section of the FSAR for the auxiliary steam generating system that provides the acceptance criteria for Test #107. In an October 21, 2009, response to RAI 260, Question 14.02-103, the applicant proposed a revision to the acceptance criteria of Test #107 to include a requirement for the auxiliary steam generating system to provide sufficient steam flow to components such as the turbine gland seals and deaerator pegging system, which are required for normal shutdown. The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 260, Question 14.02-103 resolved.

In RAI 260, Question 14.02-104, the staff noted that, in a January 15, 2009, response to RAI 77, Question 14.02-32, the applicant proposed a revision to FSAR Tier 2, Section 14.2.12.9.6,

"Reactor Coolant Drain Tank (Test #096)," which incorrectly refers to FSAR Tier 2, Section 9.3.4, in Test Methods Item 3.2 and Acceptance Criteria Item 5.1 for design requirements for the RCDT and should be replaced with FSAR Tier 2, Section 9.3.3. Additionally, Test #096 and #097, "Equipment Drain Tank," should be included with Test #098, "Equipment Floor Drainage System," in FSAR Tier 2, Section 9.3.3, since all three test abstracts are directly related to systems or components of the Nuclear Island drain/vent system (NIDVS). In a September 4, 2009, response to RAI 260, Question 14.02-104, the applicant proposed a revision to Acceptance Criteria Item 5.1 of Test #096 and #097, to reference FSAR Tier 2, Section 9.3.3.2.2, "Component Description." The applicant proposed a revision to FSAR Tier 2, Section 9.3.3.2.2 to provide a description of the reactor coolant drain tank (RCDT) and FSAR Tier 2, Section 9.3.4.1, "Design Basis," to provide additional details on the failure position of CVCS valves. Additionally, the applicant proposed a revision to Test #097 to replace the terminology of equipment drain tank (EDT) with process drain tank. The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 260, Question 14.02-104 resolved.

In RAI 260, Question 14.02-108, the staff requested that the applicant make the following revisions to FSAR Tier 2, Section 14.2.12.9.11, "Station Blackout Diesel Generator Set (Test #101)":

1. Change the title of the test abstract to, "Station Blackout Diesel Generator Mechanical (Test #101)," for completeness and accuracy with the title in FSAR Tier 2, Section 14.2.12.9.12, "Station Blackout Diesel Generator Electrical (Test #102)."

   In a September 4, 2009, response to RAI 260, Question 14.02-108, the applicant proposed a revision to FSAR Tier 2, Section 14.2.12.9.11, "Station Blackout Diesel Generator Set (Test #101)," to change its title to, "Station Blackout Diesel Generator Mechanical (Test #101)." The staff reviewed the proposed editorial change to the test abstract title and concludes the revision was editorial and acceptable.

2. Add the station blackout diesel generator (SBODG) crankcase ventilation system to the prerequisite section of Test #101.

   In a September 4, 2009, response to RAI 260, Question 14.02-108, the applicant proposed a revision to FSAR Tier 2, Section 14.2.12.9.11, to include prerequisite Item 2.1.6, which added the SBODG crankcase ventilation system. The staff reviewed this proposed change and finds the proposed change acceptable.

3. Include the SBODG electrical system to the acceptance criteria section, since the prerequisite Item 2.2 of Test #101 requires the "SBODG system instrumentation has been calibrated and is functional for performance of the following test."

   In a September 4, 2009, response to RAI 260, Question 14.02-108, the applicant proposed a revision to FSAR Tier 2, Section 14.2.12.9.11, to include acceptance criteria Item 5.2, which references the SBODG electrical and instrumentation support systems and FSAR Tier 2, Section 8.4.1, "Description." The staff reviewed the proposed changes and finds the proposed changes acceptable.

The staff finds that the proposed changes consistent with the guidance contained in RG 1.68 and, therefore, finds the proposed changes identified above acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 260, Question 14.02-108 resolved.

In RAI 260, Question 14.02-109, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.12.9.12, Acceptance Criteria Item 5.1, to state the following: "The SBODG electrical and I&C systems meet design and reliability requirements (refer to Sections 7.4.1, 8.4, and 8.4.1.4)." In a September 4, 2009, response to RAI 260, Question 14.02-109, the applicant proposed a revision to Acceptance Criteria Item 5.1 to include references to FSAR Tier 2, Sections 7.4.1, 8.4, and 8.4.1.4. The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 260, Question 14.02-109 resolved.

In RAI 260, Question 14.02-110, the staff requested that the applicant make the following revisions to FSAR Tier 2, Section 14.2.12.9.14, "Emergency Diesel Generator Set (Test #104)":

1. Change the title of the test abstract to, "Emergency Diesel Generator Mechanical (Test #104)," for completeness and accuracy with the title in FSAR Tier 2, Section 14.2.12.9.15, "Emergency Diesel Generator Electrical (Test #105)."

   In a September 4, 2009, response to RAI 260, Question 14.02-110, the applicant proposed a revision to FSAR Tier 2, Section 14.2.12.9.14, "Emergency Diesel Generator Set (Test #104)," to change its title to, "Emergency Diesel Generator Mechanical (Test #104)." The staff finds the proposed changes are editorial in nature, and therefore acceptable.

2. Include the demonstration of the alternate feed connection capability between divisions (used when one emergency diesel generator (EDG) is inoperable or in maintenance) as one of the objectives or justify its exclusion.

   In a September 4, 2009, response to RAI 260, Question 14.02-110, the applicant proposed a revision to the Test Method section of Test #105 to include Test Method Item 3.6.3, which includes the connecting and automatic loading of alternate loads. The staff reviewed the proposed addition of Test Method Item 3.6.3 and finds the proposed revision acceptable.

3. Add the EDG crankcase ventilation system to the prerequisites section of Test #104.

   In a September 4, 2009, response to RAI 260, Question 14.02-110, the applicant proposed a revision to the prerequisites section of Test #104 to include prerequisite Item 2.7.1, which includes the crankcase ventilation system. The staff reviewed the proposed addition of prerequisite Item 2.7.1 and finds the proposed revision acceptable.

4. Revise Item 3.5 of Test #104 to include "without any failures".

   In a September 4, 2009, response to RAI 260, Question 14.02-110, the applicant proposed a revision to the Test Method section of Test #104 to include the verbiage

"without any failures" in Test Method Item 3.5. The staff reviewed the proposed addition to Test Method Item 3.5 and finds the proposed revision acceptable.

5. Include FSAR Tier 2, Sections 7.3.1.2.12, and 8.4.1 to the acceptance criteria section, since portions of the electrical and I&C systems are being tested through this test abstract.

   In a September 4, 2009, response to RAI 260, Question 14.02-110, the applicant revised the acceptance criteria section to include reference to FSAR Tier 2, Sections 7.3.1.2.12, 8.3.1, and 8.4.1 to Acceptance Criteria Item 5.1. The staff reviewed the proposed revision to Acceptance Criteria Item 5.1 and finds it acceptable.

The staff finds that the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 260, Question 14.02-110 resolved.

In RAI 260, Question 14.02-111, the staff requested that the applicant make the following revisions to FSAR Tier 2, Section 14.2.12.9.15:

1. Add to Test Method Item 3.1, which requires a "demonstration of the control logic and controls including the EDG sequencer and response to ESF actuation signals" and a "demonstration of the EDG load carrying capability with the alternate feed connected between divisions (when one EDG is inoperable)."

   In a September 4, 2009, response to RAI 260, Question 14.02-111, the applicant proposed a revision to the Test Method section of Test #105 to include Test Method Items 3.1.1 and 3.1.2, which includes a "demonstration of the control logic and controls including the EDG sequencer and response to ESF actuation signals" and a "demonstration of the EDG load carrying capability with the alternate feed connected between divisions (when one EDG is inoperable)." The staff reviewed the proposed addition of Test Method Items 3.1.1 and 3.1.2 and finds the proposed revisions acceptable.

2. Include an item in the prerequisite section requiring that the "emergency diesel generator demonstration should be performed one at a time."

   In a September 4, 2009, response to RAI 260, Question 14.02-111, the applicant proposed a revision to the prerequisites section of Test #105 to include prerequisite Item 2.10, which requires that the EDG must be sequenced so that loading of divisional power or alternate supplied loads are not confused with power from another EDG. The staff reviewed the proposed addition of prerequisite Item 2.10 and finds the proposed revision acceptable.

3. Change Test Method Item 3.9.3 of Test #105 from "90% to 100%" to "95% to 100%."

   In an October 21, 2009, response to RAI 260, Question 14.02-111, the applicant stated that RG 1.9, Section 2.2.9, "Endurance and Load Margin Test," provides guidance for 22 hours of the test to be at 90 percent to 100 percent of the generator's continuous rating. Therefore, Test Method Item 3.9.3 of Test #105 will not be changed and the FSAR will not be revised. The staff reviewed the applicant's response and determined it

is consistent with the guidance contained in RG 1.9, Section 2.2.9, and therefore acceptable.

4. Add FSAR Tier 2, Section 7.3.1.2.12 to the Acceptance Criteria section of Test #105, since the test abstract verifies EDG alarms, interlocks and control functions.

   In a September 4, 2009, response to RAI 260, Question 14.02-111, the applicant proposed a revision to the acceptance criteria section of Test #105 to include reference to FSAR Tier 2, Section 7.3.1.2.12 in Acceptance Criteria Item 5.1. The staff reviewed the proposed revision to acceptance criteria Item 5.1 and finds it acceptable.

The staff finds that the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 260, Question 14.02-111 resolved.

In RAI 313, Question 14.02-131, the staff requested that the applicant revise FSAR Tier 2, Subsection 14.2.12.9.2, "Sampling Activity Monitoring System (Test #092)," as follows:

1. Revise prerequisite Item 2.5 to state: Calibration check sources are available in appropriate forms (gaseous, solutions or plated sources) for the analyses referenced in FSAR Tier 2, Table 11.5-1, "Radiation Monitor Detector Parameters."

2. Revise Test Method Item 3.4 to state: Using radioactive calibration check sources, initiate a high radiation signal to the appropriate radiation monitors to verify that control actuations meet design requirements.

3. Revise Test Method Item 3.6 to state: Using radioactive calibration check sources, initiate a high radiation signal to the radiation monitors to verify that alarm actuations function as designed.

4. The acceptance criteria section of Test #092 does not define acceptable criteria commensurate with process measurements listed in FSAR Tier 2, Section 11.5. Therefore, the staff requested that the applicant identify where such acceptance criteria are located in the FSAR, or otherwise revise FSAR Tier 2, Section 11.5 accordingly.

In a January 27, 2010, response to RAI 313, Question 14.02-131, the applicant proposed a revision to Test. #092. The applicant proposed revising the language of FSAR Tier 2, Section 14.2.12 as requested by the staff. The proposed revision included criteria to verify acceptable process measurements for radiation monitoring instrumentation used to monitor sampling activity at the vent and stack release point that is described in FSAR Tier 2, Table 11.5-1. The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds t the applicant has adequately addressed this issue and, therefore, considers RAI 313, Question 14.02-131 resolved.

In RAI 313, Question 14.02-132, the staff noted that the Test Methods section of FSAR Tier 2, Section 14.2.12.9.3, "Solid Waste Storage System (Test #093)," does not address testing all of the design features of the system, as described in FSAR Tier 2, Section 11.4.2.3.1, "Solid Radioactive Waste Processing and Storage Components (Dry Active Wastes)." Therefore, the staff requested that the applicant revise the Test Methods section of Test #093 to include testing

of all of the components described in FSAR Tier 2, Section 11.4.2.3.1. Additionally, the staff requested that the applicant include a test method item that verifies the design features of supporting systems (i.e., process ventilation, drainage, and sampling systems).

In its review, the staff noted that the Test Method section of FSAR Tier 2, Section 14.2.12.9.3, "Solid Waste Storage System (Test #093)," does not address the testing of all of the system design features, as described in FSAR Tier 2, Section 11.4.2.3.1. Therefore, in RAI 313, Question 14.02-32, the staff requested that the applicant revises Test Method section of Test #093 to include the testing of components described in FSAR Tier 2, Section 11.4.2.3.1. Also, the staff requested that the applicant include tests that verify the design features of supporting systems (i.e., process ventilation, drainage, and sampling systems). Based on the applicant's January 27, 2010, response to RAI 313, Question 14.02-132, the staff finds the inclusion of Test Method section of Test #193 in addition to Test Method section of Test #093 insufficient given that Test Method section of Test #193 addresses only the integrity of the bioshield during power ascension and not the adequacy of other equipment, such as the Drum Store and Tubular Shaft Store located in the Radwaste Processing Building. FSAR Tier 2, Section 12.3.2.2, as referenced in Test Method section of Test #193, describes design criteria for the adequacy of the shielding based on design features and modeling, and does not address testing methods.

In follow up RAI 386, Question 14.02-153, the staff requested that the applicant revise Test Method section of Test #093 to include provisions that confirm the integrity of the concrete shielding of the Drum Store and Tubular Shaft Store located in the Radwaste Processing Building and include other waste processing equipment. In January 27, 2010, and November 10, 2010, responses to RAI 313, Question 14.02-132, the applicant revised the scope of the tests in FSAR Tier 2, Section 14.2.12.9.3. The tests include the sorting box (shredder and drum compactor), drum transport carts, shielding casks, entrance and drum store cranes, and a step to verify the integrity of the concrete shielding of the Drum Store and Tubular Shaft Store and that the associated shielding meets design requirements. The applicant also noted that the testing of plant facilities used for the management of radioactive wastes is also supported by other tests, including Test Method section of Tests #080, 094, 098, 129, and 193. These tests address various aspects of the design, including ventilation systems used in radiologically controlled areas where process equipment are located, waste processing equipment, equipment and floor drainage systems, and instrumentation systems used for process information. The staff finds the revision to Test Method section of Test #093 acceptable as the revision includes provisions to confirm shielding integrity of the concrete used for the Drum Store and Tubular Shaft Store against design requirements. This inclusion provides reasonable assurance that the shielding will provide the necessary protection, and ensure compliance with the dose limits and ALARA provisions of 10 CFR Part 20 for plant workers and members of the public. The staff finds the responses and additional information presented in FSAR Tier 2, Revision 3, Section 14.2.12.9.3 acceptable, and, therefore, considers RAI 313, Question 14.02-132 and RAI 386, Question 14.02-153 resolved.

In follow-up RAI 386, Question 14.02-153, the staff noted that Test #193 in the response to Test #093 is not correct, given that Test #193 addresses only the integrity of the bioshield during power ascension and not the adequacy of the radwaste "Drum Store" and "Tubular Shaft Store" located in the Radwaste Building. FSAR Tier 2, Section 12.3.2.2, "Shielding Calculation Methods," as referenced in Test #193, describes design criteria for the adequacy of the shielding based on design features and modeling, and does not address testing. Accordingly, the staff requested that the applicant revise Test Abstract No. 093 to include provisions that

confirm the integrity of the concrete shielding for the “Drum Store” and “Tubular Shaft Store” located in the Radwaste Building. In a November 10, 2010, response to RAI 386, Question 14.02-153, the applicant revised its response to RAI 313, Question 14.02-132 as follows: “U.S. EPR FSAR Tier 2, Section 14.2.12, Test #093 was revised in U.S. EPR FSAR Revision 2 to include the subsystems described in U.S. EPR FSAR Tier 2, Section 11.4.2.3.1.” The staff finds the changes made to FSAR Tier 2, Section 14.2, Test #093 acceptable. The staff confirmed that the changes were made to the FSAR and, therefore, considers RAI 386, Question 14.2-153 resolved.

In RAI 313, Question 14.02-133, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.12.9.4, “Radioactive Concentrates Processing System (Test #094),” as follows:

1. The staff noted that the Test Method section does not address testing all of the design features of the system, as described in FSAR Tier 2, Section 11.4.2.3.2, “Radioactive Concentrates Processing System Components (Wet Solid Wastes).” Therefore, the staff requested that the applicant revise the Test Methods section of Test #94 to include testing of all of the components described in FSAR Tier 2, Section 11.4.2.3.2. Additionally, the staff requested that the applicant include a test method item that verifies the design features of supporting systems (i.e., process ventilation, drainage, and sampling systems).

2. Revise Test Method Item 3.1 to state: Using radioactive calibration check sources, initiate interlock signals from interfacing equipment and observe radioactive concentrates processing system response, including observation of alarms.

3. The acceptance criteria section of Test #094 does not define acceptable criteria commensurate with process and effluent measurements listed in FSAR Tier 2, Sections 11.5, “Process and Effluent Radiological Monitoring and Sampling Systems,” 11.2.2, “System Description,” and 11.4, “Solid Waste Management Systems.” Therefore, the staff requested that the applicant identify where such acceptance criteria are located in the FSAR, or otherwise revise FSAR Tier 2, Sections 11.5, 11.2.2, and 11.4 accordingly.

In its review, the staff noted that the Test Method section of FSAR Tier 2, Section 14.2.12.9.4, “Radioactive Concentrates Processing System – Solid Wastes (Test #094),” does not address the testing of the design features of the system, and does not define acceptable criteria commensurate with process and effluent measurement functions listed in FSAR, Tier 2, Sections 11.5, 11.2.2, and 11.4. Therefore, in RAI 313, Question 14.02-133, the staff requested that the applicant include tests that verify the design and operational features of radwaste processing subsystems. In follow-up RAI 386, Question 14.2-154, the staff noted that the proposed revision of Test Method section of Test #094 did not include "Drum Measuring Device" in the list of equipment when compared to FSAR Tier 2, Section 11.4.2.3.2. In January 27, 2010, and November 10, 2010, responses to RAI 313, Question 14.02-133, the applicant revised the scope of the tests in FSAR Tier 2, Section 14.2.12.9.4. The revised tests include a listing of 21 system components and expanded descriptions of acceptance criteria. These tests address various design and operational features, including collection tanks for liquid wastes and concentrates, flow measurement and monitoring, sampling devices, drum handling and transfer devices, drum measuring devices, condenser and drying stations, resin collections tanks and traps, and high integrity containers. The staff finds the revision to Test #094 acceptable as the revision includes provisions to confirm the operational functions of the wet

and solid waste subsystems, as described in FSAR Tier 2, Section 11.4. The staff finds this inclusion provides reasonable assurance that the operational functions of the listed subsystems will meet design requirements and generate radioactive waste products that meet the objectives described in the process control program (PCP), as described in FSAR Tier 2, Sections 11.4 and 13.4. The PCP is a required operational program implemented to ensure that waste products meet the requirements of 10 CFR 61.55, "Waste classification," and 10 CFR 61.56, "Waste characteristics," and waste acceptance criteria of the disposal site or waste processor. The staff finds the responses and additional information presented in FSAR Tier 2, Revision 3, Section 14.2.12.9.4 acceptable and, therefore, considers RAI 313, Question 14.02-133 and RAI 386, Question 14.02-154 resolved.

In follow-up RAI 386, Question 14.02-154, the staff indicated that it had reviewed the components given in Section 3.0 of revised Test #094 and noted that "Drum Measuring Device" is not included. This device is also not given in FSAR Tier 2, Table 11.5-1, since it is not part of the liquid and gaseous process and effluent monitoring system. Therefore, the staff requested that this piece of equipment and its associated acceptance criteria be addressed by Test #094. In a November, 10, 2010, response to RAI 386, Question 14.02-154, the applicant added a new item "Drum Measuring Device" to the test method. The staff concluded that the proposed change is consistent with the guidance contained in RG 1.68. Therefore, the staff finds that the proposed change is acceptable. The staff confirmed that the FSAR contains the change committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, considers RAI 386, Question 14.02-154 resolved.

In RAI 313, Question 14.02-134, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.12.9.5, "Liquid Waste Processing System (Test #095)," as follows:

1. Revise the prerequisite section to include an item that ensures the Liquid Waste Processing System's demineralizers and ultra filtration system have been loaded with and verified to contain the proper types and amounts of ion exchange resins and filtration media.

2. The staff noted that the Test Method section does not address testing all of the design features of the system, as described in FSAR Tier 2, Section 11.2.2.4.2, "Liquid Waste Processing System Components." The staff requested that the applicant revise the Test Methods section of Test #095 to include testing of all of the components described in FSAR Tier 2, Section 11.2.2.4.2.

3. Revise Test Method Item 3.7 to state: Using radioactive calibration check sources initiate a high radiation signal to the liquid waste processing system discharge radiation monitor and demonstrate that discharge isolation features and other system controls function as designed.

4. Revise Test Method Item 3.9 to state: Using radioactive calibration check sources initiate a high radiation signal to the liquid waste processing system discharge radiation monitor and verify response.

5. The acceptance criteria section of Test #095 does not define acceptable criteria commensurate with process measurements listed in FSAR Tier 2, Sections 11.2, "Liquid Waste Management System," and 11.5. Therefore, the staff requested that the applicant identify where such acceptance criteria are located in the FSAR, or otherwise revise FSAR Tier 2, Sections 11.2 and 11.5 accordingly.

In a January 27, 2010, response to RAI 313, Question 14.02-134, the applicant proposed a revision to Test #095 in FSAR Tier 2, Section 14.2.12. The applicant proposed revising FSAR Tier 2, Section 14.2 to provide reference and relevant information from FSAR Tier 2, Sections 12.9.5, 11.2, and Table 11.5-1. The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable pending the applicant's response to follow-up RAI 386, Question 14.2-155, discussed below.

In follow-up RAI 386, Question 14.02-155, the staff indicated that it had reviewed the components given in Section 3.0 of revised Test #095 and noted that "Evaporator Column" is not included. Given the description in FSAR Tier 2, Section 11.2.2.4.2.1, "Evaporator System Components," the staff requested that Evaporator and Evaporator Column be included in Test #095. In a November 10, 2010, to RAI 386, Question 14.02-155, the applicant proposed to add a new item, "Evaporator Column," to the test method. The staff concluded that the proposed change is consistent with the guidance contained in RG 1.68. Therefore, the staff finds the proposed change acceptable. The staff confirmed that the FSAR contains the change committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 386, Question 14.02-155 resolved.

In RAI 313, Question 14.02-135, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.12.9.9, "Gaseous Waste Processing System (Test #099)," as follows:

1. Revise the prerequisite section to include an item that ensures the Gaseous Waste Processing System's (GWPS) charcoal beds and gel driers have been loaded with and verified to contain the proper types and amounts of charcoal and desiccant.

2. Revise Test Method Item 3.3 to state: Using radioactive calibration check sources initiate a high radiation signal to the GWPS discharge radiation monitor.

3. Revise Test Method Item 3.5 to state: Using radioactive calibration check sources initiate a high radiation signal to the GWPS discharge radiation monitor and verify alarm actuation as designed.

4. Revise Test Method Item 3.9 to state: Demonstrate the operation of the gas analyzers to detect O2 and H2 in concentrations ranges as specified by plant technical specification.

5. The staff notes that the acceptance criteria section of Test #099 does not define acceptable criteria commensurate with process measurements listed in FSAR Tier 2, Sections 11.5 and 11.3, "Gaseous Waste Management Systems." Therefore, the staff requested that the applicant identify where such acceptance criteria are located in the FSAR, or otherwise revise FSAR Tier 2, Sections 11.5 and 11.3.

In a January 27, 2010, response to RAI 313, Question 14.02-135, the applicant proposed a revision to Test #099 in FSAR Tier 2, Section 14.2.12. The applicant's proposed revision incorporated the changes requested by the staff including adding Acceptance Criteria for the radiation monitoring instrumentation to ensure that the design requirements of the instrumentation will not adversely impact the ability of the instrumentation to measure the parameters described in FSAR Tier 2, Table 11.5-1. The staff finds the proposed change consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the change committed to in the RAI response. Accordingly,

the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 313, Question 14.02-135 resolved.

FSAR Tier 2, Section 14.2.12.10, "Electrical Systems"

In RAI 260, Question 14.02-112, the staff requested that the applicant revise Test Method Item 3.3 in FSAR Tier 2, Section 14.2.12.10.1, "Switchyard and Preferred Power (Test #108)," to state: "Verify operation and redundancy of the switchyard 125 Volts direct current (Vdc) auxiliary supply system and its associated controls, alarms and batteries." In a September 4, 2009, response to RAI 260, Question 14.02-112, the applicant proposed a revision to Test Method Item 3.3. This revision required verification of the operation of the switchyard 125 Vdc auxiliary supply system on a dual battery supply. It did not include the term "redundancy" because the dual battery supplies that send individual signals to the breaker are not totally redundant. Additionally, redundancy only applies to safety-related systems and this is not a safety-related system. The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore the staff finds that the proposed changes are acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 260, Question 14.02-112 resolved.

In RAI 260, Question 14.02-113, the staff requested that the applicant revise Test Method Item 3.4, of FSAR Tier 2, Section 14.2.12.10.2, "Main Generator (Test #109)," to verify the operation of the generator circuit breakers, since the operation of two circuit breakers are required to isolate plant power output. Additionally, the staff requested that the test abstract address a single failure of the circuit breakers (e.g., stuck breaker cases) to verify that the backup protection scheme works. In a September 4, 2009, response to RAI 260, Question 14.02-113, the applicant proposed a revision to Test Method Item 3.4 to verify the operation of each generator circuit breaker in the plant. Additionally, the applicant proposed adding the verification of the backup protection scheme to simulated single failures by verifying the operation of primary and backup relay systems to Test Method Item 3.5.1. The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 260, Question 14.02-113 resolved.

In RAI 260, Question 14.02-114, the staff requested that the applicant revise Item 3.1a of FSAR Tier 2, Section 14.2.12.10.3, "Class 1E Uninterruptible Power Supply (Test #110)," and FSAR Tier 2, Section 14.2.12.10.4, "Non-Class 1E Uninterruptible Power Supply (Test #111)," to reflect RG 1.129, "Maintenance, Testing, and Replacement of Vented Lead-Acid Storage Batteries for Nuclear Power Plants," as the acceptance criteria rather than Institute of Electrical and Electronics Engineers (IEEE) Standard (Std) 450-2002, "Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications." In a September 4, 2009, response to RAI 260, Question 14.02-114, the applicant proposed a revision to Test Method Item 3.1.a of Test #110 and #111 to state that the battery performance discharge or service test would be performed in accordance with IEEE Std 450-2002, as endorsed by RG 1.129 with exceptions. The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 260, Question 14.02-114 resolved.

In RAI 260, Question 14.02-115, the staff requested that the applicant clarify the following aspects to FSAR Tier 2, Section 14.2.12.10.9, "6.9 kV Emergency Power Supply System (Test #116)":

1. The objectives section of Test #116 describes testing the power supply from either normal or alternate source, but not the automatic bus transfer scheme. Therefore, the staff requested that the applicant clarify whether this test involves an automatic bus transfer scheme from normal to alternate power supplies.

   In a September 4, 2009, response to RAI 260, Question 14.02-115, the applicant proposed a revision to the objectives section of Test #116 to include objective Items 1.1.1, 1.1.2, and 1.1.3, that describe the normal and alternate power supplies and automatic transfer from normal to alternate power supply. The staff finds the proposed revisions to objective Items 1.1.1, 1.1.2, and 1.1.3 acceptable.

2. Clarify whether Test #116 includes the alternate feed connection capability between divisions (i.e., used when one EDG is out on maintenance).

   In a September 4, 2009, response to RAI 260, Question 14.02-115, the applicant proposed a revision to the Test Method section of Test #116 to include Test Method Items 3.6, 3.7, and 3.8, which were added to require testing while connected to the normal supply and the alternate supply, and to verify that the automatic transfer occurs from the normal supply to the alternate supply. The staff finds the proposed revisions to Test Method Items 3.6, 3.7, and 3.8 acceptable.

3. The FSAR states that EDG has no load sequencers (i.e., timing relays), since this will be performed by controlling the placement of loads onto the respective EPSS at programmed time intervals by the protection system. Therefore, the staff requested that the applicant clarify what is being tested in Item 3.8, of Section 14.2.12.10.9, "6.9 kV Emergency Power Supply System (Test #116)," for the U.S. EPR EDG load sequencing.

   In a September 4, 2009 response to RAI 260, Question 14.02-115, the applicant proposed a revision to the Test Method section of Test #116 to include Test Method Item 3.10 (which was previously Item 3.8), which will verify that the control logic and controls including the load sequencer function in the protection system respond to ESF actuation signals as designed. The staff finds the proposed revisions to Test Method Item 3.10 acceptable.

4. Clarify what type of under-voltage (loss of voltage or degraded voltage) is being tested in Items 3.5 and 4.3 of Test #116.

   In a September 4, 2009, response to RAI 260, Question 14.02-115, the applicant proposed revisions to Items 3.5 and 4.3 of Test #116 to include the design response to the under-voltage conditions described in FSAR Tier 2, Section 8.3.1.1.3, "Electric Circuit Protection and Coordination." The staff finds the proposed revisions to Items 3.5 and 4.3 of Test #116 acceptable.

The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 260, Question 14.02-115 resolved.

In RAI 260, Question 14.02-116, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.12.10.11, "13.8 kV Normal Power Supply System (Test #118)," to include an additional objective that corresponds with Acceptance Criteria Item 5.2 relative to safety-related components meeting electrical independence and redundancy requirements. In addition, the staff requested that the applicant clarify how (i.e., test method) the automatic bus transfer scheme between normal and alternate power supplies is being tested under this test abstract. In a September 4, 2009, response to RAI 260, Question 14.02-116, the applicant proposed a revision to the objectives and the Test Methods sections of Test #118 to include electrical independence and redundancy for the reactor coolant pump breakers protective devices, which are the safety-related components powered from the 13.8 kV normal power supply system. Additionally, the applicant proposed revisions to both the objective and Test Method sections of Test #118 to include the testing of the automatic transfer from the normal offsite power supply to an alternate offsite power supply at the 13.8 kV level. The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 260, Question 14.02-116 resolved.

In RAI 260, Question 14.02-117, the staff requested that the applicant revise the following aspects to FSAR Tier 2, Section 14.2.12.10.12, "6.9 kV Normal Power Supply System (Test #119)":

1. Revise Test Method Item 3.1 to state: "Demonstrate the operation and functionality of the 480 Vac source and feeder circuit breaker (isolation devices) to locally and remotely isolate class 1E and non-class 1E systems."

   In a September 4, 2009, response to RAI 260, Question 14.02-117, the applicant proposed a revision to the Test Method section of Test #119, "6.9 kV Normal Power," Item 3.1, to include a demonstration of the operation and functionality of the 480 Vac source and feeder circuit breaker (isolation devices) to locally and remotely isolate IEEE Non-Class 1E systems. The applicant also discussed that the 6.9 kV normal power supply system does not supply Class 1E systems. The staff reviewed the proposed revision to Test Method Item 3.1 and finds it acceptable. During the staff review of FSAR Revision 3, the staff noted that the requested information to Test Method Item 3.1 was removed from Test #119 and is located in Test #120, "480 V Normal Power Supply System," to provide for testing of the 480 Vac source and feeder circuit breakers, locally and remotely. The staff finds the latest change acceptable.

2. The staff requested that the applicant re-insert Test Method Item 3.6, which the applicant proposed to remove in its December 18, 2008, response to RAI 144, Question 14.02-72.

   In a September 4, 2009, response to RAI 260, Question 14.02-117, the applicant stated that the proposed removal of Test Method Item 3.6 in its response was appropriate because the realignment of power from the normal offsite supply source to the alternate offsite source occurs on the 13.8 kV level and is not duplicated on the 6.9 kV level. The staff finds the applicant's proposed deletion of Test Method Items 3.6 from Test #119 acceptable.

The staff finds the proposed changes described above consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI responses. Accordingly, the staff finds the applicant has adequately

addressed these issues and, therefore, considers RAI 144, Question 14.02-72 and RAI 260, Question 14.02-117 resolved.

In RAI 260, Question 14.02-118, the staff requested that the applicant revise Test Method Item 3.6 of FSAR Tier 2, Section 14.2.12.10.8, "Emergency Lighting System (Test #115)," to include verification of the Remote Shutdown Station (RSS) emergency lighting. In a September 4, 2009, response to RAI 260, Question 14.02-118, the applicant proposed a revision to Test Method Item 3.3, of Test #115, to clarify that emergency lighting remains energized upon a loss of normal lighting. Additionally, the applicant proposed adding Test Method Item 3.7 to Test #115 to verify that the remote shutdown station emergency lighting is powered from redundant emergency power supply system buses by selectively removing power and verifying staggered lighting loss. The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 260, Question 14.02-118 resolved.

In RAI 260, Question 14.02-119, the staff requested that the applicant revise the title of FSAR Tier 2, Section 14.2.12.10.16 (subsequently renumbered as FSAR Tier 2, Section 14.2.12.10.14),"12-Hour Accident Uninterruptible Power Supply (Test #123)," to, "12-HourUninterruptible Power Supply (Test #123)." Additionally, the staff requested that the applicantrevise Test. #123 to include meggering and visual inspection checks of buses and equipment to the prerequisite section. In a September 4, 2009, response to RAI 260, Question 14.02-119, the applicant proposed revising the title of Test #123 to, "12-Hour Uninterruptible Power Supply (Test #123)," and proposed adding a prerequisite item to megger and perform visual inspection of buses and associated components. The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 260, Question 14.02-119 resolved.

In RAI 260, Question 14.02-120, the staff requested that the applicant revise the following aspects of the test methods of FSAR Tier 2, Section 14.2.12.10.16:

1. Revise Test Method Item 3.8 to include the direct current (DC)/DC converter.

   In a September 4, 2009, response to RAI 260, Question 14.02-120, the applicant proposed a revision to Test Method Item 3.8 of Test #123 to include a verification of the alternating current (AC)/DC and DC/DC converter output to the I&C cabinets. The staff finds the proposed revision to Test Method Item 3.8 acceptable.

2. Add the following to the Test Methods section:

   Demonstrate that the batteries and battery charger meet design capacities by performing discharge and charging tests as follows:

   - Perform battery modified performance discharge or service test in accordance with RG 1.129.

   - Perform battery charger capacity test to verify battery charger output meets design criteria.

In a September 4, 2009, response to RAI 260, Question 14.02-120, the applicant proposed a revision to the Test Method section of Test #123 to include Test Method Item 3.9, which includes the demonstration of the batteries and battery charger to meet design capacities. The staff finds the proposed revision to add Test Method Item 3.9 acceptable.

The staff finds the proposed changes described above consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 260, Question 14.02-120 resolved.

In RAI 260, Question 14.02-122, the staff requested that the applicant revise the test abstracts in FSAR Tier 2, Section 14.2.12 to include provisions for electrical heat tracing and freeze protection systems. Additionally, the staff requested that the applicant include the applicable general requirements for electrical heat tracing in the applicable section(s) of the FSAR. In a September 4, 2009, response to RAI 260, Question 14.02-122, the applicant proposed adding an additional test abstract, FSAR Tier 2, Section 14.2.12.10.7, "Heat Tracing (Test #114)," to demonstrate the operability of the heat tracing system. Additionally, the applicant revised FSAR Tier 2, Section 8.3.2.3.7, "Grounding," to include the general electrical requirements for the heat tracing electrical system. The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 260, Question 14.02-122 resolved.

FSAR Tier 2, Sections 14.2.12.11, "I&C Systems," and 14.2.12.12, "I&C Functions"

In RAI 144, Question 14.02-72, the staff requested that the applicant re-evaluate FSAR Tier 2, Sections 14.2.12.11 and 14.2.12.12 to ensure initiating events and corresponding responses are identified and that descriptions clearly identify and state the criteria against which success or failure is measured, and revise the FSAR as appropriate. In a May 14, 2009, response to RAI 144, Question 14.02-72, the applicant proposed to revise the test abstracts in FSAR Tier 2, Section 14.2.12 for clarification. The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 144, Question 14.02-72 resolved.

In RAI 144, Question 14.02-75, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.12.12.17, "Integrated Engineered Safety Features/Loss of Power (Test #153)," to include verification of proper operation for all initiating events not only those that initiate upon a loss of power condition. In a December 18, 2008, response to RAI 144, Question 14.02-75, the applicant stated that FSAR Tier 2, Section 14.2.12.11.22, "Protection System (Test #146)," provides preoperational testing information for the portion of the protection system that performs engineered safety feature actuation system (ESFAS) function upon a loss of power, and Test #153 provides duplicate information. The applicant deleted Test #153 and renamed FSAR Tier 2, Section 14.2.12.12.17 from "Integrated Engineered SafetyFeatures/Loss of Power (Test #153)," to "Reserved (Test #153)." Additionally, the applicant revised the title of Test #153 in FSAR Tier 2, Table 14.2-1, "List of Initial Tests for the U.S. EPR," from "Integrated Engineered Safety/Loss of Power (Test #153)," to "Reserved." The staff interpreted the

applicant's proposal to delete Test #153 to suggest that there are no other potential operating conditions other than a loss of power for which ESF actuations will be necessary. FSAR Tier 2, Section 7.3, "Engineered Safety Features Systems," describes multiple ESF actuations that are not based solely on a loss of power condition (e.g., Main Steam Isolation or Containment Isolation). Therefore, in follow-up RAI 275, Question 4.02-123, the staff requested that the applicant identify all test abstract(s) that address all other ESF actuation conditions described in FSAR Tier 2, Section 7.3, or to revise Test #153 accordingly. In a September 21, 2009, response to RAI 275, Question 4.02-123, the applicant proposed a new Test Method Item 3.6 to FSAR Tier 2, Subsection 14.2.12.11.22, "Protection System (Test #146)," to address all ESF functions by referencing FSAR Tier 2, Section 7.3, which describes all PS inputs that generate and ESF actuation output. The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 275, Question 14.02-123 resolved.

In RAI 386, Question 14.02-149, the staff noted that RG 1.68, Appendix A, Section 1, Paragraph h states that the testing of ESFs should demonstrate that such features will perform satisfactorily in all expected operating configurations or modes; however, FSAR Tier 2, Section 14.2.12.11.22 does not demonstrate the operation of the protection system in the presence of a simulated single failure of the protection system. Additionally, FSAR Tier 2, Sections 7.2, "Reactor Trip System," and 7.3, "Engineered Safety Features Systems," (Tables 7.2-2, "FMEA Summary for Reactor Trip," and 7.3-2, "FMEA Summary for ESF Actuations") state Failure Mode and Effect Analysis (FMEA) of the protection system with certain assumptions of the protection system functionality in the presence of a 'real' single failure. Therefore, in RAI 386, Question 14.02-149, the staff requested that the applicant revise Test #146 to include assumptions made concerning reactor trip and ESF in the FMEA tables and verification of single failure in the protection system. In a May 16, 2011, response to RAI 386, Question 14.02-149, the applicant stated that FSAR Tier 2, Section 14.2.12.11.22, "Protection System (Test #146)," provides preoperational test on the protection system prior to fuel load. The applicant stated that a bounding single failure for each division will be created as described in Step 3.11 by removing electrical power for an entire division and verifying protection system response. The staff finds the applicant's response acceptable and, therefore, considers RAI 386, Question 14.02-149 resolved.

In RAI 386, Question 14.02-150, the staff requested that the applicant clarify the term "actuators" in Test Method Item 3.6 in Test #146. In a May 16, 2011, response to RAI 386, Question 14.02-150, the applicant stated that FSAR Tier 2, Section 14.2.12.11.22, "Protection System (Test #146)," uses the term "actuator" consistent with how it is used in FSAR Tier 2, Chapter 7, when referring to any component that is controlled by a priority and actuator control system (PACS) module. Actuators could be any component that uses an electrical signal to reposition. The protection system is expected to actuate the reactor trip breakers and engineered safety feature components. The staff notes that the FSAR will not be changed as a result of these questions. The staff finds the applicant's response acceptable. Therefore, the staff considers RAI 386, Question 14.02-150 resolved.

In RAI 260, Question 14.02-105, the staff requested that the applicant make the following revisions to FSAR Tier 2, Section 14.2.12.11.3, "Boron Concentration Measurement System (Test #126)":

1. Revise Test Method Item 3.9 to include the following: "Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function."

   In a September 4, 2009, response to RAI 260, Question 14.02-105, the applicant proposed a revision to Test Method Item 3.9 to include the check for electrical independence and redundancy consistent with terminology used in other test abstracts. The staff finds the proposed revision to Test Method Item 3.9 acceptable.

2. Revise Acceptance Criteria Item 5.3 to include the following: "Verify that safety-related components meet electrical independence and redundancy requirements."

   In a September 4, 2009, response to RAI 260, Question 14.02-105, the applicant proposed a revision to Acceptance Criteria Item 5.3 to include verification of the boron concentration measurement system (BCMS) safety-related components to meet electrical independence and redundancy. The staff finds the proposed revision to test Acceptance Criteria Item 5.3 acceptable.

The staff finds the proposed changes described above consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 260, Question 14.02-105 resolved.

In follow-up RAI 260, Question 14.02-106, the staff requested that the applicant provide a more detailed description of the radiation monitoring system and its functional features in FSAR Tier 2, Sections 7.1.1.5.5, "Radiation Monitoring System," or 12.3.4, "Area Radiation and Airborne Radioactivity Monitoring," than it had provided in its December 18, 2008, response to RAI 143, Question 14.02-69. Additionally, the staff requested that the applicant revise FSAR Tier 2, Subsection 14.2.12.12.7, "Integrity of Systems Likely to Contain Radioactive Material (Test #153)," Acceptance Criteria Item 5.2 to include the reference of the locations of area and airborne radiation monitors provided in FSAR Tier 2, Tables 11.5-1, "Radiation Monitor Detector Parameters," and 12.3-3, "Radiation Monitor Detector Parameters." In a September 4, 2009, response to RAI 260, Question 14.02-106, the applicant proposed a revision to FSAR Tier 2, Subsection 7.1.1.5.5 to include a more detailed description of the radiation monitoring system design including self-testing and diagnostic features of the instrumentation. Additionally, the applicant proposed a revision to FSAR Tier 2, Subsection 14.2.12.12.7 Acceptance Criteria Item 5.2 to include references to FSAR Tier 2, Section 7.1.1.5.5 and the locations of area and airborne radiation monitors given in FSAR Tier 2, Tables 11.5-1 and 12.3-3, respectively. The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 260, Question 14.02-106 resolved.

In RAI 260, Question 14.02-107, the staff requested that applicant clarify the prerequisites section of FSAR Tier 2, Section 14.2.12.11.19, "Radiation Monitoring (Test #143)," to include the following:

1. Revise prerequisite Item 2.1 to state: "Construction activities on the radiation monitoring system have been completed with all radiation monitors positioned in accordance with Table 12.3-3 of the U.S. EPR FSAR."

In a September 4, 2009, response to RAI 260, Question 14.02-107, the applicant proposed a revision to prerequisite Item 2.1 to state that construction activities on the radiation monitoring system have been completed and that the radiation monitors are positioned in accordance with FSAR Tier 2, Table 12.3-3. The staff finds the proposed revision to prerequisite Item 2.1 acceptable.

2. Revise prerequisite Item 2.7 to state: "Verify proper radiation monitoring system alarm set points, operation, control and indication functions."

   In a September 4, 2009, response to RAI 260, Question 14.02-107, the applicant proposed a revision to prerequisite Item 2.7 to include verification of the alarm set points and operations of the radiation monitors for Test. #143. The staff finds the proposed revision to prerequisite Item 2.7 acceptable.

The staff finds the proposed changes described above consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 260, Question 14.02-107 resolved.

In RAI 275, Question 14.02-124, the staff requested that the applicant clarify in FSAR Tier 2, Section 14.2.12.11.2, "Seismic Monitoring System (Test #125)" whether factory acceptance testing will be performed as part of the test method or should its completion be verified as a prerequisite for the test abstract. In a September 21, 2009, response to RAI 275, Question 14.02-124, the applicant proposed a revision to Test #125 to move factory acceptance testing from the test section to the prerequisite section. The staff finds the proposed change consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 275, Question 14.02-124 resolved.

In RAI 313, Question 14.02-127, the staff noted that the applicant stated in its May 13, 2009, response to RAI 150, Question 12.03-12.04-4 that, during commissioning, two stacks of balls from the Aeroball Measurement System (AMS) would be activated to determine and measure their time dependence and decay constants. However, the staff also noted that Test #127 (preoperational testing of the AMS), 296, 207, and 208 (power ascension testing of the AMS) do not include this activation process of the AMS ball stacks as part of the test methods and acceptance criteria. Therefore, in RAI 313, Question 14.02-127, the staff requested that the applicant identify which test abstract(s) of the ITP will include the saturation activation of the AMS ball stacks as part of the test abstract.

In a January 27, 2010, response to RAI 313, Question 14.02-127, the applicant provided the proposed changes to FSAR Tier 2, Section 14.2.12.18.7, "Self Powered Neutron Detector Calibration (Test #206)." Except the confirmatory item associated with follow-up RAI 395, Question 14.2-161, discussed below, the staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 313, Question 14.02-127 resolved.

In follow-up RAI 395, Question 14.02-161, the staff noted that the applicant provided a revised Test #206, which incorporated the verification of the aeroball system's time dependence and

decay constants into the calibration of the self powered neutron detectors (SPNDs). Test #206, Section 2.2 states, "the reactor is at equilibrium xenon conditions prior to performing tests to meet 1.2 and 1.3." However, there is no discussion on the prerequisites for the aeroball system constant checks, nor are there acceptance criteria in Section 5.0 of the test for the determination of the time dependence and decay constants. Therefore, in RAI 395, Question 14.02-161, the staff requested that acceptance criteria for the aeroball time constants be included in Test #206 to ensure that the performance of the aeroball system is as expected. Specifically, the staff requested that the applicant provide acceptance criteria and prerequisites for objective 1.1 (determination of constants) to ensure the functional adequacy of the aeroball system.

In an April 1, 2011, response to RAI 395, Question 14.02-161, the applicant proposed a revision to FSAR Tier 2, Chapter 14.2, Test #206 to clarify: (1) Objective section: that it is necessary to verify the adequacy of the time dependent decay constant functions of the vanadium steel flux measurement balls; (2) Prerequisite section: to verify that theoretical time dependent decay constant functions for the vanadium steel measurement balls within the AMS have been entered into the software; (3) Test Method section: to verify that the time dependent decay constant functions are adequate or establish revised time dependent decay constant functions; (4) Acceptance Criteria section: to ensure that the time dependent decay constant functions for the vanadium steel balls do not create a data bias for the AMS flux maps. The staff finds the proposed changes acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 395, Question 14.02-161 resolved.

In RAI 313, Question 14.02-136, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.12.11.21, "Process and Effluent Radiological Monitoring System (Test #144)," as follows:

1. Revise prerequisite Item 2.5 to state: "Calibration check sources are available in appropriate forms (gaseous, solutions or plated sources) for the analyses referenced in FSAR Tier 2, Table 11.5-1."

2. Revise Test Method Item 3.4 to state: "Using radioactive calibration check sources, initiate a high radiation signal to the appropriate radiation monitors to verify as designed control actuations."

3. The acceptance criteria section of Test #144 does not define acceptable criteria commensurate with process measurements listed in FSAR Tier 2, Section 11.5. Therefore, the staff requested that the applicant identify where such acceptance criteria are located in the FSAR, or otherwise revise FSAR Tier 2, Section 11.5 accordingly.

In a January 27, 2010, response to RAI 313, Question 14.02-136, the applicant proposed a revision to Test #144. The applicant proposed revising the language of FSAR Tier 2, Section 14.2.12.11.21 as requested by the staff which included reference to FSAR Tier 2, Table 11.5-1 for the design requirements and acceptance criteria for the radiation monitoring instrumentation addressed in Test #144. The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 313, Question 14.02-136 resolved.

In RAI 313, Question 14.02-137, the staff noted that the acceptance criteria section of FSAR Tier 2, Section 14.2.12.12.9, "Post-Accident Monitoring Instrumentation (Test #155)," does not define acceptable criteria commensurate with process measurements listed in FSAR Tier 2, Section 9.3.2, "Process Sampling System." Therefore, in RAI 313, Question 14.02-137, the staff requested that the applicant identify where such acceptance criteria are located in the FSAR, or otherwise revise FSAR Tier 2, Section 9.3.2 accordingly.

The staff determined that the applicant's response to RAI 313, Question 14.02-137, was insufficient. Therefore, the staff closed RAI 313, Question 14.02-137, and in follow-up RAI 386, Question 14.02-156, the staff requested that the applicant commit to provide the level of detail noted that the applicant's response to RAI 313, Question 14.02-137 refers to the criteria said to be contained in FSAR Tier 2, Table 9.3.2-2, but it also needs to include FSAR Tier 2, Table 9.3.2-1, "Primary Side Sampling Points." Also, the current versions of FSAR Tier 2, Tables 9.3.2-1 and 9.3.2-2 do not provide this level of detail, and the response to RAI 313, Question 14.02-137 does not commit to update FSAR Tier 2, Tables 9.3.2-1 and 9.3.2-2 to ensure that the revised acceptance criteria are complemented with supporting FSAR data and a commitment to a parallel revision of FSAR Tier 2, Tables 9.3.2-1 9.3.2-2 and include their citation in Test #155 to ensure consistency. Therefore, in RAI 386, Question 14.02-156, the staff requested that the applicant address these issues. **RAI 386, Question 14.02-156 is being tracked as an open item.**

In RAI 330, Question 14.02-144, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.12.11.19 as follows:

1. Revise Test Method Item 3.5 to state: "Using radioactive calibration check sources initiate automatic initiation signals and record control actuations."

2. FSAR Tier 2, Table 7.3-1, "ESF Actuation Variables," lists three radiation monitors as providing input to the protection system: (1) The containment high range monitors; (2) the Main Control Room (MCR) air intake duct monitors; and (3) the main steam line activity monitors. However, Test #143 only provides acceptance criteria for the MCR air intake monitors. Therefore, the staff requested that the applicant revise the acceptance criteria Item 5.1 of Test #143 to state: "The radiation monitoring system generates high radiation signals for the main steam lines, containment, and MCR air intake ducts as input to the protection system."

3. The staff requested that the applicant revise the Acceptance Criteria Item 5.2 to include: "The airborne and area radiation monitors function as described in FSAR Sections 7.1.1.5.5, 7.3.1, and 12.3.4 as well as in Section 3.3.1, 'Protection System (PS),' of FSAR Section 16, 'Technical Specifications.' The airborne and area radiation monitors are listed in FSAR Tier 2, Table 11.5-1 and Table 12.3-3, respectively."

In a January 18, 2010 response to RAI 330, Question 14.02-144, the applicant provided changes to FSAR Tier 2, Section 14.2, Test #143 to clarify guidance for generating test input for the radiation monitor and a step was added to verify that the radiation monitor generates a protection signal from the MCR air intake duct activity, containment high range activity, and a steam line activity signal. The applicant also addressed Item No. 3 above in its September 4, 2009, response to RAI 260, Question 14.02-106.

The staff determined that the applicant's response to RAI 330, Question 14.02-144, was insufficient. Therefore, the staff closed RAI 333, Question 14.02-144, and in follow-up RAI 386, Question 14.02-160 the staff requested that the applicant clarify the addition of the term "safety-related" which was added to the prerequisite section of Test #143. In a November 10, 2010, response to RAI 386, Question 14.02-160, the applicant stated that FSAR Tier 2, Section 14.2, Test #143 was revised in FSAR Revision 2 which removed the term "safety-related." The staff concludes that the proposed changes are consistent with the guidance contained in RG 1.68. Therefore, the staff finds the proposed changes acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 386, Question 14.02-160 resolved.

FSAR Tier 2, Section 14.2.12.13, "Hot Functional Tests"

In RAI 158, Question 14.02-87, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.12.13.18, "Pre-core Loss of Instrument Air (Test #178)," so that the test abstract addresses all of the applicable regulatory positions in RG 1.68.3. In a February 27, 2009, response to RAI 158, Question 14.02-87, the applicant proposed a revision to FSAR Tier 2, Section 14.2.12.13.18 to address all of the applicable regulatory positions of RG 1.68.3. Additionally, the applicant stated that U.S. EPR instrument air system was not safety-related, and it is not credited in the accident analyses. The staff determined that the applicant's response to this question is inconsistent with existing guidance, closed RAI 158, Question 14.02-87, and generated a follow-up RAI, discussed below.

In follow-up RAI 229, Question 14.02-96, the staff requested that the applicant explain and justify why the control air system does not meet any of the six criteria in RG 1.68, Regulatory Position 1, or revise the Test #178 in accordance with RG 1.68.3 In a June 19, 2008, response to RAI 229, Question 14.02-96, the applicant proposed a revision to FSAR Tier 2, Section 14.2.12.13.18 to remove the note in the beginning of the test abstract and to revise prerequisite Item 2.5 to state: "This test satisfies the requirements of RG 1.68.3 regulatory positions C.1 – C.11." The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 229, Question 14.02-96 resolved.

In RAI 275, Question 14.02-125, the staff noted that in the prerequisites section of FSAR Tier 2, Section 14.2.12.13.8, "Pre-Core Pressurizer Surge Line Stratification (Test #168)," the applicant states, "that rapid response temperature sensors have been installed on the top and bottom of horizontal sections of the pressurizer surge line at specified distances." The staff requested that the applicant clarify how this prerequisite (installation of sensors at the top and bottom of the horizontal sections of surge line piping only) will adequately establish the stratification level and thermal striping, which controls the pressurizer surge line piping global bending moments. Additionally, the staff requested that the applicant describe how the proposed test abstract will verify surge line design/analysis (including stratification, fatigue transient cycles) to address the acceptance criteria that states, "the pressurizer surge line temperature has been evaluated to not cause unanalyzed thermal cycles." In a September 21, 2009, response to RAI 275, Question 14.02-125, the applicant proposed a revision to Test. #165, "Pre-Core Reactor Coolant System Expansion Measurement," and Test #168 to address this RAI. The applicant proposed a new objective Item 1.2 to Test. #165, which would verify the absence of thermal

stratification to the pressurizer surge line. The proposed revision to Test #165 would include the pressurizer surge line in the prerequisites, test methods, and data required sections. Additionally, the applicant proposed a revision to the prerequisites section of Test #168 to identify the placement of temperature sensors on the pressurizer surge line. The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 275, Question 14.02-125 resolved.

In RAI 313, Question 14.02-138, the staff noted that FSAR Tier 2, Section 14.2.12.13.12, "Pre-Core Primary System Leak Rate Measurement (Test #172)," Acceptance Criteria Item 5.1 identifies FSAR Tier 2, Chapter 16, Technical Specification (TS) 3.4.12, "RCS Operational LEAKAGE," as the reference for RCS Operational Leakage; however, TS 3.4.14 describes the bases for the RCS leakage detection instrumentation. Therefore, in RAI 313, Question 14.02-138, the staff requested that the applicant revise the acceptance criteria of Test #172 to identify TS 3.4.14 as an applicable criterion, or refer to the appropriate test abstract for the associated instrumentation that would address the operational requirements for the RCS Leakage Detection Instrumentation.

In a January 27, 2010, response to RAI 313, Question 14.02-138, the applicant stated that it reviewed the Test #172 and its relationship to TS 3.4.12 and TS 3.4.14. The applicant stated that plants typically perform a test periodically to meet the surveillance requirements described in TS 3.4.12 and rely on the instrumentation described in TS 3.4.14 to monitor signs of reactor coolant system (RCS) leakage between TS 3.4.12 surveillances. During hot functional (pre-core) testing, there are no radiological restrictions on personnel monitoring of the RCS pressure boundary, and the instrumentation described in TS 3.4.14 is not applicable. Based on the applicant's response, the staff closed RAI 313, Question 14.02-138, and issued follow-up RAI 386, Question 14.02-157, discussed below.

In follow-up RAI 386, Question 14.02-157, the staff noted that the response to RAI 313, Question 14.02-138 referred to actions and activities that are associated with COL licensee activities in concluding that the instrumentation used to meet the reactor coolant pressure boundary (RCPB) leakage rate TS need not be considered in the ITP. The staff clarified that the focus of the RAI is on the inclusion of tests and definition of test criteria that confirm the operation of the instrumentation used to meet the associated TS. The fact that the instrumentation is used to comply with a TS does not provide an adequate basis for it being excluded from the ITP. In this context, the staff requested that the applicant address the testing of the radiation monitoring equipment, test methods, and acceptance criteria. In a November 10, 2010, response to RAI 385, Question 14.02-157, the applicant proposed a revision to Test #187 to demonstrate the proper response of reactor coolant detection systems and that the instrumentation response conforms with the operational range stated in FSAR Tier 2, Section 5.2.5.5.3. The staff finds that the proposed changes to the FSAR conform to the guidance contained in RG 1.68. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 386, Question 14.02-157 resolved.

FSAR Tier 2, Section 14.2.12.14, "Phase II: Initial Fuel Loading and Precritical Tests"

The following is a list of test abstracts described in FSAR Tier 2, Section 14.2.12.14:

14.2.12.14.1, "Initial Fuel Load (Test #179)"

14.2.12.14.2, “Post-Core Sequencing Document (Test #180)”

14.2.12.14.3, “Post -Core Loose Parts Monitoring Baseline (Test #181)”

14.2.12.14.4, “Post-Core RCS Temperature Cross Calibration (Test #182)”

14.2.12.14.5, “Post-Core Reactor Coolant System Flow Baseline (Test #183)”

14.2.12.14.6, “Post-Core Control Rod Drive Mechanism Performance (Test #184)”

14.2.12.14.7, “Post-Core Reactor Coolant and Secondary Water Chemistry Data (Test #185)”

14.2.12.14.8, “Post-Core Pressurizer Spray Valve and Control Adjustments (Test #186)”

14.2.12.14.9, “Post-Core Reactor Coolant System Leak Rate Measurement (Test #187)”

14.2.12.14.10, “Post-Core Incore Instrumentation (Test #188)”

14.2.12.14.11, “Leak Detection Systems (Test #189)”

In comparing the U.S. EPR initial fuel loading and precritical tests to the testing recommended in RG 1.68, Appendix A, Section 2, “Initial Fuel Loading and Precritical Tests,” the staff identified an area where additional information was required to complete its review. A description of the specific issue is as follows:

In RAI 158, Question 14.02-84, the staff requested that the applicant revise the prerequisites in the test abstract in FSAR Tier 2, Section 14.2.12.14.1, “Initial Fuel Load (Test #179),” to include all of the prerequisites for initial fuel loading given in RG 1.68, Appendix C.2. In a February 27, 2009, response to RAI 158, Question 14.02-84, the applicant proposed revisions to the “Prerequisites” of FSAR Tier 2, Section 14.2.12.14.1, to include the applicable prerequisites given in RG 1.68, Appendix C.2.a. The staff finds the proposed revisions consistent with the guidance contained in RG 1.68, Appendix C.2.a, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 158, Question 14.02-84 resolved.

FSAR Tier 2, Section 14.2.12.15, “Phase III: Initial Criticality and Low Power Physics Tests”

The following is a list of test abstracts described in FSAR Tier 2, Section 14.2.12.15:

14.2.12.15.1, “Critical Boron Concentration: All Rods Out (Test #190)”

14.2.12.15.2, “Isothermal Temperature Coefficient (Test #191)”

14.2.12.15.3, “Rod Worth (Test #192)”

In comparing the U.S. EPR initial criticality and low power physics tests to the testing recommended in RG 1.68, Appendix A, Section 3 and Section 4, the staff identified an area where additional information was required to complete its review. A description of the specific issue is as follows:

In RAI 158, Question 14.02-84, the staff requested that the applicant revise the prerequisites in FSAR Tier 2, Section 14.2.12.15.1, "Critical Boron Concentration: All Rods Out (Test #190)," to include all of the prerequisites for initial criticality given in RG 1.68, Appendix A, Section 3 and Appendix C, "Preparation of Procedures," Section 3, "Initial Criticality Procedures." In a February 27, 2009, response to RAI 158, Question 14.02-84, the applicant proposed a revision to the acceptance criteria of FSAR Tier 2, Section 14.2.12.15.1 to include the applicable prerequisites given in RG 1.68, Appendix A, Section 3 and Appendix C, Section 3. Additionally, the applicant proposed a revision to the Test Methods section of Test #190 to include the statements that the reactor will be taken critical by the boron dilution method and that reactor power will be below the point-of-adding-heat. The staff finds the proposed revisions consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 158, Question 14.02-84 resolved.

FSAR Tier 2, Sections 14.2.12.16, "Phase IV: Power Ascension Tests, 5 Percent Power Ascension Plateau," through 14.2.12.21, "Phase IV: Power Ascension Tests"

The following is a list of power ascension test abstracts described in FSAR Tier 2, Sections 14.2.12.16 through 14.2.12.21:

14.2.12.16.1, "Low Power Biological Shield Survey (Test #193)"

14.2.12.16.2, "Comparison of Digital Systems and Design Predictions (Test #194)"

14.2.12.16.3, "Main, Startup and Emergency Feedwater Systems (Test #195)"

14.2.12.16.4, "Natural Circulation (Test #196)"

14.2.12.16.5, "Control Systems Checkout (Test #199)"

14.2.12.17.1, "Baseline NSSS Integrity Monitoring (Test #197)"

14.2.12.17.2, "Total Loss of Offsite Power (Test #198)"

14.2.12.18.1, "Load Swings (Test #200)"

14.2.12.18.2, "Secondary Calorimetric Power (Test #201)"

14.2.12.18.3, "Primary Calorimetric (Test #202)"

14.2.12.18.4, "Ventilation Capability (Test #203)"

14.2.12.18.5, "Sampling Primary and Secondary Systems (Test #204)"

14.2.12.18.6, "Failed Fuel Detection (Test #205)"

14.2.12.18.7, "Self-Powered Neutron Detector Calibration (Test #206)"

14.2.12.18.8, "Steady-State Core Performance (Test #207)"

14.2.12.18.9, "Core-Related Reactor Trips (Test #208)"

14.2.12.18.10, “Incore/Excore Cross Calibration (Test #209)”

14.2.12.18.11, “Penetration Temperature Survey (Test #210)”

14.2.12.18.12, “Remote Shutdown Station Checkout (Test #211)”

14.2.12.18.13, “Load Follow (Test #220)”

14.2.12.19.1, “Biological Shield Survey (Test #212)”

14.2.12.19.2, “Single RCCA Misalignment (Test #213)”

14.2.12.19.3, “Securing a Single Train of Feedwater Heaters (Test #214)”

14.2.12.20.1, “Liquid Waste Storage and Processing Systems (Test #215)”

14.2.12.20.2, “Gaseous Waste Processing System (Test #216)”

14.2.12.20.3, “Loss of Feedwater (Test #217)”

14.2.12.21.1, “HZP To HFP Reactivity Difference (Test #218)”

14.2.12.21.2, “Trip of Generator Main Breaker (Test #219)”

14.2.12.21.3, Deleted

14.2.12.21.4, “Turbine-Generator Load Rejection (Test #221)”

14.2.12.21.5, “Actual Rod Drop Times (Test #222)”

14.2.12.21.6, “Cooling Tower Acceptance (Test #223)”

14.2.12.21.7, “Loss of Offsite Power with Plant Auxiliary Loads Supplied in Island Mode (Test #227)”

In comparing the U.S. EPR power ascension tests to the testing recommended in RG 1.68, Appendix A, Section 5, “Power-Ascension Tests,” the staff identified several areas where additional information was required to complete its review. Descriptions of the specific issues are as follows:

In RAI 98, Question 14.02-46, the staff requested that the applicant delete Objective Item 1.3.1 from FSAR Tier 2, Section 14.2.12.16.4, “Natural Circulation (Test #196),” which states, “It is permissible to substitute test data from plants of similar design in lieu of performing this test.” RG 1.68, Appendix A, Section 4, Paragraph t specifically states that natural circulation tests of the reactor coolant system are performed “to confirm that the design heat removal capability exists, or to verify flow (without pumps) or temperature data are comparable to prototype designs for which equivalent test have been successfully completed.” RG 1.68 does not allow for the substitution of test data from plants of similar design in lieu of performing the test. In a November 14, 2008, response to RAI 98, Question 14.02-46, the applicant proposed a revision to this test abstract that deletes the option to substitute test data from similar design in lieu of performing this test. The staff finds the proposed revisions consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains

the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 98, Question 14.02-46 resolved.

In RAI 143, Question 14.02-67, the staff requested that the applicant justify the testing of systems during the Power Ascension Phase at reactor power levels different than those required in RG 1.68. RG 1.68, Appendix A, Section 5, "Power-Ascension Tests," describes initial plant testing to be completed at the 25 percent, 50 percent, 75 percent, and 100 percent reactor power plateaus. However, initial testing in Phase IV: Power Ascension Tests of the FSAR requires the power ascension tests to be completed at 30 percent, 50 percent, 75 percent, and greater than or equal to 98 percent reactor power. In a December 18, 2008, response to RAI 143, Question 14.02-67, the applicant proposed revisions to the applicable test abstracts in the power ascension phase of FSAR Tier 2, Section 14.2.12 to accurately reflect the power ascension plateaus of ≤ five percent and 25 percent as described in RG 1.68. Additionally, the applicant proposed revising the 100 percent power plateau to ≥ 98 percent in the applicable test abstracts to provide the reactor operator a margin between the testing power level and the license limit of 100 percent. The staff finds the proposed revisions consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 143, Question 14.02-67 resolved.

In RAI 260, Question 14.02-121, the staff requested that the applicant revise FSAR Tier 2, Table 14.2-1, "List of Initial Tests for the U.S. EPR," to include RG 1.68, Appendix A, Section 5, Paragraph t for Tests #037, #060, #061, and #063, or justify its exclusion. In a September 4, 2009, response to RAI 260, Question 14.02-121, the applicant proposed a revision to FSAR Tier 2, Table 14.2-1 to include RG 1.68, Appendix A, Section 5, Paragraph t for the Tests #037, #061, #062, #068, #148, and #151. Additionally, the applicant proposed revising the following test abstracts for clarity: (1) Test #061 Test Method Item 3.3 and data required items 4.4 and 4.6 to ensure valve opening set points and response time is recorded; (2) Test #068 prerequisite Item 2.5 to specify the steam turbine visual inspection; (3) Test. #068 Test Method Item 3.2.2 to ensure response times for the valves; (4) Test #068 Test Method Item 3.5 to reference FSAR Tier 2, Section 10.2; and (5) Test #151 Test Method Items 3.1.1 and 3.1.2 to ensure that valve response time and reset pressure is recorded. The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 260, Question 14.02-121 resolved.

In RAI 313, Question 14.02-139, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.12.18.5, "Sampling Primary and Secondary Systems (Test #204)," as follows:

1. Revise prerequisite Item 2.2 to state: "Required sampling systems are functional and analysis instrumentation are calibrated using calibration gases and solutions as referenced in the radioactive and non-radioactive analyses of FSAR Tier 2, Table 9.3.2-2."

2. The acceptance criteria section of Test #204 does not define acceptable criteria commensurate with process measurements listed in FSAR Tier 2, Section 9.3.2. Therefore, the staff requests that the applicant identify where such acceptance criteria is located in the FSAR, or otherwise revise FSAR Tier 2, Section 9.3.2 accordingly.

In a January 27, 2010, response to RAI 313, Question 14.02-139, the applicant provided the proposed changes to Test #204. The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 313, Question 14.02-139 resolved.

In follow-up RAI 386, Question 14.02-158, the staff noted that the applicant's response to RAI 313, Question 14.02-139 referred to the criteria said to be contained in FSAR Tier 2, Table 9.3.2-2 (Secondary Side). The test abstract also needs to cite FSAR Tier 2, Table 9.3.2-1 (Primary Side), since Test #204 is for sampling the primary and secondary systems. Omitting a citation to FSAR Tier 2, Table 9.3.2-1 would result in an incomplete set of acceptance criteria. In addition, the current versions of FSAR Tier 2, Tables 9.3.2-1 and 9.3.2-2 do not provide this level of detail, and response does not commit to updating these tables to ensure that the revised acceptance criteria are complemented with supporting FSAR data. Therefore, in RAI 386, Question 14.02-158, the staff requested that the applicant make the appropriate changes to Test #204. **RAI 386, Question 14.02-158 is being tracked as an open item.**

In RAI 313, Question 14.02-140, the staff requested that the applicant revise FSAR Tier 2, Section 14.2.12.18.6, "Failed Fuel Detection (Test #205)," as follows:

1. Revise objective Item 1.1.4 to state: "Radioisotopic concentration data of the radioactive elements (e.g., cesium, iodine, strontium, barium, cerium, and noble gases)."

2. Revise prerequisite section to include an item that states, "Calibrating gases and solutions are available for radioactive and non-radioactive analyses referenced in Table 9.3.2-2 of the U.S. EPR FSAR."

3. The acceptance criteria section of Test #205 does not define acceptance criteria commensurate with process measurements listed in FSAR Tier 2, Section 9.3.2. Therefore, the staff requested that the applicant identify where such acceptance criteria are located in the FSAR, or otherwise revise FSAR Tier 2, Section 9.3.2 accordingly.

In a January 27, 2010, response to RAI 313, Question 14.02-140, the applicant provided the proposed changes to Test #205. The staff finds the proposed changes consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 313, Question 14.02-140 resolved.

In follow-up RAI 386, Question 14.02-159, the staff noted that the applicant's response to RAI 313, Question 14.02-140 referred to the acceptance criteria said to be contained in FSAR Tier 2, Section 9.3.2, Table 9.3.2-2 (Secondary Side). The applicant also needs to reference FSAR Tier 2, Table 9.2.2-1 for the primary side. The test is for failed fuel detection, and the response should cite FSAR Tier 2, Table 9.3.2-1 (Primary Side), since Test #205 is for sampling the primary side. Omitting a citation to FSAR Tier 2, Table 9.3.2-1 would result in an incomplete set of acceptance criteria. In addition, the current version of FSAR Tier 2, Table 9.3.2-1 does not provide this level of detail, and the response does not commit to updating FSAR Tier 2, Table 9.3.2-1 to ensure that the revised acceptance criteria are complemented with supporting FSAR data. Therefore, in RAI 386, Question 14.02-159, the staff requested that the applicant update FSAR Tier 2, Tables 9.3.2-1 and 11.5-1 and include

their citation in Test #205 to ensure consistency. **RAI 386, Question 14.02-159 is being tracked as an open item.**

In RAI 313, Question 14.02-141, the staff requested that the applicant revise the Acceptance Criteria Item 5.1 of FSAR Tier 2, Section 14.2.12.20.1, "Liquid Waste Storage and Processing Systems (Test #215)," to state: "The LWSPS processes radioactive effluents as designed (refer to Sections 11.2, 11.5 and 13.4)."

In a January 27, 2010, response to RAI 313, Question 14.02-141, the applicant provided this proposed change to FSAR Tier 2, Section 14.2.12.20.1. The staff finds the proposed change consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the change committed to in the RAI response. Accordingly, the staff finds the applicant adequately addressed this issue and, therefore, considers RAI 313, Question 14.02-141 resolved.

In RAI 313, Question 14.02-142, the staff requested that the applicant revise Acceptance Criteria Item 5.1 of FSAR Tier 2, Section 14.2.12.20.2, "Gaseous Waste Processing Systems (Test #216)," to state: "The GWPS processes radioactive and potentially flammable gases effluent as designed (refer to Sections 11.2, 11.5, and 13.4)."

In a January 27, 2010, response to RAI 313, Question 14.02-142, the applicant provided this proposed change to FSAR Tier 2, Section 14.2.12.20.2. The staff finds the proposed change consistent with the guidance contained in RG 1.68, and therefore acceptable. The staff confirmed that the FSAR contains the change committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 313, Question 14.02-142 resolved.

Based on a review of FSAR, Tier 2, Revision 3, Section 14.2.12 and the FSAR mark-up provided in responses to RAI 386, Questions 14.02-151, 14.02-152, 14.02-156, 14.02-158, and 14.02-159, the staff identified a number of inconsistencies in the descriptions of test methods and acceptance criteria for radiation monitoring systems listed in FSAR Tier 2, Sections 14.2.12, 12.3, 11.5.3, 11.5.4, 11.2, 9.4.3, and 9.2.4. The staff's review indicates that the test methods and acceptance criteria do not refer to each system's specific radiation monitor tag numbers in confirming the proper operation of automatic control functions (e.g., isolation or diversion) upon detecting high radioactivity activity levels and departures in process or discharge flow rates, or proper operation of backflow preventers for systems that are not equipped with radiation monitoring instrumentation. Therefore, in RAI 527, Question 14.02-163, the staff requested that the applicant address these inconsistencies and revise the respective sections of the FSAR. **RAI 527, Question 14.02-163 is being tracked as an open item.**

Conclusions

The staff concludes that the information provided in FSAR Tier 2, Section 14.2.12 adequately describes individual preoperational and startup test abstracts. Each abstract identifies test objectives, prerequisites, test methods, data required, and acceptance criteria. The minimum test requirements are generally based on system or component functional design requirements that were used in the safety analysis. Detailed preoperational test procedures will be developed using these test abstracts. Except for the open items discussed above, the staff concludes that the U.S. EPR individual pre-operational and startup test abstracts conform to the guidance in NUREG-0800, Section 14.2.II.5, "Individual Test Descriptions/Abstracts," and the general guidelines and applicable regulatory positions in RG 1.6, and are therefore acceptable.

14.2.5 Combined License Information Items

Table 14.2-1 provides a list of initial test program related COL information item numbers and descriptions from FSAR Tier 2, Table 1.8-2:

Table 14.2-1 U.S. EPR Combined License Information Items

Item No.	Description	FSAR Tier 2 Section
14.2-1	A COL applicant that references the U.S. EPR certified design will provide site specific information that describes the organizational units that manage, supervise, or execute any phase of the test program.	14.2.2
14.2-2	A COL applicant that references the U.S. EPR certified design will develop a test program that considers the following guidance components: (1) The applicant should allow at least nine months to conduct preoperational testing. (2) The applicant should allow at least three months to conduct startup testing, including fuel loading, low power tests, and power ascension tests. (3) Plant safety will not be dependent on the performance of untested SSC during any phase of the startup test program. (4) Surveillance test requirements will be completed in accordance with plant Technical Specification requirements for SSC operability before changing plant modes. (5) Overlapping test program schedules (for multi-unit sites) should not result in significant divisions of responsibilities or dilutions of the staff provided to implement the test program. (6) The sequential schedule for individual startup tests should establish, insofar as practicable, that test requirements should be completed prior to exceeding 25 percent power for SSC that are relied upon to prevent, limit, or mitigate the consequences of postulated accidents. (7) Approved test procedures should be in a form suitable for review by regulatory inspectors at least 60 days prior to their intended use or at least 60 days prior to fuel loading for fuel loading and startup test procedures. (8) Identify and cross reference each test (or portion thereof) required to be completed before initial fuel loading and that is designed to satisfy the requirements for completing ITAAC.	14.2.11
14.2-3	A COL applicant that references the U.S. EPR design certification will provide site-specific information for review and approval of test procedures.	14.2.3
14.2-4	A COL applicant that references the U.S. EPR design certification will address the site-specific administrative procedures for review and approval of test results.	14.2.5

Item No.	Description	FSAR Tier 2 Section
14.2-5	A COL applicant that references the U.S. EPR design certification will provide site-specific test abstract information for the circulating water supply system.	14.2.12.7.11
14.2-7	A COL applicant that references the U.S. EPR design certification will provide site-specific test abstract information for the cooling tower.	14.2.12.21.6
14.2-8	A COL applicant that references the U.S. EPR design certification will provide site-specific test abstract information for the raw water supply system.	14.2.12.15.1
14.2-9	A COL applicant that references the U.S. EPR design certification will provide site-specific test abstract information for personnel radiation monitors.	14.2.12
14.2-10	A COL applicant that references the U.S. EPR design certification will plan, and subsequently conduct, the plant startup test program.	14.2.4
14.2-11	A COL applicant that references the U.S. EPR design certification will identify the specific operator training to be conducted as part of the low-power testing program related to the resolution of TMI Action Plan Item I.G.1, as described in (1) NUREG-0660 - NRC Action Plans Developed as a Result of the TMI-2 Accident, Revision 1, August 1980, (2) NUREG-0694 - TMI-Related Requirements for New Operating Licenses, June 1980, and (3) NUREG- 0737 - Clarification of TMI Action Plan requirements.	14.2.9

The staff finds the above listing to be complete. Also, the list adequately describes actions necessary for the COL applicant or holder. No additional COL information items need to be included in FSAR Tier 2, Table 1.8-2 for initial test program consideration.

14.2.6 Conclusions

Except for the open items discussed above, the staff makes the following conclusions:

The staff has reviewed the information provided in the FSAR on the applicant's test program in accordance with SRP Section 14.2. This review included an evaluation of the applicant's administrative measures to control (1) the conduct of the ITP; (2) the schedule for conducting the test program; (3) the sequence of startup testing to be performed; (4) the methods for conducting individual tests and the acceptance criteria to be used in evaluating the test results for plant SSCs; (5) the test program's compliance with applicable regulations; (6) the responsibilities, authorities, and qualifications of the different positions in the startup group; and

(7) the conformance to RGs applicable to the ITP. The review also included an evaluation of the results of the applicant's review of operating and testing experiences at other reactor facilities and their effect on the ITP, and the incorporation and trial use of plant operating and emergency procedures during the test program. The staff concludes that the information provided in the application meets the acceptance criteria in SRP Section 14.2 and describes an acceptable ITP that, when successfully completed, will demonstrate the functional adequacy of plant SSCs.

The staff concludes that the initial plant test program meets the following requirements:

- 10 CFR 50.34(b)(6)(iii), as it relates to the requirement for inclusion of plans for preoperational testing and initial operations in the Safety Analysis Report (SAR).

- 10 CFR 30.53(c), as it relates to initial testing of radiation detection and monitoring instruments.

- 10 CFR Part 50, Appendix B, Criterion XI, as it relates to the requirement that a test program is established to assure that all testing required to demonstrate that SSCs will perform satisfactorily in service is identified and performed, in accordance with written test procedures which incorporate the requirements and acceptance limits in applicable design documents.

- 10 CFR Part 50, Appendix J, Section III.A.4, as it relates to the requirement that a preoperational measurement of the overall integrated leak-tightness of the primary reactor containment under specified pressure conditions.

- 10 CFR 52.47(b)(1), as it relates to the requirement that design certification applicants include in the application the proposed ITAAC that are necessary and sufficient to provide reasonable assurance that the SSCs in this area of review will operate in accordance with the design certification and NRC regulations.

14.3 Inspections, Tests, Analyses, and Acceptance Criteria

14.3.1 Selection Criteria and Methodology for FSAR Tier 1

14.3.1.1 *Introduction*

This section describes the staff review of selection criteria and processes used to develop the U.S. EPR certified design material (CDM) and the ITAAC. It addresses the technical adequacy and completeness of the ITAAC given in FSAR Tier 1. It describes the evaluation of information contained in FSAR Tier 2, Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria," and FSAR Tier 1.

14.3.1.2 *Summary of Application*

FSAR Tier 2, Section 14.3 discusses the criteria and methodology for selecting the SSCs to be included and described in FSAR Tier 1 as CDM, as well as their associated ITAAC. This section includes definitions and general provisions, design descriptions, ITAAC, significant site parameters, and significant interface requirements. This section specifically addresses the ITAAC for the SSCs within the scope of the U.S. EPR. In addition, this section addresses design acceptance criteria (DAC) that have been proposed for the U.S. EPR in specific areas

where a design process has been prescribed to produce predictable and acceptable designs, and it includes a proposed approach for completing the design-related ITAAC (i.e., DAC).

FSAR Tier 1 provides the results of the implementation of FSAR Tier 2, Section 14.3, selection criteria and methodology for determining the SSCs described throughout FSAR Tier 2. These are included in the FSAR Tier 1 verification program to ensure that a U.S. EPR facility has been constructed and will operate in accordance with the design certification.

14.3.1.3 *Regulatory Basis*

The relevant requirements of NRC regulations for the ITAAC, are specified in NUREG-0800, Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria," and are summarized below. Review interfaces with other SRP sections can also be found in NUREG-0800, Section 14.3.

1. 10 CFR 52.47(b)(1), as it relates to the requirement that a design certification 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 plant that incorporates the design certification is built and should operate in accordance with the design certification, the provisions of the Atomic Energy Act of 1954, and NRC regulations.

2. 10 CFR 52.47(a)(26), as it relates to the requirement that a design certification application contain justification that compliance with the interface requirements of 10 CFR 52.47(a)(25), is verifiable through inspections, tests, or analyses. The method to be used for verification of interface requirements should be included as part of the proposed ITAAC required by 10 CFR 52.47(b)(1), "Contents of applications; technical information,"

10 CFR 52.47(b)(1), requires that the design certification application contain the proposed ITAAC that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses (ITA) are performed and the acceptance criteria (AC) met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Atomic Energy Act of 1954, and NRC regulations, Office of the Secretary of the Commission (SECY)-90-377, "Requirements for Design Certification under 10 CFR Part 52," November 8, 1990, and its associated staff requirements memorandum (SRM), February 15, 1991, which provided NRC guidance on the level of detail that a design certification application should reflect. In addition, SECY-90-241, "Level of Detail Required for Design Certification under Part 52," July 11, 1990, and its associated SRM, SECY-91-178, "Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) for Design Certifications and Combined Licenses," June 12, 1991; SECY-91-210, "Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) Requirements for Design Review and Issuance of a Final Design Approval (FDA)," July 16, 1991; and SECY-92-214, "Development of Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) for Design Certifications," June 11, 1992, provide NRC guidance on the development and use of ITAAC included in the licensing process described in 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants." In SECY-92-053, "Use of Design Acceptance Criteria During 10 CFR Part 52 Design Certification Process," February 19, 1992, the staff discussed a method for using the DAC, together with detailed design information, during the 10 CFR Part 52 process for reviewing and approving designs. The NRC intended the DAC to be used for applications that do not provide design and

engineering information at a level of detail customarily required by the staff to reach a final safety decision, and primarily for areas of design that are subject to rapidly changing technologies. Finally, SECY-05-0197, "Review of Operational Programs in a Combined License Application and Generic Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria," October 28, 2005, discussed the use of programmatic emergency planning ITAAC.

NUREG-0800, Section 14.3, describes the regulatory basis for acceptance of the ITAAC associated with a design certification application and, specifically in this case, the U.S. EPR FSAR. RG 1.206 provides COL applicants referencing a certified design, guidance on the development of site-specific ITAAC and the use of ITAAC contained in a certified design.

In FSAR Tier 2, Section 14.3, the applicant provided the selection criteria and processes used to develop FSAR Tier 1 ITAAC. The FSAR Tier 1 information provides the principal design bases and design characteristics that are certified by the 10 CFR Part 52 rulemaking process and that would be included in the U.S. EPR rule.

14.3.1.4 *Technical Evaluation*

The staff reviewed FSAR Tier 2, Section 14.3 for compliance with the guidance contained in SRP Section 14.3. This section describes the staff's evaluation of the FSAR Tier 1 information. The FSAR Tier 1 information is derived from the FSAR Tier 2 information. Specifically, this information includes the following:

- Definitions and general provisions
- System-based design descriptions
- Non-system-based design descriptions
- Inspections, tests, analyses, and acceptance criteria
- Significant interface requirements
- Significant site parameters

The applicant intends to have this FSAR Tier 1 information certified in a design certification rulemaking pursuant to 10 CFR Part 52, Subpart B. To be certified, the FSAR Tier 1 information must describe the U.S. EPR design and verify that the regulations applicable to the U.S. EPR design are met. The amount of information in the FSAR Tier 1 design descriptions is proportional to the safety significance of the structures and systems in the standard plant design. The FSAR Tier 1 design descriptions are binding requirements for the life of a facility referencing the certified design.

The staff reviewed the FSAR Tier 1 information in accordance with the guidance provided in SRP Section 14.3, the requirements in 10 CFR 52.47, and the Atomic Energy Act of 1954, as amended. The staff prepared SRP Section 14.3 based on the experience gained in its reviews of the evolutionary plant designs (advanced boiling-water reactor (ABWR) and System 80+), which were certified in 1997, and passive plant designs (AP600 and AP1000), which were certified in 1999 and 2006, respectively.

The applicant organized its FSAR Tier 1 information in a manner similar to that used for the evolutionary designs, as described in SRP Section 14.3. Therefore, FSAR Tier 1, Chapter 2.0, "System Based Design Description and ITAAC," establishes the design descriptions and ITAAC for all of the systems in the U.S. EPR design; FSAR Tier 1, Chapter 3.0, "Nonsystem Based Design Descriptions and ITAAC," establishes the non-system based design descriptions and ITAAC that apply to multiple systems or structures. In FSAR Tier 1, Chapter 2.0, the applicant provided a FSAR Tier 1 entry (subsection) for every system in its design, thereby meeting the requirement that the FSAR Tier 1 information describe the standard plant design. The applicant provided a FSAR Tier 1 entry for every system that is either fully or partially captured within the scope of the U.S. EPR standard plant design. The amount of information in a given subsection is proportional to the safety significance of the particular system. The ITAAC portion of the FSAR Tier 1 information is used to verify that the as-built facility conforms to the applicable regulations.

The applicant's FSAR Tier 1 document, which was organized based on SSCs, does not provide for direct correlation to the SRP staff review guidance. The applicant's organization of FSAR Tier 1 information is acceptable, however, as it is consistent with previous U.S. EPR applications to the NRC and it facilitates a more efficient staff review of FSAR Tier 1 information in conjunction with the FSAR Tier 2 information from which it is derived. The information in FSAR Tier 1 is cross-cutting in nature and required several staff technical review branches to provide a comprehensive review. To facilitate such a comprehensive review of the FSAR Tier 1 information, the staff developed a review matrix and included it as Appendix A to this section. Appendix A identifies the SRP used to evaluate the SSCs covered in FSAR Tier 1, Chapter 2, Chapter 3, Chapter 4, "Interface Requirements," and Chapter 5, "Site Parameters," and the associated subsection of this report in which the evaluation is documented.

In FSAR Tier 1, the applicant provided the results of its implementation of the selection criteria and methodology used to develop FSAR Tier 1 information and ITAAC as described in FSAR Tier 2, Section 14.3. The FSAR Tier 1 information provided by the applicant includes the following:

- A table of contents and a list of tables, figures, and abbreviations and acronyms

- An introduction that provides definitions of terms used in the FSAR Tier 1 information and that discusses the treatment of individual items, the implementation of ITAAC, matters related to operations, the interpretation of figures and a figure legend, and the rated reactor core thermal power

- A section containing the design descriptions, including associated tables and figures, and the ITAAC necessary to demonstrate that the facility referencing the U.S. EPR standard design has been constructed and will operate in accordance with the design certification

- A section containing non-system-based material that discusses the use of DAC for piping systems and components, and human factors engineering (HFE), including the necessary design completion ITAAC and installation verification ITAAC for these areas, and that addresses areas of U.S. EPR standard design that are applicable to more than one system, initial test program, design reliability assurance program, post-accident monitoring instrumentation, and environmental qualification of mechanical and electrical equipment

- A section containing the provisions and/or specifications for interface material that license applicants referencing the U.S. EPR standard design must provide in their applications

- A section containing the site parameters upon which the U.S. EPR standard design is based and which applicants must demonstrate are parameters that envelop the site-specific parameters for the locations they have chosen to build and operate the U.S. EPR design

A COL applicant that references the U.S. EPR design certification will describe the selection methodology for site-specific SSCs to be included in ITAAC, if the selection methodology is different from the methodology described within the FSAR, and will also provide the selection methodology associated with emergency planning and physical security hardware. The staff finds that, because the selection methodology for site-specific SSCs that differ from the methodology described in the FSAR will be completed by the COL applicant, it is acceptable to defer responsibility for the development of the selection methodology associated with emergency planning and physical security hardware to the COL applicant. This is identified as COL Information Item 14.3-2 in FSAR Tier 2, Table 1.8-2, "U.S. EPR Combined License Information Items."

In FSAR Tier 2, Section 14.3 the applicant provides an overview of its FSAR Tier 1 information contents, and describes that this information is organized into five chapters. It states that there are two material categories in FSAR Tier 1: CDM and ITAAC. The CDM is in the form of design descriptions, tables, and figures. The ITAAC are used to verify U.S. EPR as-built features. In this section, the applicant sets forth a definition of as-built information and describes the regulatory basis and the overall ITAAC content for COL applications. This section reiterates the guidance provided in RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)." A COL applicant that references the U.S. EPR design certification will provide ITAAC for emergency planning, physical security, and site-specific portions of the facility that are not included in the FSAR Tier 1 ITAAC associated with the certified design (10 CFR 52.80(a)). The staff finds that, because these ITAAC are associated with site-specific portions of the facility, it is acceptable to defer responsibility for the development of the ITAAC for emergency planning, physical security, and site-specific portions of the facility that are not included in the Tier 1 ITAAC associated with the certified design to the COL applicant. This is identified as COL Information Item 14.3-1 in FSAR Tier 2, Table 1.8-2.

In RAI 182, Question 14.03-10, the staff requested the applicant to rectify some inconsistencies, wording interpretation issues, technical adequacy issues, and staff "inspectability" issues, related to the organization and wording of the ITAAC, documented in the FSAR. Representative and illustrative samples of broader issues identified were provided. Topical areas included: Inconsistent ITAAC identification and numbering; technical interpretation issues in terms of how the ITAAC are to be met; interpretation issues associated with a "reference-only" notation in the tables; mismatches between ITA design criteria and AC; AC that are written to indicate "installed per design" when a "bounding" analysis is more appropriate; and incomplete ITAAC. Several of the ITAAC are written without sufficient specificity or detail that provide meaningful acceptance criteria or attributes that can be assessed and verified by independent inspection. RAI 182, Question 14.03-10, also noted definitions and terminology issues. In the area of the "Definitions" of FSAR Tier 1, Section 1.1, the terms "as-installed" and "as-built" are defined differently. However, the ITAAC usage of these terms often appears to be not only inconsistent, but also inappropriate to the definitions. If the term "as-built" is equivalent

to “as-installed” for systems and structures fabricated onsite, this causes confusion in the distinction between these terms. Another “Definition” concern arises with the term “As-built Reconciliation.” While the definition itself appears appropriate, this term does not appear to be used in the ITAAC themselves. Specifically, regarding ASME piping systems (e.g., RCS documented in FSAR Tier 1, Table 2.2.1-5, “Reactor Coolant System ITAAC”), there appears to be no ITAAC written to check the “As-built Reconciliation” of the “as-built” piping to assure that the design requirements have been met. Additional ASME ITAAC issues are discussed in a later comment. Additional comments relating to definitions and terminology involve the inappropriate interchange of an “inspection” and a “test.” In several ITAAC sections, the ITA specifies an inspection or verification of “construction records.” The inspection requirement should be applied to the actual construction of the SSC, as documented in the quality assurance records, but not of the “records” alone. RAI 182, Question 14.03-10, also identified issues associated with the specification of ASME requirements in the ITAAC. There were problems with the use of ASME references (e.g., design reports versus data reports) and application of the criteria for proper “construction” (and not just “design”) in accordance with the ASME B&PV Code, Section III, requirements. The ITAAC appears to address the ASME Code requirements in an inconsistent and incomplete manner. In summary, in RAI 182, Question 14.03-10, the staff requested that the applicant perform a comprehensive review of all ITAAC to address the various concerns described above.

In an October 21, 2009, response to RAI 182, Question 14.03-10 (Part E), the applicant revised the definition of “as-built” in FSAR Tier 1, Section 1.1, “Definitions,” to be consistent with the Nuclear Energy Institute (NEI) 08-01, “Industry Guideline for ITAAC Closure Process Under 10 CFR Part 52,” Revision 3, January 2009, definition as follows:

> *As-built* means the physical properties of a structure, system, or component following the completion of its installation or construction activities at its final location at the plant site. Determination of physical properties of the as-built structure, system, or component may be based on measurements, inspections, or tests that occur prior to installation, provided that subsequent fabrication, handling, installation, and testing do not alter the properties.

After reviewing the proposed change to the definition of “as-built” the staff noted concerns, because the staff expects that verifications will be performed in the final, in-place location of the SSCs except in cases where it is technically justifiable to perform the verification elsewhere. The staff raised these concerns during public meetings with representatives of the NEI and design certification applicants. The staff understands that it may be impossible to perform some ITAAC verifications of an SSC in its final, in-place location. Therefore, the staff and NEI have agreed to a modified definition of “as-built” which is documented in NEI 08-01, Revision 4, July 2010, as follows:

> *As-built* means the physical properties of a structure, system, or component following the completion of its installation or construction activities at its final location at the plant site. In cases where it is technically justifiable, determination of physical properties of the as-built structure, system, or component may be based on measurements, inspections, or tests that occur prior to installation, provided that subsequent fabrication, handling, installation, and testing do not alter the properties.

The staff has endorsed NEI 08-08, Revision 4 in RG 1.215, "Guidance For ITAAC Closure Under 10 CFR Part 52." In RAI 358, Question 14.03-15, the staff requested that the applicant revise their definition of "as-built" in FSAR Tier 1, Section 1.1 to address the staff's concerns discussed above. In a July 12, 2011, response to RAI 358, Question 14.03-15, the applicant agreed to revise FSAR Tier 1, Section 1.1 to incorporate the NEI 08-01, Revision 4 definition of "as-built," and FSAR Tier 2, Section 14.3 to reference the guidance in NEI 08-01, Revision 4 for ITAAC closure. Since the applicant has agreed to make the requested revisions and the staff has confirmed that the applicant has incorporated these changes into the FSAR, the staff finds this response acceptable and, therefore, considers RAI 358, Question 14.03-15 resolved.

After reviewing the applicant's response to RAI 182, Question 14.03-10, the staff determined the response insufficient and issued a follow-up RAI to address the staff's concerns. Therefore, RAI 182, Question 14.03-10 is closed.

In follow-up RAI 469, Question 14.03-16, the staff requested that the applicant rectify ITAAC issues that were identified as a result of reviewing the ITAAC, and the staff's evaluation of the applicant's October 15, 2010, response to RAI 390, Question 09.02.02-106. Since the first staff review and comments on the FSAR Revision 0 ITAAC conducted in 2009, the staff noted significant improvements to the U.S. EPR ITAAC to correct the various generic ITAAC language and interpretation issues that were identified in Regulatory Issue Summary (RIS) 2008-05. The staff issued RIS 2008-05, Revision 1, September 23, 2010, with the intent of expanding upon previously identified generic industry wide ITAAC quality issues and to further clarify with additional examples the need for additional ITAAC "inspectability" improvements.

While the review of FSAR Revision 2 ITAAC identified improvements, most notably in the elimination of much ambiguous ITAAC language, some "inspectability" concerns remained. Also, some inconsistency in the use of FSAR Tier 1 definitions existed, not only with respect to the prescribed use of "inspection," "test," or "analyses" terminology, but also with regard to the need for validating "as-built" construction conditions, where appropriate.

The most recent revision to the NEI 08-01 document provides adequate guidance on the proper use of "as-built" terminology and its application and interpretation. Problems existed in the ITAAC not only where the term "as-built" is improperly used, but also where this term should be required and instead, has been omitted. Furthermore, as discussed in RIS 2008-05, Revision 1, the ITA should specify activities that verify construction quality and not just a review of construction records or supplementing reports. The RIS provided guidance on the need for proper ITAAC reference use and the appropriate information that should be provided.

Specific representative examples of broader ITAAC issues were provided to the applicant for the following topics:

- Format, content, application and consistency of the ITAAC related to the ASME B&PV Code requirements for systems and structures. The staff identified several issues during its review of ITAAC for systems designed to the meet the requirements in ASME B&PV Code, Section III, referred to as the ASME Code. The staff requested greater clarity, consistency, and organizational separation of the design completion and installation verification activities in the ITAAC tables. In addition, the staff requested that the AC clearly identify requirements applicable to design completion and installation. These included specific reference to requirements of the ASME Code, such as design reports, ASME Code reconciliations, and data reports. These staff requests applied to all the ASME Code systems included in the ITAAC. In addition, the staff requested that the

associated definitions for “reports” and ASME Code Reports be clearly articulated in the definition section for FSAR Tier 1 information.

- Some interpretable ITAAC word usage or inspection criteria that are unclear to the staff or sufficiently detailed to allow a common, shared understanding of what is required to complete and accept the ITAAC have been identified.

- Several ITAAC omit the term “as-built” where it appears to be needed for proper interpretation of where the subject component testing may be conducted.

- ITAAC references to tables or other documents should be specific and appropriate to the detailed criteria that require verification. In several ITAAC, reference is made to the “construction drawings” in the ITA and/or AC. Such construction drawings are not FSAR Tier 1 documents, as by their very nature they will be subject to design changes and revisions as the construction proceeds. Therefore, such references in FSAR Tier 1 ITAAC to FSAR Tier 2 construction details raise the question of the validity of what must be verified by the applicable ITAAC inspection requirements.

- Referencing problems and omissions exist in the ITAAC tables.

- RIS 2008-05, Revision 1 notes that ITA specifying only an “inspection” of construction records is inconsistent with most construction activities where the contemporaneous “inspection” of the actual construction quality should be the focus of the ITA.

- Specific words (like inspection, test, or analysis) or conditions (design basis versus system operating) should be used only in ways that comport with their proper usage and intent.

- RIS 2008-05, Revision 1 discussed the use of the ITAAC word “exists” in the context of SRP Section 14.3. In such usage, something “exists” when it is “present” and meets those criteria in its design description that can be verified by its existence. Various other design criteria (e.g., functionality) cannot be verified by “existence” alone. Throughout the ITAAC, the use of the term “exists” cannot stand alone as evidence that whatever exists provides the functionality implied in the design description of the subject systems or component.

- Miscellaneous editorial comments regarding ITAAC numbering, redundancy, interpretation, mismatches, and word were also identified.

RAI 469, Question 14.03-16 is being tracked as an open item.

In FSAR Tier 2, Section 14.3.1, “Tier 1, Chapter 1, Introduction,” the applicant presents a description of FSAR Tier 1, Chapter 1. FSAR Tier 1, Chapter 1 provides definitions, general provisions, a figure legend, and a list of acronyms and abbreviations. The intent of this information is to minimize interpretation issue relative to the design information that is provided and to clarify technical requirements.

In FSAR Tier 2, Section 14.3.2, “Tier 1, Chapter 2, System Based Design Descriptions and ITAAC,” the applicant presents its process to determine which design features addressed in FSAR Tier 2 should be addressed in the FSAR Tier I certified design material (system design descriptions (SDDs)), interface requirements, and site parameters. The FSAR Tier 1

information selection process used two distinct parallel approaches. The first is based on equipment classification. It uses criteria derived from SRP Section 14.3 including the system checklists in SRP Section 14.3, Appendix C in order to comply with the requirements of 10 CFR Part 20, "Standards For Protection Against Radiation"; 10 CFR Part 50, "Domestic Licensing of Production And Utilization Facilities"; 10 CFR Part 52; 10 CFR Part 73, "Physical Protection of Plants and Materials"; and 10 CFR Part 100, "Reactor Site Criteria." This process includes SSCs in FSAR Tier 1 at an appropriate level of detail, in accordance with a graded approach commensurate with the safety significance of the SSCs for the U.S. EPR design, an approach previously approved for other certified designs as described in SRP Section 14.3. This first approach addresses each system identified in FSAR Tier 2. Systems addressed in FSAR Tier 2 that have no safety-significance features are given in FSAR Tier 1 as "no entry for this system." The second approach to develop FSAR Tier 1 material uses the results from key safety and integrated plant safety analyses to identify FSAR Tier 1 material. The following areas were reviewed for safety-significant design features: Design-basis accidents; radiological protection; fire protection; flooding protection; anticipated transients without scram; probabilistic risk assessment (PRA) and severe accident, licensing issues (Three Mile Island); and generic safety issue (GSI) items). The results of this second approach are presented in tables in FSAR Tier 2, Section 14.3. The staff reviewed the applicant's selection criteria and process for identifying FSAR Tier 1 information contained in FSAR Tier 2, Section 14.3, and finds the applicant's process complies with the guidance contained in SRP Section 14.3, and is therefore acceptable.

In FSAR Tier 2, Section 14.3.2, the applicant also described its selection criteria for ITAAC. An ITAAC table is provided for each FSAR Tier 1 system that has a design description. Top-level information from the design descriptions provided in FSAR Tier 2, that identifies the principal performance characteristics and safety functions of the SSCs is to be verified appropriately by ITAAC. They also include design-specific and unique features of the U.S. EPR, as appropriate. ITA are prescribed to verify that the design commitment has been met, and the AC are used for determining the successful completion of the verification method. The applicant also discussed the interface between the verification performed under FSAR Tier 1 and the Initial Plant Test program. The staff reviewed the information provided by the applicant in FSAR Tier 2, Section 14.3.2 and finds it complies with the staff review guidance in SRP Section 14.3, and therefore acceptable. As a result, the staff concludes that the applicant's implementation of the selection criteria and methodology will result in the design descriptions and ITAAC necessary to demonstrate that the facility has been constructed and will operate in accordance with the certified design.

In FSAR Tier 2, Section 14.3.3, "Tier 1, Chapter 3, Non-System Based Design Descriptions and ITAAC," the applicant discusses non-system-based material and topics included in FSAR Tier 1, Chapter 3, where the design descriptions and their associated ITAAC for design and construction activities, are applicable to more than one system. The format and selection process for FSAR Tier 1, Chapter 3 information is similar to FSAR Tier 1, Chapter 2 in that it contains CDM and ITAAC tables. The staff finds the information provided by the applicant in FSAR Tier 2, Section 14.3.3 acceptable because it complies with the guidance provided in SRP Section 14.3.

In FSAR Tier 2, Section 14.3.4, "Tier 1, Chapter 4, Interface Requirements," the applicant discusses the interface material included in FSAR Tier 1, Chapter 4. FSAR Tier 1, Chapter 4 provides the regulatory basis for the interface requirements, the scope of these requirements with respect to the use of site-specific designs to support the U.S. EPR system designs, and the

selection criteria and methodology for the interface requirements. This chapter specifies that applicants for a license that reference the U.S. EPR design certification are responsible for ensuring that their applications include site-specific design features or characteristics that comply with these interface requirements, along with any necessary verification requirements included in site-specific ITAAC in accordance with 10 CFR 52.47(a)(26). The staff reviewed the information provided by the applicant in FSAR Tier 2, Section 14.3.4 in accordance with SRP Section 14.3. The staff finds it complies with the staff's review guidance, and is acceptable.

In FSAR Tier 2, Section 14.3.5, "Tier 1, Chapter 5, Site Parameters," the applicant discusses the site parameters included in FSAR Tier 1, Chapter 5. This section describes the site parameters as the basis for the U.S. EPR standard design and represents them as a bounding envelope of site conditions for any license application referencing the U.S. EPR design. The discussion provides the regulatory basis for the inclusion of site parameters in FSAR Tier 1 and requires any license applicant that references the U.S. EPR design certification to demonstrate that the characteristics for the selected site are within the U.S. EPR certification envelope. The tabulation in FSAR Tier 1, Section 5.0, is a consolidation of the site parameters contained in FSAR Tier 2, Chapter 2. The staff has reviewed the tabulation of U.S. EPR site parameters provided by the applicant in FSAR Tier 1, Section 5.0, for compliance with SRP Section 14.3 and the applicable SRP Section 14.3 subsections, and concludes that they are acceptable and conform to those parameters contained in FSAR Tier 2, Chapter 2 and evaluated in Section 2.0 of this report. As a result, the staff finds the applicant's criteria for establishing interface requirements and site parameters acceptable.

In FSAR Tier 2, Section 14.3.6, "Design Acceptance Criteria," the applicant discusses the basis for using DAC and discusses the limited use of DAC for piping systems and components, and HFE. The DAC are to be objective and must be verified as part of the ITAAC performed to demonstrate that the as-built facility conforms to the certified design. The application describes the following three options available to close DAC, as given in NEI 08-01 and endorsed by RG 1.215: (1) Closure through the amendment of the design certification rule; (2) closure through the Combined License Application (COLA) review process; and (3) closure after COL issuance. The application lists the tables in FSAR Tier 1 where DAC are identified. The application specifies that a COL applicant that references the U.S. EPR design certification must identify a plan for implementing DAC. The plan must identify: (1) The evaluations that will be performed for DAC; (2) the schedule for performing these evaluations; and (3) the associated design processes and information that will be available to the NRC for audit. The staff finds that, because development of an implementation plan for DAC will require detailed plant-specific design information and review and approval by the NRC, it is acceptable to defer responsibility for the development of an implementation plan for DAC to the COL applicant. This is identified as COL Information Item 14.3-3. The application states that for subsequent plants, this implementation plan may include an indication that the COL will apply portions or all of the DAC completion that were used for the first standard plant. The staff reviewed the information provided by the applicant in FSAR Tier 2, Section 14.3.6 in accordance with the guidance contained in NUREG-0800, Section 14.3, as well as the Commission policy on the use of DAC contained in SECYs-90-241, 91-178, 91-210, 92-053, and 92-214, and their associated SRMs, and finds the applicant's use of DAC meets the SRP guidance and established NRC policy.

In addition to its review in accordance with SRP Section 14.3, the staff reviewed FSAR Tier 1 in accordance with the following SRP Section 14.3 subsections:

- 14.3.2, “Structural and Systems Engineering – Inspections, Tests, Analyses, and Acceptance Criteria”
- 14.3.3, “Piping Systems and Components - Inspections, Tests, Analyses, and Acceptance Criteria”
- 14.3.4, “Reactor Systems - Inspections, Tests, Analyses, and Acceptance Criteria”
- 14.3.5, “Instrumentation and Controls - Inspections, Tests, Analyses, and Acceptance Criteria”
- 14.3.6, “Electrical Systems - Inspections, Tests, Analyses, and Acceptance Criteria”
- 14.3.7, “Plant Systems - Inspections, Tests, Analyses, and Acceptance Criteria”
- 14.3.8, “Radiation Protection - Inspections, Tests, Analyses, and Acceptance Criteria”
- 14.3.9, “Human Factors Engineering - Inspections, Tests, Analyses, and Acceptance Criteria”
- 14.3.10, “Emergency Planning - Inspections, Tests, Analyses, and Acceptance Criteria”
- 14.3.11, “Containment Systems - Inspections, Tests, Analyses, and Acceptance Criteria”
- 14.3.12, “Physical Security Hardware - Inspections, Tests, Analyses, and Acceptance Criteria"

In Sections 14.3.2 through 14.3.12 of this report, the staff discusses its review of the FSAR Tier 1 in accordance with SRP Sections 14.3.2 through 14.3.12 and focuses its discussions primarily on the RAIs that dealt with specific SSC performance requirements.

14.3.1.5 *U.S. EPR Combined License Information Items*

Table 14.3.1-1 provides a list of all ITAAC related COL information item numbers and descriptions from FSAR Tier 2, Table 1.8-2:

Table 14.3.1-1 U.S. EPR Combined License Information Items

Item No.	Description	FSAR Tier 2 Section
14.3-1	A COL applicant that references the U.S. EPR design certification will provide ITAAC for emergency planning, physical security, and site-specific portions of the facility that are not included in the Tier 1 ITAAC associated with the certified design (10 CFR 52.80(a)).	14.3

Item No.	Description	FSAR Tier 2 Section
14.3-2	A COL applicant that references the U.S. EPR design certification will describe the selection methodology for site-specific SSC to be included in ITAAC, if the selection methodology is different from the methodology described within the FSAR, and will also provide the selection methodology associated with emergency planning and physical security hardware.	14.3
14.3-3	A COL applicant that references the U.S. EPR design certification will identify a plan for implementing DAC. The plan will identify (1) the evaluations that will be performed for DAC, (2) the schedule for performing these evaluations, and (3) the associated design processes and information that will be available to the NRC for audit.	14.3

The staff finds the above listing to be complete. Also, the list adequately describes actions necessary for the COL applicant or licensee. No additional COL information items need to be included in FSAR Tier 2, Table 1.8-2 for ITAAC consideration.

14.3.1.6 *Conclusions*

The staff has reviewed the applicant's criteria and methodology for selecting the SSCs to be included and described in FSAR Tier 1 as CDM, as well as their associated ITAAC in accordance with SRP Section 14.3. This review included an evaluation of FSAR Tier 2, Section 14.3 for compliance with the guidance contained in SRP Section 14.3. Specifically, the staff reviewed the applicant's definitions and general provisions information, system and non-system based descriptions, ITAAC, significant interface requirements, and significant site parameters. In addition, the staff reviewed the FSAR Tier 1 information in accordance with the guidance provided in SRP Section 14.3 and the requirements in 10 CFR 52.47.

Except for the open item discussed above, the staff concludes that information provided in the FSAR describes an acceptable criteria and methodology for selecting the SSCs to be included and described in FSAR Tier 1 as CDM, and their associated ITAAC; and that the requirements in 10 CFR 52.47(b)(1) and 10 CFR 52.47(a)(26) are satisfied.

14.3.2 Structural and Systems Engineering

14.3.2.1 *Introduction*

SRP Section 14.3.2 addresses ITAAC for building structures and structural aspects of major components such as the reactor pressure vessel. In this section of the report, the staff evaluates FSAR Tier 2, Section 14.3.2 which covers FSAR Tier 1 information and ITAAC for major building structures including the Nuclear Island (NI), Reactor Building (RB), Safeguard Buildings, Fuel Building (FB), Essential Service Water Buildings (ESWBs), Emergency Power Generating Buildings (EPGBs), Nuclear Auxiliary Building (NAB), and Radioactive Waste Processing Building (RWPB).

14.3.2.2 *Summary of Application*

FSAR Tier 1: The applicant has provided design descriptions and ITAAC for Structural and Systems Engineering in FSAR Tier 1, Chapter 2.0, "System-Based Design Description and ITAAC." Design descriptions and ITAAC for building structures are provided in FSAR Tier 1, Section 2.1, "Structures."

FSAR Tier 2: FSAR Tier 2, Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria," provides a general description of the U.S. EPR ITAAC, the ITAAC selection criteria, and ITAAC content. FSAR Tier 2, Section 14.3.2, "Tier 1, Chapter 2, System Based Design Descriptions and ITAAC," provides a general description of the approach used to develop FSAR Tier 1, Chapter 2.0 design descriptions and ITAAC for systems and structures.

ITAAC: The applicant has provided ITAAC for building structures in FSAR Tier 1, Section 2.1. These are identified in FSAR Tier 1, Section 2.1.1, "Nuclear Island," for the NI, FSAR Tier 1, Section 2.1.2, "Emergency Power Generating Buildings," for the EPGBs, FSAR Tier 1, Section 2.1.3, "Nuclear Auxiliary Building," for the NAB, FSAR Tier 1, Section 2.1.4, "Radioactive Waste Building," for the RWPB, and FSAR Tier 1, Section 2.1.5, "Essential Service Water Building," for the ESWB.

Technical Specifications: There are no technical specifications provided for this area of review.

14.3.2.3 *Regulatory Basis*

The relevant requirements of NRC regulations for this area of review, and the associated acceptance criteria, are given in NUREG-0800, Sections 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria," and 14.3.2, "Structural and Systems Engineering – Inspections, Tests, Analyses, and Acceptance Criteria." Review interfaces with other SRP sections can also be found in SRP Section 14.3.2.

10 CFR 52.47(b)(1), "Contents of applications; technical information," requires that a design certification application contain the ITAAC that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification is built and will operate in accordance with the design certification, the provisions of the Atomic Energy Act of 1954, and NRC regulations.

Acceptance criteria adequate to meet these requirements include the NRC rules and regulations for the review of the top level commitments in FSAR Tier 1. Other sources of review guidelines include RGs, SRP guidelines, and PRA insights from the standard design safety and severe accident analyses and operating experience.

The top level requirements for structural design are established in the General Design Criteria (GDC) of 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants." Based on the technical requirements of the GDC for building structures, the following top-level attributes should be verified by ITAAC:

1. GDC 1, "Quality Standards and Records," as it relates to codes and standards.

2. GDC 2, “Design Bases for Protection Against Natural Phenomena,” as it relates to normal loads.

3. GDC 2, as it relates to seismic loads.

4. GDC 2, at it relates to flood, wind, and tornado loads.

5. GDC 2, as it relates to rain and snow loads.

6. GDC 4, “Environmental and Dynamic Effects Design Bases,” as it relates to environmental and dynamic effects.

7. GDC 4, as it relates to pipe rupture loads.

8. GDC 16, “Containment Design,” and GDC 50, “Containment Design Basis” as they relate to pressure boundary integrity.

10 CFR Part 50, Appendix J, “Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors,” provides the Regulatory Basis for requirements related to containment leak rate testing.

To ensure that the final as-built plant structures are built in accordance with the certified design as required by 10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants,” structural analyses should be performed which reconcile the as-built configuration of the plant structures with the structural design bases of the U.S. EPR certified design.

14.3.2.4 *Technical Evaluation*

In this section of the report, the staff reviews the information provided in FSAR Tier 2, Section 14.3.2 and the design description and ITAAC for building structures presented in FSAR Tier 1, Section 2.1. The FSAR Tier 1 information was reviewed by the staff to determine if it was sufficient to meet the top level requirements for structural design included in 10 CFR Part 50, Appendix A (GDC 1, GDC 2, GDC 4, GDC 16, and GDC 50) and 10 CFR 50, Appendix J (leak rate testing). In addition, the FSAR Tier I information and ITAAC were reviewed against the acceptance criteria of SRP Section 14.3.2 and the Building Structures Review Checklist provided in SRP Section 14.3, Appendix C.

FSAR Tier 2, Section 14.3.2 provides a general overview of the approach the applicant used for developing FSAR Tier 1, Section 2.1 system design descriptions and associated ITAAC. An ITAAC table is provided for each FSAR Tier 1, Section 2.1 structure that has a design description. The ITAAC table defines the activities to be performed to verify the as-built system conforms to the design features and performance characteristics contained within the design description, as well as providing the acceptance criteria for these activities.

The staff reviewed design descriptions and ITAAC presented in FSAR Tier 1, Section 2.1, for the building structures of the U.S. EPR design. These descriptions included the NI, RB, SB, FB, EPGB, ESWB, NAB, and RWPB. The RB design description and ITAAC includes the Reactor Shield Building (RSB), Reactor Containment Building (RCB), and RB internal structure. The staff review of this section determined that the design descriptions and associated ITAAC provided in the section were too brief and lacked key design information. In the review of this information, the staff determined that there were ITAAC items in the ITAAC tables that were not

presented in the FSAR Tier 1 design descriptions, FSAR Tier 1 design description information that was not presented in the ITAAC table, and information that should have been in both the FSAR Tier 1 design description and ITAAC tables but was not provided. The main areas of concern were the following:

- Not all of the design loads were described or included.
- Key building dimensions appeared to be missing.
- ITAAC for cubicle pressurization could not be identified.
- ITAAC for pipe rupture protection was inconsistent and seemed incomplete.
- Internal hazard barriers and their thicknesses were not provided.
- ITAAC for protection from external and internal flood was incomplete.
- Containment leak rate and pressure testing requirements were missing.
- ITAAC for non-Seismic Category I structures was lacking information relative to interaction prevention with Seismic Category I structures.

Therefore, in RAI 132, Question 14.03.02-11 (Parts 1 through 30), the staff requested that the applicant clarify the above listed issues. In a March 20, 2009, response to RAI 132, Question 14.03.02-11, the applicant stated that the design descriptions and associated ITAAC had undergone a major revision to address the concerns raised by the staff. These were identified in FSAR Tier 1, Section 2.1, Revision 1. The changes which were intended to address the staff concerns are described below.

Description of Design Loads

In a March 20, 2009, response to RAI 132, Question 14.03.02-11, Part 1(a), the applicant stated that FSAR Tier 1, Section 2.1 had been revised to provide additional details regarding loading conditions associated with natural phenomena, internal events, and normal plant operations. These changes were documented in FSAR Tier 1, Revision 1, Section 2.1, which accompanied the applicant's response to RAI 132, Question 14.03.02-11. The staff's assessment of the revised FSAR .concluded that the design loads for the NI structures had been appropriately provided in the design descriptions and ITAAC. The staff finds this part of the response acceptable because the design loads are now provided in the design descriptions and, therefore, considers RAI 132, Question 14.03.02-11, Part 1(a) resolved.

Key Building Dimensions

In RAI 132, Question 14.03.02-11, Part 1(c), the staff requested that the applicant include tables of critical dimensions to be verified by ITAAC. In a March 20, 2009, response to RAI 132, Question 14.03.02-11, Part 1(c), the applicant stated that the intent of FSAR Tier 1 ITAAC was to confirm the most safety significant features of the certified design. In that regard, the applicant stated that the FSAR Tier 1, text, figures, and ITAAC were revised to provide additional information to identify the critical plant configurations and key dimensions. However, in reviewing FSAR Tier 1, Section 2.1, Revision 1, it was unclear to the staff if all key dimensions had been provided or what the safety significance was for the dimensions that were

provided. Therefore, in RAI 230, Question 14.03.02-13, the staff requested that the applicant provide additional information providing the bases for the selection of key dimensions for inclusion in ITAAC.

In an October 29, 2009, response to RAI 230, Question 14.03.02-13, the applicant stated that key structural dimensions include the overall building dimensions (i.e., length, width, and height) and those dimensions confirmed by the structural design of the critical sections in FSAR Tier 2, Appendix 3E. The overall building dimensions are key dimensions, because they confirm the building size for global stability evaluations. Critical sections are those portions of individual Seismic Category I structures (i.e., shear walls, floor slabs and roofs, structure-to-structure connections) that prevent or mitigate consequences of postulated design basis accidents, are expected to experience the largest structural demands during design-basis conditions, or are needed to evaluate a complete design. The applicant stated that the overall building dimensions and the key dimensions of the critical sections defined in FSAR Tier 2, Appendix 3E define the structural key dimensions for the Seismic Category I structures. Regarding the applicant's response to RAI 230, Question 14.03.02-13, the staff had the following comments:

- For the Reactor Building structures, critical sections were identified in FSAR Tier 2, Appendix 3E but were not included in the tables or figures of FSAR Tier 1, Section 2.1. These are the equipment hatch and typical cylinder walls and buttresses.

- There are no critical dimensions provided for the reactor pressure vessel (RPV) cavity walls or floor. The applicant should explain why these were not provided and why this portion of the Reactor Building is not considered to be a critical element of the Reactor Building design.

- The connections of the Fuel Building and Safeguard Buildings 2 and 3 roofs to the Reactor Shield Building are identified as critical sections in FSAR Tier 2, Appendix 3E but are not included in the tables or figures of FSAR Tier 1, Section 2.1. The applicant should either include these or justify why they are not included.

The staff noted that not all of the critical dimensions had been provided, so the staff issued follow-up RAI 386, Question 14.03.02-44, requesting that the applicant identify any additional critical sections that should be included in FSAR Tier 1, Section 2.1 including those for the EPGB and ESWB. Therefore, the staff considers RAI 132, Question 14.03.02-11, Part 1(c) and RAI 230, Question 14.03.02-13 closed. However, **RAI 386, Question 14.03.02-44 is being tracked as an open item.**

Cubicle Pressurization

In RAI 132, Question 14.03.02-11 Part 1(h), the staff requested information on ITAAC regarding design for protection from cubicle pressurization. In a March 20, 2009, response the applicant indicated that FSAR Tier 1, Section 2.1 would be revised to provide additional details regarding the basis for protection against pressurization effects associated with postulated rupture of pipes. In FSAR Tier 1, Section 2.1, Revision 1, descriptions and ITAAC for accident pressure loads and pipe break loads were provided; however, there is nothing that specifically addresses cubicle pressurization loads and the basis for protection against pressurization effects. As a result, in follow-up RAI 260, Question 14.03.02-42 the applicant was requested to do the following as it relates to cubicle pressurization:

1. Include in the design description for the NI the basis for protection against cubicle pressurization effects.

2. For Item 3.4 of ITAAC Table 2.1.1-4 under "Commitment Wording," specify what pipe break effects the pipe break hazards analysis includes and include cubicle pressurization if it applies to this item. Also, specify which NI structures this item is applicable to and whether or not it includes the Reactor Building.

3. For Item 3.4 of ITAAC Table 2.1.1-4 under "Inspection, Analysis or Test," include an inspection of the structure and require a reconciliation of the inspection with the structural requirements of the pipe break hazards analysis.

4. For Item 3.4 of ITAAC Table 2.1.1-4 under "Acceptance Criteria," include the acceptance criteria for cubicle pressurization.

5. As both Item 3.4 and Item 3.5 of Table 2.1.1-4 address design features to protect against the effects of pipe break and because Item 3.5 could be a subset of Item 3.4, the applicant should provide a distinction between the "Commitment Wording," "Inspection Analysis or Test," and "Acceptance Criteria" for each of these items so that there is no ambiguity as to what each is intended to address.

6. Regarding Item 2.4 of ITAAC Table 2.1.1-8, "Reactor Building ITAAC," the applicant should revise this item such that there is no confusion between the scope of Item 2.4 as it relates to pipe break loads and pipe break effects (including cubicle pressurization) and the scope that Items 3.4 and 3.5 of Table 2.1.1-4 are intended to cover.

Therefore, RAI 132, Question 14.03.02-11 Part 1(h) is closed. However, **RAI 260, Question 14.03.02-42 is being tracked as an open item.**

Protection from Pipe Rupture

FSAR Tier 1, Revision 0, Table 2.1.1-7, "Nuclear Island Inspections, Tests, Analyses, and Acceptance Criteria," Item 4.9, had a commitment that essential SSCs in reactor containment building (RCB) rooms listed in FSAR Tier 1, Revision 0, Table 2.1.1-4, "RCB Rooms With Pipe Whip Restraints," are protected from the dynamic effects of pipe breaks. FSAR Tier 1, Revision 0, Table 2.1.1-7 indicates in the column "Inspection, Analysis, or Test," that an analysis will be performed but did not describe the analysis purpose or what type of analysis will be performed to confirm that essential SSCs are protected from the dynamic effects of pipe breaks. FSAR Tier 1, Revision 0, Table 2.1.1-4, identified RCB rooms with pipe whip restraints, but did not identify what was being protected. As a result, in RAI 132, Questions 14.03.02-11 Part 18 the staff requested additional information regarding the analysis and protection for pipe rupture. In a March 20, 2009, response to RAI 132, Questions 14.03.02-11 Part 18, the applicant provided revised ITAAC for pipe rupture in FSAR Tier 1, Revision 1, Section 2.1. The staff's review of the revised ITAAC concluded that in FSAR Tier 1, Revision 1, Table 2.1.1-4, "Nuclear Island ITAAC," under "Inspections, Tests, Analyses," there is a disconnect between Items 3.5.a and 3.5.b in that the analysis performed in Item 3.5.a does not state what the analysis is based on, while in Item 3.5.b the inspection of the as-installed protective features is done to the construction drawings. Item 3.5.a should be revised to state that the analysis is performed using the final as-built construction drawings and Item 3.5.b should be revised to state that instead of construction drawings, final as-built construction drawings should be used. Under "Acceptance Criteria" for Item 3.5.b, instead of construction drawings, final as-built construction

drawings should be used. The staff requested these changes in RAI 230, Question 14.03.02-32. In a September 30, 2009, response to RAI 230, Question 14.03.02-32 the applicant stated that FSAR Tier 1, Table 2.1.1-4, Item 3.4 was revised to add an inspection of the features identified in the pipe break hazards analysis. In addition, FSAR Tier 1, Table 2.1.1-4, Item 3.4 would be revised to incorporate the wording "final as-built construction drawings." The staff found these changes as identified in FSAR Tier 1, Section 2.1, addressed the staff's concerns, and therefore were acceptable. However, in FSAR Tier 1, Table 2.1.1-4, Item 3.4 was deleted in its entirety such that there is no reference to pipe break hazards analysis. As a result, the staff issued follow-up RAI 499, Question 14.03.02-54 in which the applicant was requested to explain why Item 3.4 was deleted from Table 2.1.1-4 and why there is no specific item in the ITAAC tables that addresses pipe break hazards analysis. Therefore, RAI 132, Question 14.03.02-11 Part 18 and RAI 230, Question 14.03.02-32 are closed. However, **RAI 499, Question 14.03.02-54 is being tracked as an open item.**

Internal Hazards Barriers - Purpose and Thickness Requirements

FSAR Tier 1, Revision 0, Section 2.1.1, requires that the dimensions on figures are identified as being for information only. A similar statement was provided in the description of other building structures contained in FSAR Tier 1, Revision 0, Section 2.1. FSAR Tier 1, Figures 2.1.1-1 through 2.1.1-13, and similar figures provided in FSAR Tier 1, Sections 2.1.2 through 2.1.5 are pictorial depictions of U.S. EPR structures with names of structures annotated therein, and thus, would not be useful for the purposes of U.S. EPR structural ITAAC implementation. Therefore, in RAI 132, Question 14.03.02-11, Part 2, the staff requested that the applicant revise the FSAR Tier 1 sections and provide more complete and detailed structural drawings needed for ITAAC inspections and verification. In a March 20, 2009, response to RAI 132, Question 14.03.02-11, Part 2, the applicant stated that it is the intent of FSAR Tier 1 and associated ITAAC to confirm that the most safety significant features of the certified design are included in the as-built facility. Based on this criterion, FSAR Tier 1, Section 2.1 text, figures, and ITAAC were revised as described in FSAR Tier 1, Revision 1, Section 2.1, to provide additional figures and tables necessary to describe and clearly identify the design requirements for the critical plant configuration and dimensions. The ITAAC items include design commitments requiring that Seismic Category I structures are designed and constructed to withstand design basis loads, as well as the verification of critical dimensions throughout the plant. The applicant contends it is not required to include the specific plant design details, such as wall or slab thickness requirements, for all structural members.

In its assessment, the staff concludes that the level of detail provided in the response does not meet the Building Structures Review Checklist guidance found in SRP Section 14.3, Appendix C. This indicates that design descriptions should provide enough dimensions for a COL applicant to develop dynamic models for seismic analysis. Information meeting this acceptance criterion has not been provided in either the FSAR Tier 1 design descriptions for structures or in the accompanying ITAAC tables. In addition, SRP Acceptance Criteria 14.3.2.II.2 indicates that key dimensions of structures should be provided. As the safety functions of Seismic Category I structures include providing barriers for protection against missile impact, pipe whip, jet impingement, flooding, etc., the key dimensions of these safety-related features should be included in the design descriptions and referenced in the ITAAC tables or provided in the ITAAC tables directly. The approach should be similar to what was done for radiation barriers given in FSAR Tier 1, Table 2.1.1-3, "Radiation Barriers," Revision 0. Therefore, in RAI 230, Question 14.03.02-22, the staff requested that the applicant

include this information in FSAR Tier 1, Section 2.1, not only for the NI Common Basemat Structures, but also for the EPGB and ESWB.

In an October 29, 2009, response to RAI 230, Question 14.03.02-22, the applicant stated that the level of detail provided in FSAR Tier 1 for key dimensions is based on the U.S. EPR approach for defining the safety-significant building features in FSAR Tier 1, Section 2.1. The dimensions needed to develop dynamic models for seismic analysis are provided in FSAR Tier 2, Appendix 3B. The applicant stated that there is no need to repeat this voluminous quantity of information in FSAR Tier 1, because the COL applicant may readily obtain it from FSAR Tier 2, Appendix 3B. The staff agrees that the dimensions to develop dynamic models need not be included in FSAR Tier 1, since the ITAAC tables require that an analysis of safety-related structures be performed to verify that their as-built condition has been reconciled with their respective final design basis loads.

Regarding key dimensions to protect against internal hazards, certain design features have been identified by the applicant as providing internal hazards barriers. These are shown in FSAR Tier 1, Revision 2, Figures 2.1.1-20 through 2.1.1-44; Figure 2.1.2-4, "Emergency Diesel Generator Building Internal Hazards Separation Barrier"; and Figure 2.1.5-6, "Essential Service Water Building Internal Hazards Separation Barrier." While this is an improvement over previously supplied material, it is unclear to the staff that all internal hazard barriers have been identified. For instance, it would seem that some of the walls within the Reactor Building are needed to provide missile protection for internal missiles, yet none have been identified in the figures presented. The applicant should state if all barriers are shown, and if not, provide justification as to why they are not. In addition, the applicant should provide the barrier thickness and protective function that each barrier provides, and for multi-function barriers, identify each of the barrier's protective functions. In RAI 386, Question 14.03.02-45, the staff requested that the applicant address these issues. Therefore, RAI 132, Question 14.03.02-11, Part 2 and RAI 230, Question 14.03.02-22 are closed. However, **RAI 386, Question 14.03.02-45 is being tracked as an open item.**

Protection from Flooding

In FSAR Tier 1, Revision 0, Section 2.1.1, flood loads were not included as a design requirement for NI structures. However, this is a requirement under GDC 2. The design features to protect against flood and water ingress for safety-related structures need to be added as an ITAAC requirement. The staff had requested this information in RAI 132, Question 14.03.02-11, Part 6. In a March 20, 2009, response to RAI 132, Question 14.03.02-11, Part 6, the applicant stated that FSAR Tier 1, Section 2.1 would be revised to include flood loads as a design basis load for both internal and external events for NI structures. As FSAR Tier 1, Revision 1, Section 2.1, has been revised to include flood loads as a design basis load for both internal and external flooding events for NI structures, as well as the other Seismic Category I structures of the U.S. EPR certified design, the staff finds this part of the response acceptable and, therefore, considers RAI 132, Question 14.03.02-11, Part 6 resolved.

SRP Acceptance Criteria 14.3.2.II.8 for internal flood states that ITAAC should require inspections to verify that penetrations in division walls are at least 2.5 m (8.20 ft) above the floor and that safety-related electrical, instrumentation, and control equipment are located at least 20 cm (7.9 in.) above the floor surface. In RAI 230, Question 14.03.02-15, the staff requested that inspections for these features be added to the ITAAC tables or that the applicant provide

justification for not including them. In a September 30, 2009, response to RAI 230, Question 14.03.02-15, the applicant stated that the requirements for penetration and equipment locations are not part of the U.S. EPR design approach for protection against internal flooding described in FSAR Tier 2, Section 3.4.1. Therefore, an ITAAC to confirm that these requirements are met in FSAR Tier 1 is not appropriate. The staff's assessment is that FSAR Tier 2, Revision 0, Section 3.4.1, "Internal Flood Protection," describes the principal protective measure for internal flood as physical separation of the redundant safe shutdown systems and components. However, FSAR Tier 2, Section 3.4.1 states that division walls below zero elevation provide separation and serve as flood barriers to prevent flood waters spreading to adjacent divisions. Furthermore, these division walls are water tight, have no doors, and a minimal number of penetrations. Therefore, the staff notes that it appears possible for water to flow from one division to another division through these penetrations, thus compromising the design approach for protection of internal flooding through physical separation. The applicant should state how water is prevented from entering adjacent safety divisions through the penetrations and why the SRP Acceptance Criteria 14.3.2.II.8 need not be met in the design. In RAI 386, Question 14.03.02-48, the staff requested that the applicant address these issues.

In a November 10, 2010, response to RAI 386, Question 14.03.02-48, the applicant stated that penetrations through division walls in the Safeguard Building and the Fuel Building are watertight up to elevation zero preventing water from entering adjacent safety divisions. Penetrations through division walls in the EPGBs are watertight to prevent water from entering adjacent safety divisions. There are no common division walls for the ESWBs that require internal flooding protection. Design requirements for penetrations to be at least 2.5 m (8.20 ft) above the floor and safety-related electrical, instrumentation, and control equipment to be located at least 20 cm (7.8 in.) above the floor surface do not apply to the U.S. EPR design, because penetrations in division walls are watertight and flooding above the cited distances above the floor can occur in the U.S. EPR design. For instance, in Seismic Category I buildings designed with divisional separation, including the Safeguard Building, FB, EPGB, and ESWB, one division of safe-shutdown systems and components can flood without compromising the plant's ability to safely shut down. In buildings not designed with divisional separation (e.g., Reactor Building), all safety-related structures, SSCs required to achieve safe shutdown or mitigate the consequences of an accident, are located above the maximum flood water level.

The design approach for protection from internal flooding through physical separation for the Safeguard Building and FB was confirmed in FSAR Tier 1, Revision 1, Table 2.1.1-10, "Safeguard Buildings ITAAC," Item 2.2 and FSAR Tier 1, Table 2.1.1-11, "Fuel Building ITAAC," Item 2.2. The Commitment Wording for these ITAAC items states that internal hazards barriers are provided to maintain physical separation between adjacent divisions in the event of an internal hazard, such as internal flooding. The ITAAC requires that an internal flooding analysis and a walkdown be performed to establish that flooding protection features are installed to confirm that the impact of an internal flood in one building or division cannot affect an adjacent building or division. Since adjacent divisions are protected by physical separation from the hazard of internal flooding, the staff finds the response acceptable. Therefore, the staff considers RAI 230, Question 14.03.02-11, Part 15 and RAI 386, Question 14.03.02-48 resolved.

Reactor Containment Building Design and Testing Requirements

FSAR Tier 1, Revision 0, Section 2.1.1, describes the primary functions of the Reactor Containment Building as the protection of the safety-related SSCs located within it, the prevention of the release of radiation during plant operations, and the prevention of the release

of radiation and contamination in the event of accident conditions. The staff notes that to meet the requirements of GDC 16 and GDC 50, the last phrase in this sentence needs to be revised to state that one of the primary functions of the RCB is to establish an essentially leak-tight barrier against the uncontrolled release of radioactivity and to accommodate without exceeding the design leakage rate and with sufficient margin the calculated pressure and temperature conditions resulting from any loss-of-coolant accident. In addition, the ITAAC provided in FSAR Tier 1, Revision 0, Table 2.1.1-7, Item 4.3 did not address the building leak rate and pressure tests which are major verification activities for this structure. Therefore, in RAI 132, Question 14.03.02-11, Part 7, the staff requested that the applicant revise the primary function of the RCB to meet the requirements of the GDC and to add the containment test requirements to the ITAAC.

In a March 20, 2009, response to RAI 132, Question 14.03.02-11, Part 7, the applicant replied that FSAR Tier 1, Section 2.1 was revised to include the requested statement such that it meets the requirements of GDC 16 and GDC 50. The staff reviewed the proposed markups to FSAR Tier 1, Section 2.1, which accompanied the response and determined that additional information is required. The Commitment Wording for a pressure integrity test is located in FSAR Tier 1, Table 2.1.1-8, "Reactor Building ITAAC," Item 2.5. The staff notes that Commitment Wording for this item should be revised to include the penetration assemblies. FSAR Tier 1, Table 2.1.1-8, Item 2.5.a should be reworded in the Inspection, Analysis or Test column, to state that an analysis of the RCB including its liner and penetration assemblies will be performed against the applied design pressure per ASME Code, Section III design requirements. FSAR Tier 1, Table 2.1.1-8, Item 2.5.b should be reworded to state that inspections will be performed against the construction drawings to determine the final as-built installation. FSAR Tier 1, Table 2.1.1-8, Item 2.5.c should be reworded to state that a test report will document that a Structural Integrity Test (SIT) of the containment structure is performed in accordance with Article CC-6000 of ASME Code, Section III, Division 2, and RG 1.136, "Design Limits, Loading Combinations, Materials, Construction, and Testing of Concrete Containments," March 2007, Revision 3. In addition, the applicant should address the fact that prototype containment structures should be instrumented to measure strains per ASME Code, Section III, Division 2, CC-6221. Under the Acceptance Criteria column, Item 2.5.a should be reworded to state that the analysis of the RCB including its liner and penetration assemblies has been reconciled with the as-built condition and ASME Code, Section III stress reports exist and conclude the ASME III design code requirements have been met. Under FSAR Tier 1, Table 2.1.1-8, Item 2.5.c, should state that a test report documents that the containment system pressure boundary retains its structural integrity when tested and evaluated in accordance with ASME Code, Section III, Division 2 at a test pressure of at least 1.15 times the design pressure. In RAI 230, Question 14.03.02-26, the staff requested that the applicant address the issues discussed above.

In a September 30, 2009, response to RAI 230, Question 14.03.02-26, the applicant indicated that in FSAR Tier 1, Table 2.1.1-8, "Reactor Building ITAAC," Item 2.5 would be revised to include penetration assemblies in the ITAAC, and in Item 2.5.b the words "as fabricated" will replace the words "as-built". The staff finds this portion of the response acceptable. According to the applicant, listing the test pressure in FSAR Tier 1, Section 2.1, Table 2.1.1-8, Item 2.5 is not required, because this is performed in accordance with ASME Code, Section III requirements, and compliance with the test pressure requirements is documented in the ASME Code, Section III Data Report. However, FSAR Tier 1, Table 2.1.1-8, Item 2.5 under Acceptance Criteria in Subparagraph (d), states that the RCB including the liner plate and penetration assemblies, maintains its integrity at the design pressure of at least 0.427 MPa

(62 psig). To meet the SIT requirements of ASME Code, Section III, Division 2, the containment is to be tested at 115 percent of the design pressure and must meet the acceptance criteria of Subarticle CC-6410. The staff notes that the applicant needs to revise Subparagraph (d) under the Acceptance Criteria column to reflect the SIT requirements of the ASME Code, Section III, Division 2 and the acceptance criteria of Subarticle CC-6410. In addition, the applicant failed to address the need to provide instrumentation to measure strains for prototype containments during the SIT as required by ASME Code, Section III, Division 2, Subarticle CC-6370. If strains are not to be measured, the applicant should provide justification for not doing so. In follow-up RAI 386, Question 14.03.02-51, the staff identified its concerns and requested that the applicant address the above issues. Therefore, RAI 132, Question 14.03.02-11, Part 7 and RAI 230, Question 14.03.02-26 are closed. However, **RAI 386, Question 14.03.02-51 is being tracked as an open item.**

Similar to the issues identified in RAI 386, Question 14.03.02-51 discussed above, Section C.I.3.8.1.7 of RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," states, in part, that the applicant should describe the testing and inservice inspection (ISI), including milestones, for the containment, with emphasis on the extent of compliance with ASME Code, Section III, Division 2, Articles CC-6000 and CC-9000. FSAR Tier 1, Section 2.1, Revision 0, Table 2.1.1-8, Item 2.6, under the Inspections, Tests, Analyses column, Subparagraph (c) states that a Structural Integrity Test (SIT) of the RCB pre-stressed, post-tensioned concrete structure will be performed. The Acceptance Criteria column in Subparagraph (c), states that the RCB pre-stressed, post-tensioned concrete structure maintains its integrity at the design pressure of at least 0.427 MPa (62 psig). To meet the SIT requirements of the ASME Code, the containment needs to be tested at 115 percent of the design pressure and must meet the acceptance criteria of Subarticle CC-6410. Subparagraph (c) of the Acceptance Criteria as currently written is incorrect. In RAI 386, Question 14.03.02-49, the staff requested that the applicant revise Subparagraph (c) to reflect the SIT requirements of the ASME Code, Section III, Division 2 and the acceptance criteria of Subarticle CC-6410. **RAI 386, Question 14.03.02-49 is being tracked as an open item.**

FSAR Tier 1, Section 3.3, "Initial Test Program," describes the initial test program. In FSAR Tier 1, Revision 0, Section 3.3.2, "Design Features," provides a description of the integrated tests for the preoperational test phase. Among the tests given is the integrated leak rate test (ILRT) for the containment. The purpose of this test is to verify that the leak rate does not exceed the maximum rate allowed. FSAR Tier 1, Revision 0, Table 3.3-1, "Integrated Tests, Analyses, and Acceptance Criteria," Item 1.0 provided the ITAAC for the ILRT. The staff notes that the test described was the Type A test required by 10 CFR Part 50, Appendix J. In addition to the Type A, Type B and Type C tests are also required. The staff also notes that FSAR Tier 1, Revision 2, Section 3.3.2, "Design Features," specific integrated tests are no longer identified and ITAAC FSAR Tier 1, Table 3.3-1 has been deleted. As containment leakage testing is performed to verify that one of the primary safety functions of the containment has been met, it is the staff's position that containment leakage testing should be part of ITAAC should be provided in order to meet the requirements of 10 CFR 52.47(a)(vi). Therefore, in RAI 499, Question 14.03.02-52, the staff requested that the applicant justify why ITAAC for this testing has not been included in FSAR Tier 1. **RAI 499, Question 14.03.02-52 is being tracked as an open item.**

FSAR Tier 1, Revision 0, Section 2.1.1, stated that downward expansion of the lower reactor vessel head is limited by concrete support structures which preserve sufficient space for the outflow of a meltdown and the formation of a molten pool in the reactor cavity. The staff notes

this is an important design feature of the RB internal structure for meeting the requirements of GDC 16. Therefore, in RAI 132, Question 14.03.02-11, Part 9, the staff requested that the applicant add as an ITAAC requirement in FSAR Tier 1, Table 2.1.1-7, the design features of the RCB internal structure as it relates to containment of a core melt. In a March 20, 2009, response to RAI 132, Question 14.03.02-11, Part 9, the applicant stated that SRP Section 14.3, Appendix C.I.A.iii, Item (6) states:

> Severe Accident Features - These features should be described in the design description, and the basic configuration ITAAC should verify that they exist. In general, the capabilities of the features need not be included in the ITAAC. Detailed analyses should be retained in Tier 2.

In addition, the applicant stated that based on this criterion, the ITAAC item in its current configuration verifies the existence of a concrete barrier and is sufficient. The staff noted in its review that although the SRP Section 14.3, Appendix C cited by the applicant is from the Fluid Systems Review Checklist, this same philosophy should apply to building structures. Based on the SRP Section 14.3.2 checklist regarding severe accident features, the staff finds the response acceptable and, therefore, considers RAI 132, Question 14.03.02-11, Part 9 resolved.

ITAAC for Non-Seismic Category I Structures

The NAB is a reinforced concrete structure that houses non-safety-related auxiliary systems required for normal plant operations. In FSAR Tier 2, Revision 0, Section 3.7.2.8, "Interaction of Non-Seismic Category I Structures with Seismic Category I Structures," the applicant stated the potential for seismic-induced interaction between Seismic Category I structures and non-Seismic Category I structures is assessed to verify the ability of Seismic Category I structures to perform their intended safety functions. The basis for the seismic interaction assessment is the prevention of structure-to-structure interaction. The ITAAC for the NAB was described in FSAR Tier 1, Revision 0, Section 2.1.3, Nuclear Auxiliary Building." In RAI 132, Question 14.03.02-11, Part 24, the staff noted that in FSAR Tier 1, Revision 0, Section 2.1.3, the only ITAAC requirements in FSAR Tier 1 Table 2.1.3-1, "Nuclear Auxiliary Building Inspections, Tests, Analyses, and Acceptance Criteria," for this structure were verification of a physical location and a requirement for a seismic separation. There was no commitment requiring that the NAB not fail on the adjacent FB or SB 4. In addition, the staff concluded that the ITAAC table needed to be revised to include the building's design loads and to require a reconciliation of the as-built conditions with the NAB structural design. In addition, the staff noted that the required separation distance should be specified and through inspection verified that it had been met.

In a March 20, 2009, response to RAI 132, Question 14.03.02-11, Part 24, the applicant added a reconciliation of the NAB design with the as-installed configuration in FSAR Tier 1, Revision 1, Section 2.1.3. However, the method of documenting this reconciliation was not specified. Regarding the seismic separation, the applicant added to FSAR Tier 1, Table 2.1.3-1 a requirement that the minimum acceptable separation would be based on an analysis of site specific conditions. This leaves it up to the COL applicant to determine and verify the separation distance between the NAB and the NI. However, the NAB is part of the certified design application, the required separation distance based on the certified design's seismic and geotechnical parameters should be provided as part of the ITAAC for this structure. The required separation should include a margin of safety which should be identified in the ITAAC. Therefore in follow-up RAI 499, Question 14.03.02-55, the staff requested that the applicant

include in the ITAAC for the NAB the documentation requirements for the reconciliation of the design with the NAB's as-installed configuration, and the required separation between the NI and NAB including a safety margin as determined in the certified design and a verification that the required separation had been met. Therefore, RAI 132, Question 14.03.02-11, Part 24 is closed. However, **RAI 499, Question 14.03.02-55 is being tracked as an open item**.

The Radioactive Waste Building (RWB) is a reinforced concrete structure that houses non-safety-related liquid waste storage tanks, storage facilities, and associated support systems required for normal plant operation. It has the potential to seismically interact with the EPGBs. In FSAR Tier 1, Revision 0, Section 2.1.4, "Radioactive Waste Building," the only ITAAC requirements for this structure were to verify its physical location and to verify a seismic separation between the RWPB and the surrounding buildings. However, this building should meet the guidance of RG 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants," Revision 2, November 2001, and, as such, should be designed for one-half safe-shutdown earthquake (SSE) load, as well as a reduced tornado load and a tornado missile as specified in RG 1.143, Table 2. The staff notes that the criteria for this building should be added to FSAR Tier 1, Section 2.1.4. In addition, in accordance with the guidance of SRP Acceptance Criteria 14.3.2.II.2, FSAR Tier 1, Table 2.1.4-1, "Radioactive Waste Building ITAAC," should be revised to reconcile the as-built conditions with the structural design basis loads and approved design documents. In addition, it is not sufficient to merely verify there is a seismic separation between the RWPB and adjacent structures. The required separation must be specified and verified to be correct. Therefore, in RAI 132, Question 14.03.02-11, Part 25, the staff requested that the applicant provided this information in FSAR Tier 1, Section 2.1.4 and ITAAC Table 2.1.4-1. In a March 20, 2009, response to RAI 132, Question 14.03.02-11, Part 25, the applicant stated that FSAR Tier 1, Section 2.1 would be revised to state that the RWPB is classified as an RS Structure and is designed for one-half SSE using criteria in RG 1.143 for RW-IIa structures. In addition, FSAR Tier 1, Table 2.1.4-1 would require that changes which occur during building construction must be reconciled with the building analysis. Also the required separation between the RWPB and adjacent Seismic Category I EPGB would be added to the table. In FSAR Tier 1, Section 2.1.4, Revision 1, the staff confirmed these changes had been made. Since the changes indicated by the applicant are contained in the FSAR and satisfy the staff's concerns, the staff considers RAI 132, Question 14.03.02-11, Part 25 resolved.

The vent stack is a steel structure approximately 3.66 m, 2.4 cm (12 ft 6 in.) in diameter by 30.48 m (100 ft) high located on top of the stair tower structure between the FB and SB 4. The vent stack serves as the exhaust for the NAB. In RAI 132, Question 14.03.02-11, Part 30, the staff requested that the applicant provide information regarding ITAAC for the vent stack. In a March 20, 2009, response to RAI 132, Question 14.03.02-11, Part 30, the applicant stated that ITAAC covering the vent stack were not required, because it was not classified as a safety-related structure and served no safety-related function. In FSAR Tier 2, Revision 2, Table 3.2.2-1, "Classification Summary," the vent stack is now classified as a Seismic Category I structure, safety class S. As such, in follow-up RAI 499, Question 14.03.02-53, the staff requested that the applicant include a design description of this structure in FSAR Tier 1, Section 2.1 and provide appropriate ITAAC consistent with that of the other Seismic Category I structures. Therefore, RAI 132, Question 14.03.02-11, Part 30 is closed, and **RAI 499, Question 14.03.02-53 is being tracked as an open item.**

14.3.2.5 *Combined License Information Items*

Section 14.3.1.5, Table 14.3.1-1 of this report provides a list of all ITAAC related COL information item numbers and descriptions from FSAR Tier 2, Table 1.8-2 that are applicable to FSAR Tier 2, Section 14.3. The staff finds the list in Section 14.3.1.5, Table 14.3.1-1 of this report to be complete. Also, the list adequately describes actions necessary for the COL applicant or licensee. No additional COL information items need to be included in FSAR Tier 2, Table 1.8-2.

14.3.2.6 *Conclusions*

Except for the open items specified above, the staff concludes that the applicant has provided sufficient information to satisfy the acceptance criteria provided in SRP Sections 14.3 and 14.3.2. The staff finds that the requirements, including description of design loads, pressure boundary integrity, and key dimensions, described in FSAR Tier 1, Section 2.1, along with ITAAC that ensure the final as-built condition of the plant conforms to the basis for the structural design and associated design documents, provide assurance that the building structures of the U.S. EPR standard design will meet the requirements of GDC 1, GDC 2, GDC 4, GDC 16, and GDC 50. The staff concludes that the proposed ITAAC provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification is built and will operate in accordance with the design certification, the Atomic Energy Act of 1954, and NRC regulations.

14.3.3 Piping Systems and Components

14.3.3.1 *Introduction*

SRP Section 14.3.3, "Piping Systems and Components - Inspections, Tests, Analyses, and Acceptance Criteria," addresses the review of ITAAC for piping systems and components for the U.S. EPR design. The staff reviewed the proposed ITAAC to determine whether a plant that incorporates the design certification can be built and operated in accordance with the design certification and NRC regulations.

The scope of review for piping systems and components ITAAC includes:

- Piping design
- Component and system design
    - Safety classification of structures, systems, and components
    - Welding
    - Hydrostatic testing
    - Dynamic qualification
    - Treatment of valves

14.3.3.2 *Summary of Application*

FSAR Tier 1 and ITAAC: The applicant has provided design descriptions for piping systems and components, simplified drawings, and ITAAC in FSAR Tier 1, Chapter 2.0, "System Based Design Descriptions and ITAAC," and Chapter 3, "Nonsystem Based Design Descriptions and ITAAC."

FSAR Tier 2: FSAR Tier 2, Chapter 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria," provides a general description of the ITAAC including its relationship to other FSAR Tier 1 information, the selection criteria, content and the applicant's plans for addressing piping DAC.

14.3.3.3 *Regulatory Basis*

The relevant requirements of NRC regulations for this area of review, and the associated acceptance criteria, are given in NUREG-0800, Sections 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria," and 14.3.3, "Piping Systems and Components – Inspections, Tests, Analyses, and Acceptance Criteria." Review interfaces with other SRP sections also can be found in NUREG-0800, Section 14.3.3.

10 CFR 52.47(b)(1) requires that a design certification 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 plant that incorporates the design certification is built and will operate in accordance with the design certification, the provisions of the Atomic Energy Act of 1954, and NRC regulations.

14.3.3.4 *Technical Evaluation*

14.3.3.4.1 Piping Design Acceptance Criteria (DAC)

Section 3.12, "ASME Code Class 1, 2, and 3 Piping Systems, Piping Components, and their Associated Supports," of this report evaluates the piping design aspects of the U.S. EPR design provided in FSAR Tier 2, Chapter 3, "Structures, Components, Equipment, and Systems." The applicant did not provide the complete design information in that the ASME Code required design specifications and design reports have not been completed. In FSAR Tier 2, Table 1.8-2, "U.S. EPR Combined License Information Items," Item 3.12-2, the applicant indicated that the COL applicant referencing the U.S. EPR design certification will perform the piping and pipe support stress analysis. In order for the staff to reach a reasonable assurance finding based on the requirements of 10 CFR Part 52.47, "Contents of applications; technical information," certain information is required during the staff's review of the design certification application. SRP Section 14.3, Appendix A, states that design certification applicants may provide less than the complete design information for piping design before the design certification is issued, because the design may depend upon as-built and as-procured information. Instead, the design certification applicant should provide the design-related process and associated DAC in FSAR Tier 1.

In RAI 156, Question 14.03.03-25 and RAI 210, Question 14.03.03-32, the staff requested that the applicant provide the design-related processes, schedule to complete the design of piping systems available for NRC audit, and associated DAC in FSAR Tier 1. Specifically, the staff requested that the applicant (1) document, in FSAR Tier 2, the process of using DAC in lieu of completing the piping design; and (2) include a COL information item in FSAR Tier 2,

Section 3.12 to allow each COL applicant to identify the strategy to address completion of the piping design.

In a February 6, 2009, response to RAI 156, Question 14.03.03-25, and a July 24, 2009, response to RAI 210, Question 14.03.03-32, the applicant revised FSAR Tier 2, Section 14.3 to include a discussion of construction ITAAC and design ITAAC. The ASME Code, Section III piping design was identified as an example of design ITAAC that establishes the commitment for completing the design of an SSC. The applicant also indicated that there can be three scenarios for closing design ITAAC: (1) Closure through amendment of design certification rule; (2) closure through the COL review process; and (3) closure after COL issuance. A new COL Information Item14.3-3 was added in FSAR Tier 2, Section 14.3 indicating that the COL applicant will identify a plan for implementing design ITAAC including the evaluations to be performed, the schedule for performing these evaluations, and associated processes and information that will be available for NRC audit. Plans for SCOL applicants may indicate that the design ITAAC completion for the first plant is to be used.

The staff identified the following remaining concerns with the applicant's response:

The applicant has not indicated in the application that DAC will be used in piping design area. These special ITAAC are acceptable, because piping design is one of the areas allowed to use DAC during the staff's review of design certifications and subsequent safety determination. According to SECY-92-053, "Use of Design Acceptance Criteria During 10 CFR Part 52 Design Certification Process," February 19, 1992, and its associated SRM, the staff implemented the policy of accepting the use of DAC in lieu of detailed design information in a limited number of design areas on a case-by-case basis, as requested by the design certification applicants. Thus, the applicant is requested to indicate in the FSAR Tier 2 that DAC will be used in lieu of detailed design information for piping design.

1. The staff disagreed with the applicant regarding the concept of having COL Information Item 14.3-3 be completed by the "COL Holder" as identified in FSAR Tier 2, Table 1.8-2. It is the staff's position that the COL applicant referencing U.S. EPR design certification should provide the plan for the staff to make the safety determination prior to the issuance of the license. In COL Information Item 14.3-3, the applicant indicated that the plan provided by the COL applicant will identify the evaluations to be performed. The staff agreed that the COL applicant will provide the details of the evaluations. However, for piping design, the staff notes that the applicant needs to specify what those evaluations are. In particular, the applicant should indicate what is not completed in the FSAR and how those evaluations relate to specific design ITAAC. The staff requested that the applicant include a separate paragraph or section in FSAR Tier 2, Section 14.3 to discuss the specifics of piping DAC and associated design ITAAC for piping design reports, as-built reconciliation, and other piping areas (e.g., as-designed pipe break hazard analysis).

2. In COL Information Item 14.3-3, the applicant indicated that for subsequent plants, Subsequent Combined License (SCOL) applicants/licensees may apply the design ITAAC completion that was used for the first standard plant. The staff agrees that the piping design completed for the first plant will be available to subsequent plants for closure of the design ITAAC under the "one issue, one review, one position" approach, only if the same standard piping design is used by the SCOL applicant. Therefore, the

staff requested that the applicant amend the statement to illustrate that referencing the completed design ITAAC only applies if a standard piping design is used.

The staff closed RAI 156, Question 14.03.03-25 and RAI 210, Question 14.03.03-32, and in follow-up RAI 307, Question 14.03.03-45, the staff requested that the applicant address the issues discussed above.

In its February 18, 2010, and March 17, 2010, responses to RAI 307, Question 14.03.03-45, the applicant indicated that FSAR Tier 1, DAC will be used in lieu of detailed design information for the piping design. The applicant proposed to include a discussion in FSAR Tier 2, Section 14.3 for a process to generically address and resolve DAC. For piping DAC, the applicant identified specific design ITAAC included to allow review of the piping design. The applicant also identified that piping DAC consists of both ASME Code, Section III piping analyses and pipe break analyses. The applicant also indicated that subsequent plants may plan to apply DAC resolution used for the first standard U.S. EPR plant with the exception of site-specific parameters, as long as standard design is used.

The standard approach outlined above is voluntary on the part of each licensee referencing the U.S. EPR design certification. The process envisions an NRC review, inspection, or audit of the DAC completion that applies the "one issue, one review, one position" concept as discussed in RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," June 2007, Section C.III.5, to DAC resolution for the first U.S. EPR plant and to subsequent U.S. EPR plants. A COL applicant can apply this standard approach to each of the U.S. EPR design areas that include DAC (i.e., piping design and human factor engineering design). When DAC is used, the process indicates the COL applicant is to identify their plan for DAC resolution including: (1) The evaluations to be performed for DAC; (2) the schedule for performing the evaluations; and (3) the information that will be available for NRC audit. The staff finds that this standard approach consistent with NRC policy for a design-centered-review approach and the regulations, and therefore acceptable. The applicant further revised FSAR Tier 2, Table 1.8-2 to delete the "COL Applicant" and "COL Holder" columns. The changes will allow the staff to request piping information from COL applicants, and the established COL information would allow the staff to resolve DAC during the COL review stage. The staff finds these responses to RAI 307, Question 14.03.03-45 acceptable because the applicant provided an acceptable process to implement and verified the completion of piping DAC by the COL applicant, and confirmed that the FSAR has been revised accordingly. Therefore, the staff considers RAI 307, Question 14.03.03-45 resolved.

14.3.3.4.2 Verification of Piping

During the review of previous U.S. EPR applications, the staff worked with industry stakeholders to refine ITAAC pertaining to design and construction of ASME Code, Section III piping and components. For clarity and inspectability, the staff determined that three distinct ITAAC covering (1) design, (2) as-built reconciliation, and (3) fabrication and installation activities would encompass the complete scope to ensure the piping system or components are properly designed and constructed in accordance with ASME Code, Section III requirements.

In FSAR Tier 1, Chapter 2, the applicant identified ITAAC for the design of piping and piping supports. The ITAAC requires an ASME Code design report to ensure that piping identified as ASME Code, Section III are designed in accordance with ASME Code, Section III requirements. The second ITAAC required that piping supports identified as ASME Code, Section III will be designed in accordance with ASME Code, Section III requirements. In both ITAAC, the

Acceptance Criteria indicated that a report shall exist. The staff reviewed FSAR Tier 1 and FSAR Tier 2 information and identified the following concerns.

Design

In RAI 156, Question 14.03.03-27, Part (a), the staff requested that the applicant identify what type of reports shall exist in the Acceptance Criteria column. SRP Section 14.3.3 indicates that an acceptable version of an ASME Code certified stress report is the design document required by ASME Code, Section III, Subarticle NCA-3550. A certified design report provides assurance that requirements of ASME Code, Section III have been met and that the design complies with the design specification. Furthermore, the staff also requested that the applicant revise the wording in the Inspections, Tests, Analyses in which, an inspection of the ASME Code Design Report, as opposed to an analysis, should be conducted. Additionally, the staff requested that the applicant address the same issue in other systems in FSAR Tier 1, Chapters 2 and 3.

In an April 29, 2009, response to RAI 156, Question 14.03.03-27, Part (a) the applicant stated that ITAAC related to piping system design would be revised. Using FSAR Tier 1, Table 2.2.1-5, "RCS ITAAC," Item 3.20 of the RCS as an example, the applicant modified the ITA and included the ASME Code, Section III, Design Reports (NCA-3550) in the AC. The staff finds this portion of the response acceptable, because the ASME Code provides the specific contents and requirements of the certified design report. An ASME certified design report is the design document required by ASME Code, Section III, Subarticle NCA-3550. However, the staff had two additional concerns regarding the proposed changes.

First, in the ITA of Item 3.20, the staff noted that inspection for the existence of the Design Reports is not the objective of the ITAAC. Rather, the ITA should be reworded as "Inspections of the ASME Code, Section III, Design Reports (NCA-3550) and required documents will be performed." Second, the AC should be reworded to state, "ASME Code, Section III, Design Reports (NCA-3550) exist and conclude that for portions of the RCS piping shown as ASME Code, Section III in Figure 2.2.1-1 comply with the ASME Code, Section III requirements." Therefore, the staff closed RAI 156, Question 14.03.03-27, Part (a), and in follow-up RAI 255, Question 14.03.03-38, Part (a), the staff requested that the applicant to address the deficiencies described above.

In a September 10, 2009, response to RAI 255, Question 14.03.03-38, Part (a), the applicant revised the piping design ITAAC to identify the appropriate ITA and AC for piping design. The ITA consists of an inspection of the ASME Code, Section III, Design Reports (NCA-3550), and the AC reflects that an ASME Code, Section III Design report exists and concludes that the piping design complies with ASME Code, Section III requirements. The staff finds the response acceptable because, as discussed in SRP Section 14.3.3, the design ITAAC ensures that the design process for the piping occurs as described in the design description, and confirmed that the FSAR has been revised accordingly. Therefore, the staff considers RAI 255, Question 14.03.03-38, Part (a) resolved.

As-built Reconciliation

As described in SRP Section 14.3.3, one ITAAC item that should be included is to require that a report exists and documents the result of an as-built reconciliation analysis confirming the final piping systems have been built and deviations have been reconciled in accordance with ASME Code certified stress reports. In FSAR Tier 1, Table 2.2.1-5, an ITAAC for as-built reconciliation is not included. Therefore, in RAI 156, Question 14.03.03-27, Part (b), the staff requested that

the applicant include an ITAAC to reflect that an analysis will be performed to reconcile the as-built condition of the piping system with approved design documents. The staff also requested that the applicant address the same issue in other systems in FSAR Tier 1, Chapters 2 and 3.

In an April 29, 2009, response to RAI 156, Question 14.03.03-27, Part (b) the applicant revised the related ITAAC to include piping systems as-built reconciliation. Using the RCS as an example, the applicant included the ITAAC Item 3.21 of FSAR Tier 1, Table 2.2.1-5, to address the as-built reconciliation activity. The staff reviewed the response and associated FSAR markup and determined that the applicant should make three additional modifications to clarify the statements in the Commitment Wording, ITA, and AC.

First, the staff requested that the applicant revise the Commitment Wording to "The as-built portions of the RCS piping shown as ASME Code, Section III in Figure 2.2.1-1 shall be reconciled with the piping design requirements." Second, an inspection is not appropriate for the ITA. Rather, the ITA should be revised to "A reconciliation analysis of the piping using the as-designed and as-built information and ASME Code certified Design Report (NCA-3550) will be conducted." Third, in order to clarify the AC regarding the as-built reconciliation activity, the AC should be revised to "For portions of … in Figure 2.2.1-1, ASME Code Design Report(s) exist and conclude that design reconciliation has been completed in accordance with the ASME Code for as-built reconciliation. The report(s) document the results of the reconciliation analysis." The staff closed RAI 156, Question 14.03.03-27, Part (b), and in follow-up RAI 255, Question 14.03.03-38, Part (b), the staff requested that the applicant improve the clarity and inspectability of the piping as-built ITAAC.

In a September 10, 2009, response to RAI 255, Question 14.03.03-38, Part (b), the applicant revised the piping as-built reconciliation ITAAC to identify the appropriate ITA and AC. The ITA consists of analyses to reconcile as-built deviation to ASME Code Design Report. Piping analyzed using time-history methods will be reconciled to the as-built information. The AC reflects that an ASME Code, Section III, Data Report exists and concludes that the piping design reconciliation has been completed. The staff determined the response not acceptable, because in the ITA, the applicant proposed that piping analyzed using time-history methods will be reconciled to the as-built information. This restricts the reconciliation only to those piping analyzed using time-history methods. Therefore, the staff closed RAI 255, Question 14.03.03-38, Part (b), and in RAI 411, Question 14.03.03-48, the staff requested that the applicant remove the statement regarding time-history methods in the ITA.

In a June 7, 2011, response to RAI 411, Question 14.03.03-48, the applicant deleted the statement, "Piping analyzed using time-history methods will be reconciled to the as-built information" in the ITA. The staff finds the response acceptable because the analyses to reconcile as-built deviations to the ASME Code, Section III, Design Report should not be limited to those piping analyzed using time-history methods, and confirmed that the FSAR has been revised accordingly,. Therefore, the staff considers RAI 411, Question 14.03.03-48 resolved.

Fabrication and Installation

For piping designated as ASME Code, Section III, SRP Section 14.3.3 identifies that a certified report provides assurance that requirements of the ASME Code, Section III for fabrication, installation, and examination have been met. In FSAR Tier 1, an ITAAC for fabrication and installation of piping is not included. Therefore, in RAI 156, Question 14.03.03-27, Part (c), the staff requested that the applicant include an ITAAC to reflect that an inspection of the piping will

be conducted. The staff also requested that the applicant address the same issue in other systems in FSAR Tier 1, Chapters 2 and 3.

In an April 29, 2009, response to RAI 156, Question 14.03.03-27, Part (c), the applicant revised the ITAAC related to piping systems in FSAR Tier 1. Using the RCS as an example, the applicant included the ITAAC Item 3.24 of FSAR Tier 1, Table 2.2.1-5, to address the fabrication and installation activities. The staff identified three additional modifications to clarify the fabrication, installation, and inspection. First, in the ITA, the wording should be revised to "An inspection of the piping will be conducted" instead of "An inspection for the existence of ASME N-5 Data reports." Second, in the Commitment Wording, the wording, "…are installed…" should be revised to "…are fabricated, installed and inspected…." Similarly, in the AC, the wording, "…conclude that installation is…" should be revised to "…conclude that fabrication, installation and inspection are…." The staff closed RAI 156, Question 14.03.03-27, Part (c) and in follow-up RAI 255, Question 14.03.03-38, Part (c), the staff requested that the applicant improve the clarity and inspectability of the piping as-built ITAAC.

In a September 10, 2009, response to RAI 255, Question 14.03.03-38, Part (c), the applicant revised the piping fabrication and installation ITAAC to identify the appropriate ITA and AC. The ITA consists of an inspection of the as-built piping, and the AC reflects that an ASME Code, Section III, Data Report exists and concludes that the piping is installed and inspected in accordance with ASME Code, Section III. The staff finds the response acceptable because this ITAAC provided an overall verification by inspection that the as-built piping systems are fabricated, installed, and inspected consistent with the certified design commitment. The staff also verified that the FSAR has been revised accordingly and, therefore, considers RAI 255, Question 14.03.03-38, Part (c) resolved.

14.3.3.4.3 Pressure Boundary Welds for Piping

ITAAC for pressure boundary welds for ASME Code, Section III piping are provided in FSAR Tier 1, Chapter 2. The ITAAC states that inspection of pressure boundary weld is performed in accordance with ASME Code, Section III requirements. The AC is that ASME Code, Section III, Data Reports exist and conclude that pressure boundary weld has been designed, welded and hydrostatically tested in accordance with ASME Code, Section III. ITAAC involving welding and hydrostatic testing are currently listed together in FSAR Tier 1, Chapter 2. These ITAAC should have their individual sub-steps numbered. Therefore, in RAI 148, Question 14.03.03-23, the staff requested that the applicant address two cases to which this applies: (1) In the case where there are multiple criteria stated in the Commitment Wording, these criteria and the respective sub-steps in the ITA and AC should be separately numbered. (2) In the case when there is one criterion stated in Commitment Wording with multiple sub-steps in the ITA and AC, these sub-steps in the ITA and the AC should be separately numbered.

In a January 9, 2009, response to RAI 148, Question 14.03.03-23, the applicant indicated that the ITAAC items with separate actions will be revised to provide numbering of the separate actions. The staff finds the response acceptable because two distinct ITAAC are provided to verify that welding and hydrostatic testing will be performed in accordance with the design commitment. The staff also confirmed that the FSAR has been revised accordingly and, therefore, considers RAI 148, Question 14.03.03-23 resolved.

14.3.3.4.4 Verifications of Components and Systems

In addition to addressing piping design, the staff confirmed that FSAR Tier 1 addresses verification of component classification, fabrication, dynamic and seismic qualification, and selected testing and performance requirements through specific ITAAC in the individual FSAR Tier 1 systems. During the review of previous design certifications, the staff worked to refine ITAAC pertaining to design and construction of ASME Code, Section III components as discussed above.

Design

The applicant provided ITAAC for the design of components. The ITAAC requires an ASME Code design report to ensure that components identified as ASME Code, Section III are designed in accordance with ASME Code, Section III requirements. The staff reviewed FSAR Tier 1 and FSAR Tier 2 information, but the applicant did not identify what the particular reports are or the contents of the reports. Therefore, in RAI 156, Question 14.03.03-26, Part (a), the staff requested that the applicant identify the reports.

In a February 6, 2009, response to RAI 156, Question 14.03.03-26, Part (a) the applicant identified that the ITAAC entry will be modified to reference ASME Code, Section III, Design Reports (NCA-3550) in the AC. The staff finds this portion of the response acceptable because the ASME Code gives the specific contents and requirements of the certified design report. However, the staff determined that the Commitment Wording of the ITAAC on design, welding, and hydrostatic testing should be separated. To enhance clarity of the entry, using the RCS as an example, in FSAR Tier 1, Table 2.2.1-5, Item 3.1, the Commitment Wording should be separated into 3.1a, 3.1b, and 3.1c to address design, welding, and testing, respectively. The staff closed RAI 156, Question 14.03.03-26, Part (a), and in follow-up RAI 210, Question 14.03.03-33, Part (a), the staff requested that the applicant modify the ITAAC entry.

In a July 24, 2009, response to RAI 210, Question 14.03.03-33, Part (a), the applicant agreed to make individual steps such as design, welding, and hydrostatic testing into separate commitments. In particular, the AC would refer to the existence of the ASME Code, Section III, Design Reports (NCA-3550). The staff identified two additional concerns in the response. First, in the ITA, the staff noted that inspection for the existence of the Design Reports is not the objective of the ITAAC. Rather, the ITA should be reworded as “Inspections of the ASME Code, Section III, Design Reports (NCA-3550) and associated reference documents will be performed.” Similarly, the staff concludes the AC is not acceptable because simply verifying the existence of the report is insufficient. The staff finds that the proper AC should be “ASME Code, Section III, Design Reports (NCA-3550) exist and conclude that for components listed as ASME Code, Section III in Table x.x.x-x comply with the ASME Code, Section III requirements.” Therefore, the staff closed RAI 210, Question 14.03.03-33, Part (a), and in follow-up RAI 411, Question 14.03.03-49, Part (a), the staff requested that the applicant address the issues discussed above.

In a June 7, 2011, response to RAI 411, Question 14.03.03-49, Part (a), the applicant revised the ITA to inspection of the ASME Code, Section III, Design Reports and associated documents rather than the existence of these documents. In the AC, the applicant revised the wording to “ASME Code Section III Design Reports (NCA-3550) exist and conclude that components listed as ASME Code Section III in Table x.x.x-x comply with ASME Code Section III requirements.” The staff finds this response acceptable because, as discussed in SRP Section 14.3.3, the design ITAAC ensures the design process for the components occurs as described in the

design description. The staff also confirmed that the FSAR has been revised accordingly and, therefore, considers RAI 411, Question 14.03.03-49, Part (a) resolved.

In RAI 496, Question 14.03.03-51, the staff requested that the applicant ensure that ITAAC for the functional design and qualification of pumps and valves to perform their safety-related functions under design-basis conditions are specified in the applicable sections of the FSAR Tier 1. In a July 19, 2011, response to RAI 496, Question 14.03.03-51, the applicant indicated that new ITAAC would be added to the FSAR Tier 1 for verifying that as-built safety-related pumps and valves meet the functional design and qualification requirements to perform their design-basis safety functions. The staff finds that the planned ITAAC will provide assurance of the functional design and qualification of pumps and valves in performing their design-basis safety functions. The staff also confirmed that the FSAR has been revised accordingly and, therefore, considers RAI 496, Question 14.03.03-51 resolved.

In RAI 496, Question 14.03.03-52, the staff requested that the applicant describe the plans for verification of the design and qualification of dynamic restraints to be used in the U.S. EPR design. In a July 19, 2011, response to RAI 496, Question 14.03.03-52, the applicant stated that the number and type of snubbers had not been determined for the U.S. EPR design. The applicant referenced FSAR Tier 2, Section 3.9.6.4, "Inservice Testing Program for Dynamic Restraints," that specified the COL applicant will provide a table identifying the safety-related systems and components that use snubbers in their support systems. FSAR Tier 2 specifies the use of ASME QME-1-2007 as accepted in to RG 1.100, "Seismic Qualification of Electrical and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants," Revision 3, for the functional qualification of dynamic restraints. Therefore, the staff finds that the applicant has clarified the provisions for the functional design and qualification of dynamic restraints to be used in the U.S. EPR design and, therefore, considers RAI 496 Question 14.03.03-52 resolved.

As-built Reconciliation

In RAI 156, Question 14.03.03-26, Part (b), the staff requested that the applicant provide an ITAAC to document the result of an as-built reconciliation analysis confirming the components have been build in accordance with the ASME Code certified stress report.

In a February 6, 2009, response to RAI 156, Question 14.03.03-26, Part (b), the applicant stated that as-built reconciliation analyses are not necessary because as-built reconciliation analyses are part of the process to develop ASME Code, Section III, Design Reports (NCA-3550). The staff disagreed with this response. To verify that a component is designed in accordance with the methodology called out in the ASME Code and in the FSAR, the staff verifies the design (through review of the design report prior to construction) and that the plant is built in accordance with the design (through review of as-built reconciliation of the design report). SRP Section 14.3.3 specifically indicates that a distinct ITAAC is required for an as-built reconciliation analysis of the component using as-designed and as-built information and the ASME Code certified Design Report to be performed. Therefore, the staff closed RAI 156 Question 14.03.03-26, Part (b), and in follow-up RAI 210, Question 14.03.03-33, Part (b), the staff requested that the applicant include an ITAAC to verify that an analysis will be performed to reconcile the as-built condition of the components with the approved design documents.

In a July 24, 2009, response to RAI 210, Question 14.03.03-33, Part (b), the applicant again stated that an ITAAC to perform as-built analyses is not necessary because the applicant's position is that the nth plant will be built like the (n-1)th plant and few reconciliation analyses

should be required. While the first plant may have more deviations to the design analyses, each subsequent plant will have fewer deviations. The applicant further stated that the ASME Code does not define or require an "as-built analysis," only a reconciliation of deviations to the design analyses and that the components are ASME Code, Section III when they leave the factory before their installation at their final location onsite.

The staff finds the applicant's justification not acceptable for several reasons. First and foremost, the staff requested that the applicant perform "as-built reconciliation." These are analyses to reconcile deviations from ASME Code requirements. The staff believes that the applicant misunderstood the term "as-built analysis" to imply a full analysis of the as-built condition. Therefore, the staff closed RAI 210, Question 14.03.03-33, Part (b), and in follow-up RAI 411, Question 14.03.03-49, Part (b), the staff requested that the applicant modify the ITA to "An analysis will be performed to reconcile the as-built condition of the components with the ASME Code Section III Design Reports" and the AC to "ASME Code Design Report(s) exists and concludes that design reconciliation has been completed in accordance with the ASME Code for as-built reconciliation of the components identified in Table x.x.x-x as ASME Code Section III. The report documents the results of the reconciliation analysis."

In a June 7, 2011, response to RAI 411, Question 14.03.03-49, Part (b), the applicant indicated that the phrase "as-built" means in the final location at the plant site according the NEI-08-01, "Industry Guidelines for the ITAAC Closure Process Under 10 CFR Part 52," Revision 4, July 2010. The applicant further stated that ASME Code, Section III component design reports do apply to the site installation of the components; however, the phrase "as-built analysis" does not apply to the ASME Code component design report in FSAR Tier 1. Furthermore, the applicant revised the ITA to "An analysis will be performed to verify that deviations to the component design reports (NCA-3550) have been reconciled," and the AC to "ASME Code Section III Design Reports (NCA-3550) exist and conclude that components listed as ASME Code Section III in Table x.x.x-x comply with the ASME Code Section III requirements and any deviations to the design report have been reconciled."

The staff finds the proposed ITA and AC acceptable because an analysis, instead of inspection, is needed to ensure deviations to the component design reports have been reconciled. The staff also confirmed that the FSAR has been revised accordingly; however, since the intent of this ITAAC is to address reconciliation rather than fabrication of components, the Commitment Wording should be reworded as "Components listed in Table x.x.x-x as ASME Code Section III are reconciled in accordance with ASME Code Section III requirements" instead of "Components listed… are fabricated in accordance…Section III requirements." **RAI 411, Question 14.03.03-49, Part (b) is being tracked as an open item.**

Fabrication and Installation

In the area of fabrication and installation, in RAI 156, Question 14.03.03-26, Part (c), the staff requested that the applicant provide a distinct ITAAC to verify that ASME Code, Section III, components are fabricated, installed, and inspected based on the results recorded in ASME Code Data Reports.

In a February 6, 2009, response to RAI 156, Question 14.03.03-26, Part (c), the applicant stated that proper installation of ASME Code components is covered by welding and hydrostatic testing to verify pressure boundary integrity. The staff determined this response inadequate because the scope of assuring the components will be fabricated, installed, and inspected is broader than just welding and hydrostatic testing. Therefore, the staff closed RAI 156,

Question 14.03.03-26, Part (c), and in follow-up RAI 210, Question 14.03.03-33, Part (c), the staff requested that the applicant include an ITAAC to reflect that ASME Code Data Reports and inspection reports exist and conclude that the components identified as ASME Code, Section III will be fabricated, installed, and inspected in accordance with ASME Code, Section III requirements.

In a July 24, 2009, response to RAI 210, Question 14.03.03-33, Part (c), the applicant again indicated that there exists ITAAC for welding inspections and hydrostatic testing. The applicant also stated that the fabrication and installation ITAAC, which require the verification of the N-5 Data Report for a portion of the piping system, would also cover the installation of the components. The staff determined this response to be inadequate because the scope of assuring the components are fabricated, installed, and inspected is broader than that of the welding and hydrostatic testing. Furthermore, the N-5 Data Report required for the piping may not include all the ASME Code, Section III components at the system level. A distinct ITAAC for component fabrication, installation, and inspection is necessary. Therefore, the staff closed RAI 210, Question 14.03.03-33, Part (c), and in follow-up RAI 411, Question 14.03.03-49, Part (c) the staff requested that the applicant address the concern discussed above.

In a June 7, 2011, response to RAI 411, Question 14.03.03-49, Part (c), the applicant agreed to add a distinct ITAAC to address the installation of components. However, the staff is still concerned that the applicant did not address the complete scope of the ITAAC, which encompasses fabrication, installation, and inspection. **RAI 411, Question 14.03.03-49, Part (c) is being tracked as an open item.**

14.3.3.4.5 Hydrostatic Test

The integrity of the pressure boundary is required to be maintained, because it is directly involved in preventing or mitigating an accident or event under the defense-in-depth principle. The pressure boundary integrity is also ensured, in part, through a hydrostatic test verifying the leak-tightness of the ASME Code piping systems.

The applicant proposed an ITAAC in FSAR Tier 1 for hydrostatic testing of components identified as ASME Code, Section III to be performed. The acceptance criteria of this ITAAC indicated that those components have been hydrostatically tested per ASME Code, Section III hydrostatic testing requirements. The staff finds the proposed ITAAC adequately ensures that the integrity of the pressure boundary is maintained.

14.3.3.4.6 Equipment Seismic and Dynamic Qualification

The ITAAC for equipment seismic qualification inspection should verify the capability of mechanical and electrical components in the as-built condition, including anchorages, to perform safety functions during and following an SSE. The applicant proposed a two part ITAAC for this purpose. Item (a) of the ITAAC utilizes type test, analyses, or a combination of both to verify that the design of the components identified as Seismic Category I can withstand seismic design basis load; Item (b) of this ITAAC calls for inspection of the as-built component.

In FSAR Tier 2, Section 3.10.4, “Test and Analysis Results and Experience Database,” the applicant indicated that the COL applicant referencing the U.S. EPR design certification will create and maintain the Seismic Qualification Data Package (SQDP) file during the equipment selection and procurement phase. Specifically, in FSAR Tier 2, Table 1.8-2, Item 3.10-2, the applicant states that a COL applicant referencing the U.S. EPR design certification will address

the final resolution of the issue. However, a COL applicant must address all COL items whether final action will be taken before or after the license is issued. To allow the staff to perform necessary review or to confirm the creation of the SQDP during the equipment selection and procurement phases, the staff finds that an ITAAC in the FSAR is necessary. In follow-up RAI 260, Question 14.03.03-39, the staff requested that the applicant add an appropriate ITAAC in FSAR Tier 1 to address the issue. Furthermore, the staff identified concerns with wording of the ITA and AC for seismic equipment qualification.

In a September 4, 2009, response to RAI 260, Question 14.03.03-39, the applicant included reference of SQDP, EQDP, or analyses in the ITA and AC for the as-built inspection of the ITAAC related to the Seismic Category I components. Furthermore, the applicant indicated that since ITAAC must be closed out prior to fuel loading, seismic qualification reports will be available for staff review during plant construction. The applicant also stated that these seismic qualification ITAAC were clarified and standardized in its response to RAI 210, Question 14.03.02-12. However, the staff determined the response not acceptable with the following two concerns:

1. In the proposed ITAAC, the applicant indicated that the inspection will verify the components, including anchorage, are installed as specified on the construction drawings. However, this activity will not verify whether the Seismic Category I components will be located in a Seismic Category I building. Therefore, in follow-up RAI 386, Question 14.03.03-46, the staff requested that the applicant amend the ITA and AC of the ITAAC to reflect that the Seismic Category I components should be installed in the Seismic Category I building as specified on the construction drawing.

2. In the ITA and AC of the as-built inspection of the ITAAC, the applicant proposed that deviations will be reconciled to the seismic qualification reports (SQDP, Environmental Qualification Data Package (EQDP), or analyses). The proposed wording clarifies that reconciliation will be performed to compare deviations with the SQDP, EQDP, or analyses and the staff finds this portion of statement acceptable. However, simply indicating that deviations will be reconciled is insufficient. The proper acceptance criteria should be such that the conclusion of reconciliation reflects that the components, including anchorage, are seismically bounded by the tested or analyzed conditions. Therefore, the staff closed RAI 260, Question 14.03.03-39, and in RAI 386 Question 14.03.03-46, the staff requested that the applicant amend the ITA and AC to reflect that "the reconciliation concludes that components identified in Table x.x.x-x, including anchorage, are seismically bounded by the tested or analyzed conditions."

As a result of the staff concerns above, **RAI 386, Question 14.03.03-46 is being tracked as an open item.**

14.3.3.4.7 Environmental Qualification

In RAI 501, Question 14.03.03-53, the staff noted that the ITAAC for the environmental qualification (EQ) of U.S. EPR components given in FSAR Tier 1 do not appear to be consistent with the EQ requirements specified in FSAR Tier 2. The EQ ITAAC given in FSAR Tier 1 for other U.S. EPR systems should also be revised to be consistent with the EQ requirements in FSAR Tier 2, Section 3.11, "Environmental Qualification of Mechanical and Electrical Equipment," similar to the proposed language for ITAAC 6.1 in FSAR Tier 1, Table 2.2.3-3, "Safety Injection System and Residual Heat Removal System ITAAC." **RAI 501, Question 14.03.03-53 is being tracked as an open item.**

14.3.3.4.8 ITAAC for Other Systems

In RAI 156, Question 14.03.03-29, the staff requested that the applicant provide an ITAAC or justification for not including an ITAAC for the High Range Dose Rate Monitors in Radiation Monitoring System that is given as Seismic Category I in FSAR Tier 2, Table 3.2.2-1. In FSAR Tier 1, Section 2.4.22, "Radiation Monitoring System," there is no ITAAC to address the Design Commitment that equipment identified as Seismic Category I can withstand a design basis seismic load without loss of function.

In a February 6, 2009, response to RAI 156, Question 14.03.03-29, the applicant indicated that its April 7, 2009, response to RAI 43, Question 14.03.08-1a addressed ITAAC for the High Range Dose Rate Monitors and added ITAAC for Safety-Significant Dose Rate Monitors. The staff reviewed the applicant's April 7, 2009, response to RAI 43, Question 14.03.08-1a and the revised FSAR and finds the proposed ITAAC sufficient to verify the capability of the equipment in as-built condition to perform safety-related functions during and following a SSE. Accordingly, the staff considers RAI 156, Question 14.03.03-29 resolved.

14.3.3.4.9 Documentation of Code Class Boundaries

SRP Section 14.3, Appendix C, Section (I)(B)(iv) indicates that ASME Code class boundaries for mechanical equipment and piping should be shown on the figures in FSAR Tier 1. The staff reviewed the figures in FSAR Tier 1 but did not find the boundaries between ASME Code Class 1 and Class 2 and boundaries between ASME Code Class 2 and Class 3. In RAI 399, Question 14.03.03-47, the staff requested that the applicant modify FSAR Tier 1 figures to address the deficiency.

In a May 19, 2011, response to RAI 399, Question 14.03.03-47, the applicant revised FSAR Tier 1 figures to indicate the ASME Code, Section III Class 1, 2, and 3 boundaries. The staff finds this response acceptable and confirmed that the FSAR has been revised to meet the description in SRP Section 14.3 which calls for ASME Code class boundaries for mechanical equipment and piping to be shown in FSAR Tier 1. Therefore, the staff considers RAI 399, Question 14.03.03-47 resolved.

14.3.3.5 *Combined License Information Items*

Section 14.3.1.5, Table 14.3.1-1 of this report provides a list of all ITAAC related COL information items and descriptions from FSAR Tier 2, Table 1.8-2 that are applicable to FSAR Tier 2, Section 14.3. The staff finds the list in Table 14.3.1-1 to be complete. Also, the list adequately describes actions necessary for the COL applicant or holder. No additional COL information items need to be included in FSAR Tier 2, Table 1.8-2.

14.3.3.6 *Conclusions*

Except for the open items discussed above and based on the staff's review conducted in accordance with the acceptance criteria in SRP Section 14.3.3, the staff's review of the applicant's implementation of the selection criteria and methodology for the development of the FSAR Tier 1 information in FSAR Tier 2, Section 14.3 and on the above discussions, the staff concludes that the top-level design features and performance characteristics of the SSCs are appropriately described in FSAR Tier 1 and finds the FSAR Tier 1 information associated with the scope of SRP Section 14.3.3 acceptable.

Furthermore, except for the open items discussed above, the staff concludes that the FSAR Tier 1 design descriptions associated with the scope of SRP Section 14.3.3 can be verified adequately by ITAAC. Therefore, except for the open items discussed above, the staff concludes that the proposed ITAAC associated with the scope of SRP Section 14.3.3 provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification is built and will operate in accordance with the design certification, the Atomic Energy Act of 1954, and NRC regulations.

14.3.4 Reactor Systems

14.3.4.1 *Introduction*

FSAR Tier 2, Section 14.3, "Inspections, Tests, Analysis, and Acceptance Criteria," discusses the selection criteria and methods used to develop the FSAR Tier 1 certified design material (CDM) and the ITAAC. FSAR Tier 1 chapters include the portion of the design-related information contained in a generic FSAR that is approved and certified by the design certification rule, 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." The design descriptions, interface requirements, and site parameters are derived from FSAR Tier 2 information.

The staff reviewed the ITAAC with respect to reactor systems described in the FSAR in accordance with NUREG-0800, Sections 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria," and 14.3.4, "Reactor Systems – Inspections, Tests, Analyses, and Acceptance Criteria." The staff reviewed the proposed ITAAC to determine whether a plant that incorporates the design certification can be built and operated in accordance with the design certification and the NRC regulations.

The scope of the review of the reactor systems ITAAC included the FSAR Tier 1 sections given in Table 14.3.4-1, "FSAR Tier 1 and FSAR Tier 2 Design Description Cross Reference," of this report, that are significantly related to normal operation, transients, and accidents.

14.3.4.2 *Summary of Application*

FSAR Tier 1

The applicant provided design descriptions for reactor systems in FSAR Tier 1 sections given in Table 14.3.4.2-1 that are directly or indirectly related and impact these sections. FSAR Tier 1, Chapter 1, "Introduction," provides definitions, general provisions, and a legend for figures, acronyms, and abbreviations.

Table 14.3.4-1 FSAR Tier 1 and FSAR Tier 2 Design Description Cross Reference

FSAR Tier 2 Section	FSAR Tier 1 Section	Comments
4.3	2.2.6, 2.2.7, 2.4.1, 2.4.11, 2.4.17, 2.4.19	These sections are indirectly related but have an impact on nuclear design.
4.4	2.4.1, 2.4.17, 2.4.19	These sections are indirectly related.
4.6	2.2.1, 2.2.2, 2.2.6, 2.2.7, 2.4.13, 2.4.24	Section 2.4.24 is indirectly related.

FSAR Tier 2 Section	FSAR Tier 1 Section	Comments
5.2.2	2.2.1, 2.8.2	
5.4.7	2.2.3	
5.4.11	2.2.1	
5.4.12	2.2.1	
6.3	2.2.2, 2.2.3, 2.4.24	Section 2.4.24 is indirectly related.
9.3.4	2.2.6	
Chapter 15	2.4.1	Section 2.4.1 is indirectly related.

FSAR Tier 2

FSAR Tier 2, Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria," provides a general description of the U.S. EPR ITAAC including its relationship to other FSAR Tier 1 information, the selection criteria, and content.

ITAAC

The applicant has provided ITAAC for reactor systems in FSAR Tier 1 sections as listed above in Table 14.3.4-1.

Technical Specifications

There are no technical specifications for this area of review.

14.3.4.3 *Regulatory Basis*

The relevant requirements of NRC regulations for this area of review, and the associated acceptance criteria, are given in NUREG-0800, Sections 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria," and 14.3.4 "Reactor Systems – Inspections, Tests, Analyses, and Acceptance Criteria." Review interfaces with other SRP sections are also identified in this SRP section.

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

- 10 CFR 52.47(b)(1), "Contents of applications; technical information," as it relates to the requirement that a design certification 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 plant that incorporates the design certification is built and will operate in accordance with the design certification, the provisions of the Atomic Energy Act of 1954, and NRC regulations.

14.3.4.4 *Technical Evaluation*

The staff performed its review of the system and non-system based ITAAC in accordance with the SRP Section 14.3 sections described above and SRP Section 14.3.4, particularly the applicable review procedures identified in each SRP Section III. The staff review examined the ITAAC to ensure that they can be inspected by the organization holding the combined license and closed out by the staff. The review examined the phrasing and format of the ITAAC to

determine if they were consistent (i.e., the Commitment Wording; the Inspection, Test, or Analysis; and the Acceptance Criteria are parallel and in agreement). In addition, the staff determined that the FSAR Tier 1 ITAAC items were derived from the FSAR Tier 2 information.

In performing the evaluation of the ITAAC items, the staff considered the safety function significance of each item with regard to its adequacy including the results of transient and accident analyses, core cooling in all modes of operation and shutdown conditions, anticipated transient without scram (ATWS), and severe accident assessments. Specifically, FSAR Tier 2, Table 14.3-1, "Design Basis Accident Analysis (Safety-Significant Features)," FSAR Tier 2, Table 14.3-5, "ATWS (Safety- Significant Features)," FSAR Tier 2, Table 14.3-6, "PRA and Severe Accident Analysis (Safety-Significant Features)," and FSAR Tier 2, Table 14.3-7, "Licensing (Safety-Significant Features)," were reviewed to confirm that the table entries are complete with respect to the safety analyses in FSAR Tier 2, Chapter 4, "Reactor," FSAR Tier 2, Chapter 5, "Reactor Coolant System And Connected Systems," FSAR Tier 2, Chapter 6, "Engineered Safety Features," and FSAR Tier 2, Chapter 15, "Transient And Accident Analyses," and consistent with FSAR Tier 2, Section 14.2, "Initial Plant Test Program." FSAR Tier 2, Table 14.3-8, "ITAAC Screening Summary," was reviewed by the staff to ensure that entries were comprehensive and consistent with the initial plant test program, and the identification of safety significant features identified in the above tables.

In addition, the staff used the SRP sections identified in SRP Section 14.3.4 that have a potential impact on the reactor systems ITAAC sections. These included the following SRP sections that provide information related to SRP Section 14.3.4: SRP Section 14.3 (general guidance on ITAAC), SRP Section 14.3.2 (SSCs ability to withstand various natural phenomena), SRP Section 14.3.3 (piping design), SRP Section 14.3.5 (Instrumentation and Controls), SRP Section 14.3.6 (electrical systems and components), and SRP Section 19 (SSCs design features and functions that should be addressed based on severe accident, PRA, and shutdown safety evaluations).

Also, in accordance with SRP Section 14.3.4, the staff reviewed Chapter 15 systems sequence of events and reviewed the SSCs functional responses to each abnormal event described in the transient and accident analysis. The staff confirmed that the required actions of the SSCs are tested in FSAR Tier 1, Section 2.4.1 from initiating test signals that simulate the reactor conditions to the actuation of the systems that mitigate the abnormal events. The staff finds the testing and acceptance criteria to be complete and acceptable because the ITAAC included the SSCs that are required to mitigate or terminate the abnormal events to be sufficient in demonstrating functional operability as described in DCD Tier 2.

Although not a requirement, the staff also reviewed the FSAR to determine that the ITAAC items conformed to the recommendations and guidance provided in RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," Section C.II.1.2.4, "ITAAC for Reactor Systems (SRP Section 14.3.4)."

The staff assessed the reactor systems ITAAC items for the following FSAR Tier 2 sections in accordance with the applicable procedures and guidance provided in SRP Sections 14.3 and 14.3.4:

- Section 4.6, "Functional Design of Reactivity Control Systems"
- Section 5.2.2, "Overpressure Protection"

- Section 5.4.7, “Residual Heat Removal System”
- Section 5.4.11, “Pressurizer Relief Tank”
- Section 5.4.12, “Reactor Coolant System High Point Vents”
- Section 6.3, “Emergency Core Cooling System”
- Section 9.3.4, “Chemical and Volume Control System (Including Boron Recovery System)”

The staff’s specific evaluation results of the above sections relating to the adequacy of their ITAAC items are presented in the individual Technical Evaluation of each of these sections in this report. With the exception of open items related to ITAAC in these sections, the staff considers the ITAAC to be adequately addressed and acceptable. The staff’s brief discussion below identifies the RAIs requiring resolution that are identified as open items in other sections of this report.

Gas Accumulation

In FSAR Tier 2, Sections 5.4.7 and 6.3, and the corresponding FSAR Tier 1, Section 2.2.2, “In-Containment Refueling Water Storage Tank System,” and FSAR Tier 1, Section 2.2.3, “Safety Injection System and Residual Heat Removal System,” the applicant did not address gas accumulation as described in DC/COL-ISG-019, “Proposed Interim Staff Guidance Review of Evaluation to Address Gas Accumulation Issues in Safety Related Systems.” Therefore, in RAI 310, Question 06.03-12, the staff requested that the applicant provide this information. In a November 20, 2009, response to RAI 310, Question 06.03-12, the staff concluded that the applicant complied with Guidance 1 and 3 but did not address Guidance 2 that requires an ITAAC for the applicant to compare the as-built plant configuration to the piping and instrumentation drawings (P&ID) and isometric drawings to confirm all potential gas accumulation areas have been properly identified and that appropriate prevention measures are in place. Therefore, the staff closed RAI 310, Question 06.03-12, and in follow-up RAI 480, Question 06.03-17, the staff requested that the applicant address the ITAAC issue. **RAI 480, Question 06.03-17 is being tracked as an open item** in Section 6.3 of this report.

Self-Powered Neutron Detector (SPND)

With regard to SPND, in-core instrumentation, as related to FSAR Tier 2, Section 4.3, “Nuclear Design,” Section 4.4, “Thermal-Hydraulic Design,” and FSAR Tier 2, Chapter 15, the staff reviewed the corresponding FSAR Tier 1, Section 2.4.19, “Incore Instrumentation System,” and in RAI 505, Question 07.01-33, the staff requested that the applicant provide an evaluation of the most limiting location of the undetected single failure of a SPND and any associated changes to ITAAC. **RAI 505, Question 07.01-33 is being tracked as an open item** in Section 7.1 of this report.

Power Measurement Uncertainty

The staff reviewed FSAR Tier 1, Section 2.4.17, “Excore Instrumentation System,” with respect to power measurements, and in RAI 432, Question 15.00.02-1, the staff requested that the applicant provide a description of the mechanism, such as the FSAR and ITAAC and/or COL information item, to support the claim of 0.48 percent power measurement uncertainty and how

it will be verified and confirmed. The applicant's June 29, 2011, response to RAI 432, Question 15.00.02-1 is under staff review, therefore, **RAI 432, Question 15.00.02-1 is being tracked as an open item** in Section 15.0.2 of this report.

Ex-Core Instrumentation

The staff reviewed FSAR Tier 1, Section 4.4 with respect to ex-core instrumentation and the applicant's May 20, 2011, response to RAI 441, Questions 04.04-62 through 04.04-65, and determined that the applicant needs to provide a description of the mechanism, such as an ITAAC and/or COL information item to demonstrate that the ex-core instrumentation would still satisfy the design criteria under the as-built conditions. **RAI 441, Questions 04.04-62 through 04.04-65 are being tracked as open items** in Section 4.4 of this report.

Additional Systems and Features

Additional systems and features presented in FSAR Tier 2 that may be considered within the scope of reactor systems under SRP Section 14.3.4, such as the loose parts monitoring system discussed in FSAR Tier 2, Section 4.4.6.6, "Loose Parts Monitoring System," and Section 7.1.1.5.9, "Loose Parts Monitoring System," and additional sections within FSAR Tier 2 Chapters 4 and 5, were evaluated by the staff and determined, as part of this staff review, that ITACC is not required since they do not perform safety-related functions.

Fuel, Control Rod, and Core Design

The following FSAR Tier 2 sections are identified in SRP Section 14.3.4 as being within the scope of reactor systems and were reviewed by the staff in accordance with SRP Section 14.3.4 and other applicable SRP sections. However, the specific fuel, control rod and core designs presented in FSAR Tier 2 will constitute an approved design that may be used for the COL applicant's first cycle core loading, without further NRC review. If any other core design is requested for the first cycle, the COL applicant or licensee will be required to submit for staff review the specific fuel, control rod and core design analyses. Therefore, no ITAAC are required for FSAR Tier 1 information regarding the fuel, control rod, and core design areas because of the requirement for prior NRC approval of any proposed changes to the approved certified design. Post-fuel-load testing programs (e.g., startup and power-ascension testing) verify that the actual core performs in accordance with the analyzed core design.

If a COL applicant or licensee that references the U.S. EPR certified design, elects in the future to deviate from the approved parameters of the FSAR Tier 2, Chapter 4 sections listed below, then prior approval will be required by the NRC for the deviations. Guidance is provided in RG 1.206 and SRP 14.3, with respect to Tier 2* information, in accordance with 10 CFR Part 52, Design Certification Rule Appendix, Paragraphs VIII.B.5a, 6.b, and 6.c.

- FSAR Tier 2, Section 4.2, "Fuel System Design"
- FSAR Tier 2, Section 4.3, "Nuclear Design"
- FSAR Tier 2, Section 4.4, "Thermal-Hydraulic Design"

14.3.4.5 *Combined License Information Items*

Section 14.3.1.5, Table 14.3.1-1 of this report provides a list of all ITAAC related COL information items and descriptions from FSAR Tier 2, Table 1.8-2 that are applicable to FSAR Tier 2, Section 14.3. The staff finds the list in Table 14.3.1-1 to be complete. Also, the list adequately describes actions necessary for the COL applicant. No additional COL information items need to be included in FSAR Tier 2, Table 1.8-2.

14.3.4.6 *Conclusions*

Based on the staff's review conducted in accordance with the acceptance criteria in SRP Section 14.3.4, and the staff's review of the FSAR Tier 1 ITAAC, the staff finds, except for the open items discussed above, the related sections of the FSAR acceptable. In addition and except for the open items discussed above, the staff concludes that the FSAR Tier 1 ITAAC associated with the scope of SRP Section 14.3.4 are necessary and sufficient for reasonable assurance that, if the ITAAC are performed and the acceptance criteria met, then the facility referencing the U.S. EPR certified design can be constructed and operated in accordance with the certified design, the Atomic Energy Act of 1954, and applicable NRC regulations.

14.3.5 Instrumentation and Controls

14.3.5.1 *Introduction*

ITAAC information is contained in FSAR Tier 1. The ITAAC evaluation includes a review of the commitments to be verified by ITAAC inspection. These commitments also define the scope of the U.S. EPR design and are identified in the design description for each system that establishes the scope of ITAAC.

The scope of review for instrumentation and controls (I&C) ITAAC includes I&C systems involving reactor protection and control, engineered safety features (ESF) actuation, and other systems using I&C equipment. The review also addresses information related to the design process of digital computers in I&C systems and selected interface requirements related to I&C issues.

14.3.5.2 *Summary of Application*

FSAR Tier 2, Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria," discusses the selection criteria and methods used to develop the FSAR Tier 1 design descriptions (DD) and the ITAAC. In FSAR Tier 2, Section 14.3, the applicant states that the DD, interface requirements, and site parameters are derived from FSAR Tier 2 information and that FSAR Tier 1 information includes:

- Definitions and general provisions
- Design descriptions
- ITAAC
- Significant interface requirements
- Significant site parameters

There are two material categories in FSAR Tier 1: DD and ITAAC.

- DD address the most safety-significant features of a system. DD is in the form of descriptions, tables, and figures, and is binding for the lifetime of a facility.

- ITAAC will be used to verify the U.S. EPR as-built features. ITAAC material is in tabular format only and expires at initial fuel loading.

The U.S. EPR I&C-related ITAAC are provided in FSAR Tier 1, Section 2.4, "Instrumentation and Control Systems."

14.3.5.3 *Regulatory Basis*

The relevant requirements of NRC regulations for this area of review, and the associated acceptance criteria, are given in NUREG-0800, Sections 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria," and 14.3.5, "Instrumentation and Controls – Inspections, Tests, Analyses, and Acceptance Criteria." Review interfaces with other SRP sections can also be found in SRP Section 14.3.5.

The acceptance criteria are based on the relevant requirements of the following NRC regulations:

- 10 CFR 52.47(b)(1), "Contents of applications; technical information," as it relates to the requirement that a design certification application contain the ITAAC that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification is built and will operate in accordance with the design certification, the provisions of the Atomic Energy Act of 1954, and NRC regulations.

The applicable acceptance criteria used to meet the above relevant requirement of the NRC regulations as described in SRP Section 14.3.5, are summarized below:

1. The methodology for selecting SSCs that will be subject to ITAAC, as well as the criteria for establishing the necessary and sufficient ITAAC should be appropriate for, and consistently applied to, I&C systems.

2. FSAR Tier 1 DD and ITAAC should describe the top-level I&C design features and performance characteristics that are significant to safety. For safety systems, this should include a description of system purpose, safety functions, equipment quality (e.g., meet the functional requirements of IEEE Std 603-1998, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations," and the digital system life cycle design process), equipment qualification, automatic decision-making and trip logic functions, manual initiation functions, and design features (e.g., system architecture) provided to achieve high functional reliability. The functions and characteristics of other I&C systems important to safety should also be discussed to the extent that the functions and characteristics are necessary to support remote shutdown, support required operator actions or assessment of plant conditions and safety system performance, maintain safety systems in a state that assures their availability during an accident, minimize or mitigate control system failures that would interfere with or cause unnecessary challenges to safety systems, or provide diverse back-up to protection systems.

3. SRP Section 14.3, Appendix A, "Information on Prior Design Certification Reviews," provides additional guidance on the content of FSAR Tier 1 DD and ITAAC.

4. ITAAC should identify the I&C system features upon which the staff is relying to assure compliance with NRC requirements and guidance identified in SRP Appendix 7.1-A, "Acceptance Criteria and Guidelines for Instrumentation and Control Systems Important to Safety." Tests, analyses, and acceptance criteria associated with each commitment should, when taken together, be sufficient to provide reasonable assurance that the final as-built I&C system fulfills NRC requirements. SRP Appendix 7.1-C, "Guidance for Evaluation of Conformance to IEEE Std 603," provides an expanded discussion of SRP acceptance criteria for safety system compliance with 10 CFR 50.55a(h). SRP Appendix 7.1-D, "Guidance for Evaluation of the Application of IEEE Std 7-4.3.2," further discusses SRP acceptance criteria for safety and protection systems using digital computer-based technology. SRP Section 14.3, Appendix A, provides additional guidance on the expected scope, content, and format of ITAAC.

5. For U.S. EPR applications, FSAR Tier 1 DD and ITAAC should be based on and consistent with the FSAR Tier 2 material.

10 CFR 50.55a(a)(3) allows an applicant under 10 CFR Part 52, "Licenses, Certifications, And Approvals For Nuclear Power Plants," to propose alternatives to the requirements of 10 CFR 50.55a(h). The applicant proposes to use IEEE Std 603-1998, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations," as an alternative to 10 CFR 50.55a(h), which requires the use of IEEE Std 603-1991. Section 7.1.4.1 of this report discusses the staff's evaluation and approval of this alternative. Therefore, the staff evaluated the application in accordance with the requirements stated in IEEE Std 603-1998.

The specific areas of review are as follows:

1. FSAR Tier 1 information on I&C systems involving reactor protection and control, ESF actuation, and other systems using I&C equipment

2. FSAR Tier 1 information related to design process of digital computers in I&C systems

3. Selected interface requirements related to I&C issues

4. Functional requirements of IEEE Std 603-1998 and General Design Criteria (GDC) when implementing the safety system

14.3.5.4 *Technical Evaluation*

The applicant provided design information, including associated tables and figures, in accordance with the selection methodology for FSAR Tier 1, as described in FSAR Tier 2, Section 14.3 to support the ITAAC for the U.S. EPR SSCs. The applicant organized the FSAR Tier 1 information in the systems, structures, and topical areas format shown in the FSAR Tier 1, "Table of Contents." The staff reviewed the FSAR Tier 1 information provided by the applicant in accordance with SRP Section 14.3.5. For its review, the staff used FSAR Tier 2 markups provided the applicant's June 22, 2011, response to RAI 452, Question 07.03-36. The staff's review focused on individual systems following the format presented by the applicant. To ensure incorporation of all material into FSAR Tier 1, Section 2.4, **RAI 452, Question 07.03-36 is being tracked as a confirmatory item** in Section 7.3 of this report.

Many of the ITAAC acceptance criteria used by the applicant in FSAR Tier 1 sections include language referring to "a report exists and concludes." In comparing the definition of "exists" between FSAR Tier 1, and SRP Section 14.3, Appendix A.IV.2.B, the applicant does not have a complete definition. Specifically, the applicant should include the second sentence in the SRP definition of "exists," which links back to FSAR Tier 2. Therefore, in RAI 506, Question 14.03.05-26, the staff requested that the applicant address the full definition of the term "exists."

In a November 8, 2011, response to RAI 506, Question 14.03.05-26, the applicant responded that FSAR Tier 1, Section 1.2 will be revised to add the following statement: "Detailed supporting information on what should be present to conclude that an item 'exists' and meets the design description is contained in the appropriate sections of Tier 2." The staff has reviewed the RAI response and the relevant FSAR Tier 2 sections, and finds that the applicant has adequately specified the contents and nature of the report to be submitted. The staff finds this response acceptable, and **RAI 506, Question 14.03.05-26 is being tracked as a confirmatory item** to ensure that the FSAR is revised accordingly**.**

In RAI 78, Question 14.03.05-2, the staff requested that the applicant provide additional information on how the ITAAC in FSAR Tier 1, Section 2.4, "Instrumentation and Control Systems," addresses the compliance of U.S. EPR software lifecycle processes with SRP Branch Technical Position (BTP) 7-14, "Guidance on Software Reviews for Digital Computer-Based Instrumentation and Control Systems," for safety-related I&C systems. In a November 3, 2008, response to RAI 78, Question 14.03.05-2, the applicant stated that compliance of U.S. EPR software lifecycle processes with SRP BTP 7-14 is addressed in Topical Report ANP-10272, "Software Program Manual for Teleperm XS Safety Systems," Revision 3, October 31, 2010. Further discussion on the staff's review of Topical Report ANP-10272 is provided in Section 7.1.4.7.2 of this report.

In RAI 78, Question 14.03.05-4, the staff requested that the applicant provide additional detail on how the ITAAC in FSAR Tier 1, Section 2.4 addresses the qualification aspect of safety systems. In a June 12, 2009, response to RAI 78, Question 14.03.05-4, the applicant identified instances in which environmental qualification is verified for IEEE Class 1E equipment exposed to harsh environments, but stated that ITAAC is not required for IEEE Class 1E equipment exposed to mild environments. The staff agrees that qualification required for harsh environments is different than that required for mild environments (see 10 CFR 50.49(c)). However, 10 CFR 50.55a(h) sets forth the qualification requirements for mild environments (see IEEE Std 603-1998, Clause 5.4). Therefore, in follow-up RAI 506, Question 14.03.05-28, the staff requested that the applicant clarify how the ITAAC addresses equipment qualification requirements for mild environments.

In a January 13, 2012, response to RAI 506, Question 14.03.05-28, the applicant stated that FSAR Tier 1 will be revised to add an ITAAC item for environmental qualification of digital I&C Class 1E equipment located in a mild environment to the following systems:

- Protection System (Section 2.4.1, Item 6.1).
- Safety Automation System (Section 2.4.4, Item 6.1).
- Priority and Actuator Control System (Section 2.4.5, Item 6.1).
- Boron Concentration Measurement System (Section 2.4.11, Item 6.1).

- Control Rod Drive Control System (Section 2.4.13, Item 5.1).
- Hydrogen Monitoring System (Section 2.4.14, Item 6.2)
- Excore Instrumentation System (Section 2.4.17, Item 6.2).
- Incore Instrumentation System (Section 2.4.19, Item 5.2).
- Radiation Monitoring System (Section 2.4.22, Item 6.2).
- Signal Conditioning and Distribution System (Section 2.4-25, Item 6.1).
- Rod Positioning Measurement System (Section 2.4.26, Item 6.1).

The applicant provided FSAR markups indicating these changes. The staff finds this response acceptable, and **RAI 506, Question 14.03.05-28 is being tracked as a confirmatory item** to ensure that the FSAR is revised accordingly.

Additional discussion and evaluation of ITAAC information is provided in Chapter 7 of this report, as cited in several parts of Section 14.3.5. Staff evaluations of ITAAC related to physical separation between redundant portions of safety systems and ITAAC related to physical separation between safety-related systems and non-safety-related systems are discussed in Sections 7.1.4.10.1.1 and 7.1.4.10.4.2 of this report, respectively.

14.3.5.4.1 Protection System

The applicant provided DD and ITAAC verifying design features for the protection system (PS) in FSAR Tier 1, Section 2.4.1, "Protection System." In this section, the applicant provided design information, including associated tables, in the manner described in FSAR Tier 2, Section 14.3 to identify necessary and sufficient ITAAC for the U.S. EPR protection system. The staff reviewed the DD and ITAAC to ensure compliance with 10 CFR 52.47(b)(1).

FSAR Tier 1, Section 2.4.1, includes a system description which provides the PS safety-related functions. FSAR Tier 1, Table 2.4.1-1, "Protection System Equipment," lists the location of the PS cabinets, seismic category, and IEEE Class 1E divisional power source.

The PS provides the following safety-related functions:

- Performs automatic initiation of reactor trip (RT) functions
- Performs automatic initiation of ESF functions
- Provides for initiation of RT manual functions
- Provides for actuation of ESF manual functions
- Generates permissive signals that authorize the activation or deactivation of certain protective actions according to current plant conditions
- Generates permissive signals that maintain safety-related interlocks

The following tables are provided in FSAR Tier 1:

- Table 2.4.1-1, “Protection System Equipment”
- Table 2.4.1-2, “Protection System Automatic Reactor Trip Signals and Input Variables”
- Table 2.4.1-3, “Protection System Automatic Engineered Safety Features and Input Variables”
- Table 2.4.1-4, “Protection System Manually Actuated Functions”
- Table 2.4.1-5, “Protection System Permissives and Operating Bypasses”
- Table 2.4.1-6, “Protection System Interlocks”
- Table 2.4.1-7, “Protection System ITAAC”

In FSAR Tier 2, Section 14.3, the applicant described the selection criteria and methods used to develop the DD and ITAAC. The staff reviewed the PS DD to ensure the selection criteria and methods are correctly and consistently applied as set forth. The staff finds that the methodology for selecting SSCs subject to ITAAC is appropriate for and properly applied to the PS. In addition, the staff finds that the applicant provided an acceptable level of information in the system DD by detailing the purpose, safety-related functions, equipment quality, qualification, and design features of the PS.

The staff reviewed FSAR Tier 1, Table 2.4.1-7 to ensure sufficient ITAAC were provided for the PS. The staff finds that the applicant included ITAAC entries for all given safety-related functions and design features.

FSAR Tier 1, Section 2.4.1, states that the PS provides for the manual initiation of ESF functions, listed in FSAR Tier 1, Table 2.4.1-4. FSAR Tier 1, Table 2.4.1-7, Item 4.11 provides the applicant’s commitment for verifying system-level manual activation of ESF functions in the main control room (MCR). ITAAC Item 4.15 addresses manual reactor trip from the remote shutdown station (RSS). The staff finds that no ITAAC was identified to verify system-level manual actuation of ESF functions from the RSS. Therefore, in RAI 506, Question 14.03.05-38, the staff requested that the applicant address the necessary ITAAC to verify system-level manual actuation of ESF functions from the RSS.

In a November 8, 2011, response to RAI 506, Question 14.03.05-38, the applicant stated that the inventory of safety information and control system (SICS) controls in the RSS identified in FSAR Tier 2, Section 7.4.1.1 will be added to FSAR Tier 1, Section 2.4.2. The applicant provided FSAR markups indicating these changes. The staff finds this response acceptable, and **RAI 506, Question 14.03.05-38 is being tracked as a confirmatory item** to ensure that the FSAR is revised accordingly.

Acceptance criteria for ITAAC Item 4.11 do not present the level of detail similar to that of ITAAC Item 4.2, which addresses Clause 5.2 (Completion of Protective Action) for automatic actuations. It is unclear to the staff that ITAAC Item 4.11 verifies that the manual system-level actuation takes all functions to full completion of protective function, exactly as the automatic actuation would, while requiring operator action to reset the sequence. Therefore, in RAI 506, Question 14.03.05-42, the staff requested that the applicant address the necessary ITAAC to verify the design functionality of safety-related, component-level controls and indications for the MCR and RSS.

In a November 8, 2011, response to RAI 506, Question 14.03.05-42, the applicant stated that FSAR Tier 1, Section 2.4.1, Item 4.11 will be clarified to reflect the level of detail seen in ITAAC for MCR controls and Tier 1 ITAAC Item 4.2 will be clarified with regards to the removal of the ESF signal by the ESF reset, and not the test signal. The inventory of SICS controls, including ESF reset functionality, will be added to FSAR Tier 1, Section 2.4.2, as discussed in the response to RAI 506, Question 14.03.05-38. The applicant provided FSAR markups indicating these changes. The staff finds this response acceptable, and **RAI 506, Question 14.03.05-42 is being tracked as a confirmatory item** to ensure that the FSAR is revised accordingly**.**

The staff identified the following ITAAC items to verify adequate communication independence exists between PS and non-Class 1E equipment:

- FSAR Tier 1, Table 2.4.1-7, Item 4.4 to verify communication independence is provided between the four PS divisions.

- FSAR Tier 1, Table 2.4.1-7, Item 4.9 to verify that the PS uses TXS system communication messages that are sent with a specific protocol.

- FSAR Tier 1, Table 2.4.1-7, Item 4.17 to verify that communication independence is provided between PS equipment and non-Class 1E equipment.

The staff reviewed the ITAAC provided in FSAR Tier 1 and finds that additional information is required to verify that communication independence exists between redundant portions of safety systems. Specifically, the staff finds that the acceptance criteria for the ITAAC in FSAR Tier 1, Table 2.4.1-7 is insufficient in the following ways:

- There is one acceptance criterion to verify that sufficient communication independence exists between the PS and non-Class 1E equipment, which is the criterion that the PS uses a hardware device to confirm that unidirectional signals are sent to non-safety-related I&C systems. The staff finds that this acceptance criterion is inadequate to verify that independence is enforced through a Class 1E device as required by IEEE Std 603-1998, Clause 5.6.3. The staff requests the applicant to demonstrate that the acceptance criterion verifies that independence between the PS/safety automation system (SAS) and non-Class 1E equipment is enforced through a Class 1E device.

- Does not verify that the MSI precludes messages that are not predefined as acceptable from propagating to safety systems. The staff finds that this feature is key to ensuring a failure within one division will not allow non-predefined messages from propagating to other safety divisions, which may result in loss or degradation of the safety function and that when the service unit (SU) is connected to a safety system, a failure within the SU will not allow non-predefined messages from affecting the performance of safety functions. As such, the staff requests the applicant to demonstrate how this feature is verified in the safety system.

In RAI 506, Question 14.03.05-25, the staff requested that the applicant clarify the issues listed above.

In a November 8, 2011, response to RAI 506 Question 14.03.05-25, the applicant stated that FSAR Tier 1 will be revised in the following ways: FSAR Tier 1, Table 2.4.1-7, Item 4.17 and FSAR Tier 1, Table 2.4.4-6, Item 4.9 will be revised to demonstrate that the device enforcing unidirectional communication is Class 1E. FSAR Tier 1 Sections 2.4.1 and 2.4.4 will be revised

to verify that only predefined messages are allowed during data communications by adding FSAR Tier 1, Table 2.4.1-7, Item 4.27 and FSAR Tier 1, Table 2.4.4-6, Item 4.19. The applicant provided FSAR markups indicating these changes. The staff finds this response acceptable, and **RAI 506, Question 14.03.05-25 is being tracked as a confirmatory item** to ensure that the FSAR is revised accordingly**.**

Additional evaluations of the ITAAC associated with the PS are provided in Sections 7.1 through 7.6 and 7.9 of this report. Section 7.9.4.6.1 includes a discussion of independence of data communication between PS equipment divisions and Section 7.1.4.10.1.2 includes a discussion of electrical isolation of redundant portions of safety systems.

14.3.5.4.2 Safety Information and Control System

The applicant provided DD and ITAAC verifying design features for the SICS in FSAR Tier 1, Section 2.4.2, "Safety Information and Control System." In this section, the applicant provided design information, including associated tables, in the manner described in FSAR Tier 2, Section 14.3 to identify necessary and sufficient ITAAC for the SICS. The staff reviewed the DD and ITAAC to ensure compliance with 10 CFR 52.47(b)(1).

FSAR Tier 1, Section 2.4.2 includes a system description which provides the SICS safety-related functions. FSAR Tier 1, Table 2.4.2-1, "Safety Information and Control System Equipment," lists the location, seismic category, and power source of the hardwired I&C system.

The SICS is provided as a safety-related human-machine interface (HMI) and is specifically designed to provide the operator with the necessary inventory of controls and indications for the following:

- Mitigation of anticipated operational occurrences in the MCR
- Mitigation of postulated accidents in MCR
- Reach and maintain safe-shutdown in MCR and RSS
- Mitigation of anticipated operational occurrences concurrent with a common cause failure (CCF) of the PS in MCR
- Mitigation of postulated accidents concurrent with a CCF of the PS in MCR
- Mitigation of severe accidents in MCR

The following FSAR Tier 1 tables are provided:

- Table 2.4.2-1, "Safety Information and Control System Equipment"
- Table 2.4.2-2, "Safety Information and Control System ITAAC"

In FSAR Tier 2, Section 14.3, the applicant described the selection criteria and methods used to develop the DD and ITAAC. The staff reviewed the SICS DD to ensure the selection criteria and methods are correctly and consistently applied as set forth. The staff finds that the methodology for selecting SSCs subject to ITAAC is appropriate for and properly applied to the

SICS. The staff finds the applicant has provided information in the system DD by detailing the purpose, qualification, power sources, and design features of the SICS.

The staff reviewed FSAR Tier 1, Table 2.4.2-2 to ensure sufficient ITAAC were provided for the SICS. The staff finds that the applicant included ITAAC entries for all listed design features, but it is unclear to the staff which ITAAC verify the safety-related functions of the SICS. The applicant failed to provide a specific ITAAC item in Table 2.4.2-2 to verify the safety-related functions of the SICS. FSAR Tier 1, Table 2.4.2-2, Item 4.10 states, "The SICS is designed so that safety-related functions...," but these functions are not detailed in the FSAR Tier 1 information for this system. Therefore, in RAI 506, Question 14.03.05-27, the staff requested that the applicant provide identification of the safety functions of SICS and how the ITAAC verify them. **RAI 506, Question 14.03.05-27 is being tracked as an open item**.

The staff determined that FSAR Tier 1, Table 2.4.2-2, Item 4.2 was inadequate since the acceptance criterion to verify the commitment does not describe what is considered acceptable electrical isolation. Therefore, in RAI 506, Question 14.03.05-36, the staff requested that the applicant clarify how the acceptance criterion in FSAR Tier 1, Table 2.4.2-2, Item 4.3 will verify that electrical isolation exists (e.g., qualified Class 1E isolation device) between the Class 1E divisions that power the controls and indications of the SICS to meet the requirements of 10 CFR 52.47(b)(1).

In a November 8, 2011, response to RAI 506, Question 14.03.05-36, the applicant stated that the FSAR Tier 1, Table 2.4.2-2, Item 4.2 will be revised to clarify that electrical isolation exists (by means of a qualified Class 1E isolation device) between the Class 1E divisions that power the controls and indications of the SICS. The staff finds this acceptable, and **RAI 506, Question 14.03.05-36 will be tracked as a confirmatory item** to ensure that the FSAR is revised accordingly**.**

The staff could not identify an ITAAC to verify features that support control of access to cabinets for the SICS in FSAR Tier 1, Section 2.4. Therefore, in RAI 506, Question 14.03.05-37, the staff requested that the applicant provide an ITAAC to verify this design requirement.

In a November 8, 2011, response to RAI 506, Question 14.03.05-37, the applicant stated that FSAR, Tier 1, Sections 2.4.2, 2.4.11, 2.4.17, 2.4.19, 2.4.22, 2.4.25, and 2.4.26, will each be revised to include an ITAAC item that verifies features that support control of access to cabinets of the SICS, boron concentration measurement system (BCMS), excore instrumentation system (EIS), incore instrumentation system (ICIS), radiation monitoring system (RMS), conditioning and distribution system (SCDS) and rod position measurement system (RPMS). The staff finds this response acceptable, and **RAI 506, Question 14.03.05-37 will be tracked as a confirmatory item** to ensure that the FSAR is revised accordingly**.**

Additional evaluations of the ITAAC associated with the SICS are provided in Sections 7.1, 7.4 through 7.6, and 7.8 of this report.

14.3.5.4.3 Safety Automation System

The applicant provided DD and ITAAC verifying design features for the SAS in FSAR Tier 1, Section 2.4.4, "Safety Automation System." In this section, the applicant provided design information, including associated tables, in the manner described in FSAR Tier 2, Section 14.3 to identify necessary and sufficient ITAAC for the U.S. EPR SAS. The staff reviewed the DD and ITAAC to ensure compliance with 10 CFR 52.47(b)(1).

FSAR Tier 1, Section 2.4.4, includes a system description which provides the SAS safety-related functions. FSAR Tier 1, Table 2.4.4-1, "Safety Automation System Equipment" identifies the SAS cabinets by location, seismic category, IEEE class, and IEEE Class 1E divisional power source.

The SAS provides the following safety-related functions:

- Provides control and monitoring of systems required to transfer the plant to cold shutdown and maintain it in this state following an anticipated operational occurrence (AOO) or postulated accident (PA)
- Provides control and monitoring of safety-related functions of auxiliary support systems
- Provides acquisition and processing of Type A, B, and C post-accident monitoring variables for display to the operators in the MCR and RSS
- Provides a safety interlock function

The following FSAR Tier 1 tables are provided:

- Table 2.4.4-1, "Safety Automation System Equipment"
- Table 2.4.4-2, "Safety Automation System Input Signals"
- Table 2.4.4-3, "Safety Automation System Output Signals"
- Table 2.4.4-4, "Safety Automation System Interlocks"
- Table 2.4.4-5, "Safety Automation System Automatic Functions"
- Table 2.4.4-6, "Safety Automation System ITAAC"

In FSAR Tier 2, Section 14.3, the applicant described the selection criteria and methods used to develop the DD and ITAAC. The staff reviewed the SAS DD to ensure the selection criteria and methods are correctly and consistently applied as set forth. The staff finds that the methodology for selecting SSCs subject to ITAAC is appropriate for and properly applied to the SAS. The staff finds that the applicant provided DD detailing the purpose, safety-related functions, equipment quality, qualification, and design features of the SAS. However, this design description does not include details concerning self-test functionality for SAS similar to that of the PS stated in FSAR Tier 1, Section 2.4.1, Item 4.26. Also, there is no ITAAC item for testing SAS self-testing functionality shown on the Revision 3-Interim markups for FSAR Tier 1, Table 2.4.4-6. Technical Report ANP-10315P, "U.S. EPR Protective System Surveillance Testing and TELEPERM XS Self-Monitoring Technical Report," Revision 1, June 13, 2011, states that the TXS inherent and engineered monitoring features, also collectively referred to as "self-testing features," applies to both the PS and SAS. In addition, IEEE Std 603-1998, Clause 5.7, "Capability for Test and Calibration," applies to SAS as well, requiring a verification of design functionality of SAS self-testing features. Therefore, in RAI 506, Question 14.03.05-41, the staff requested that the applicant address this issue. **RAI 506, Question 14.03.05-41 is being tracked as an open item**.

The staff reviewed FSAR Tier 1, Table 2.4.4-6 to ensure sufficient ITAAC were provided for the SAS. The staff noted that the applicant included ITAAC entries for all listed design features.

The staff uses the following ITAAC items to verify adequate communication independence exists between Class 1E and non-Class 1E equipment:

- FSAR Tier 1, Table 2.4.4-6, Item 4.8 to verify communications independence is provided between the four SAS divisions.

- FSAR Tier 1, Table 2.4.4-6, Item 4.9 to verify that communications independence is provided between SAS equipment and non-Class 1E equipment. The staff reviewed the ITAAC provided in the FSAR Tier 1 markups and find that additional information is required to verify that communications independence exists between redundant portions of safety systems. Specifically, the staff finds that the acceptance criteria for the ITAAC in FSAR Tier 1, Table 2.4.4-6 is insufficient in the following ways:

    - There is one acceptance criterion to verify that sufficient communication independence exists between the SAS and non-Class 1E equipment, which is the criterion that the SAS uses a hardware device to confirm that unidirectional signals are sent to non-safety-related I&C systems. The staff determined this acceptance criterion inadequate to verify that independence is enforced through a Class 1E device as required by IEEE Std 603-1998, Clause 5.6.3. The staff requested that the applicant demonstrate that the acceptance criterion verifies that independence between the PS/SAS and non-Class 1E equipment is enforced through a Class 1E device.

    - Does not verify that the monitoring and service interface (MSI) precludes messages that are not pre-defined as acceptable from propagating to safety systems. The staff determined this feature is key to ensuring a failure within one division will not allow non-pre-defined messages to propagate to other safety divisions, which may result in loss or degradation of the safety function and that when the SU is connected to a safety system, a failure within the SU will not allow non-predefined messages to affect the performance of safety functions. As such, the staff requested that the applicant demonstrate how this feature is verified in the as-built safety system.

In RAI 506, Question 14.03.05-25, the staff requested that the applicant clarify the issues listed above. In a November 8, 2011, response to RAI 506 Question 14.03.05-25, the applicant stated that FSAR Tier 1 will be revised in the following ways: FSAR Tier 1, Table 2.4.1-7, Item 4.17 and FSAR Tier 1, Table 2.4.4-6, Item 4.9 will be revised to demonstrate that the device enforcing unidirectional communication is Class 1E. FSAR Tier 1 Sections 2.4.1 and 2.4.4 will be revised to verify that only predefined messages are allowed during data communications by adding FSAR Tier 1, Table 2.4.1-7, Item 4.27 and FSAR Tier 1, Table 2.4.4-6, Item 4.19. The applicant provided FSAR markups indicating these changes. The staff finds this response acceptable, and **RAI 506, Question 14.03.05-25 is being tracked as a confirmatory item** to ensure that the FSAR is revised accordingly.

Additional evaluations of the ITAAC associated with the SAS are provided in Sections 7.1, 7.3 through 7.6, and 7.9 of this report. Section 7.9.4.6.1 includes a discussion of independence of data communication between SAS equipment divisions and Section 7.1.4.10.1.2 includes a discussion of electrical isolation of redundant portions of safety systems.

14.3.5.4.4 Priority and Actuator Control System

The applicant provided DD and ITAAC verifying design features for the priority and actuator control system (PACS) in FSAR Tier 1, Section 2.4.5, "Priority and Actuator Control System." In this section, the applicant provided design information, including associated tables, in the manner described in FSAR Tier 2, Section 14.3 to identify necessary and sufficient ITAAC for the U.S. EPR PACS. The staff reviewed the DD and ITAAC to ensure compliance with 10 CFR 52.47(b)(1).

FSAR Tier 1, Section 2.4.5 includes a system description which provides the PACS safety-related functions. FSAR Tier 1, Table 2.4.5-1, "Priority and Actuator Control System Equipment" lists the location of the PACS cabinets, seismic category, IEEE class, and the division which powers the components.

The PACS provides the following safety-related functions:

- Prioritizes actuation requests from I&C systems
- Performs essential equipment protection
- Performs drive actuation
- Performs drive monitoring

The following FSAR Tier 1 tables are provided:

- Table 2.4.5-1, "Priority and Actuator Control System Equipment"
- Table 2.4.5-2, "Containment Isolation Valves"
- Table 2.4.5-3, "Priority and Actuator Control System ITAAC"

In FSAR Tier 2, Section 14.3, the applicant described the selection criteria and methods used to develop the DD and ITAAC. The staff reviewed the PACS DD to ensure the selection criteria and methods are correctly and consistently applied as set forth. The staff finds the methodology for selecting SSCs subject to ITAAC appropriate for and properly applied to the PACS. The staff finds the applicant provided an acceptable level of information in the system DD by detailing the purpose, safety-related functions, equipment quality, qualification, and design features of the PACS.

The staff reviewed FSAR Tier 1, Table 2.4.5-3 to ensure sufficient ITAAC were provided for the PACS. The staff finds that the applicant included ITAAC entries for all listed design features, but it is unclear to the staff which ITAAC verify the given safety-related functions. Specifically, PACS provides drive actuation/monitoring and essential equipment protection, but the staff did not identify ITAAC to verify these functions. The staff recognizes that each PACS is tied to specific mechanical equipment. If these functions are tested with mechanical equipment, then the staff seeks a commitment that ensures the respective PACS equipment is tested with the mechanical equipment. Therefore, in RAI 506, Question 14.03.05-30, the staff requested that the applicant clarify how the ITAAC verify the PACS safety-related functions. **RAI 506, Question 14.03.05-30 is being tracked as an open item**.

Additional evaluations of the ITAAC associated with the PACS are provided in Sections 7.1, 7.5, 7.6, 7.8, and 7.9 of this report.

14.3.5.4.5 Plant Fire Alarm System

The applicant provided DD and ITAAC verifying design features for the plant fire alarm system (PFAS) in FSAR Tier 1, Section 2.4.6, "Plant Fire Alarm System." In this section, the applicant provided design information, including associated tables, in the manner described in FSAR Tier 2, Section 14.3 to identify necessary and sufficient ITAAC for the U.S. EPR PFAS. The staff reviewed the DD and ITAAC to ensure compliance with 10 CFR 52.47(b)(1).

FSAR Tier 1, Section 2.4.6, includes a system description which provides the PFAS non-safety-related functions. The PFAS provides the following non-safety-related functions:

- Provides a fire alarm management interface to the operators
- Controls and monitors plant fire suppression and detection systems
- Provides the MCR operators with information displays and supports automatic and manual control of fire protection equipment

The following FSAR Tier 1 tables are provided:

- Table 2.4.6-1, "Plant Fire Alarm System Display and Alarms – Main Control Room and Remote Shutdown Station"
- Table 2.4.6-2, "Plant Fire Alarm System ITAAC"

In FSAR Tier 2, Section 14.3, the applicant described the selection criteria and methods used to develop the DD and ITAAC. The staff reviewed the PFAS DD to ensure the selection criteria and methods are correctly and consistently applied as set forth. The staff finds the methodology for selecting SSCs subject to ITAAC appropriate for and properly applied to the PFAS. The staff finds the applicant provided an acceptable level of information in the system DD by detailing the purpose, functions, and design features of the PFAS.

The staff reviewed FSAR Tier 1, Table 2.4.6-2 to ensure sufficient ITAAC were provided for the PFAS. The staff found that the applicant included ITAAC entries for all listed DD.

Additional evaluations of the ITAAC associated with the PFAS are provided in Section 9.5.1 of this report.

14.3.5.4.6 Seismic Monitoring System

The applicant provided DD and ITAAC verifying design features for the seismic monitoring system (SMS) in FSAR Tier 1, Section 2.4.7, "Seismic Monitoring System." In this section, the applicant provided design information, including an associated table, in the manner described in FSAR Tier 2, Section 14.3 to identify necessary and sufficient ITAAC for the U.S. EPR SMS. The staff reviewed the DD and ITAAC to ensure compliance with 10 CFR 52.47(b)(1).

FSAR Tier 1, Section 2.4.7, includes a system description which provides the SMS functions.

The following FSAR Tier 1 table is provided:

- Table 2.4.7-1, "Seismic Monitoring System ITAAC"

In FSAR Tier 2, Section 14.3, the applicant described the selection criteria and methods used to develop the DD and ITAAC. The staff reviewed the SMS DD to ensure the selection criteria and methods are correctly and consistently applied as set forth. The staff finds that the methodology for selecting SSCs subject to ITAAC is appropriate for and properly applied to the SMS. The staff finds the applicant provided an acceptable level of information in the system DD by detailing the purpose and design features of the SMS.

The staff reviewed FSAR Tier 1, Table 2.4.7-1 to ensure sufficient ITAAC were provided for SMS. The staff finds the applicant included ITAAC entries for all listed DD.

14.3.5.4.7 Leakage Detection System

The applicant provided DD and ITAAC verifying design features for the leakage detection system (LDS) in FSAR Tier 1, Section 2.4.8, "Leakage Detection System." In this section, the applicant provided design information, including an associated table, in the manner described in FSAR Tier 2, Section 14.3 to identify necessary and sufficient ITAAC for the U.S. EPR LDS. The staff reviewed the DD and ITAAC to ensure compliance with 10 CFR 52.47(b)(1).

FSAR Tier 1, Section 2.4.8 includes a system description which provides the LDS function.

The following FSAR Tier 1 table is provided:

- Table 2.4.8-1, "Leakage Detection System ITAAC"

In FSAR Tier 2, Section 14.3, the applicant described the selection criteria and methods used to develop the DD and ITAAC. The staff reviewed the LDS DD to ensure the selection criteria and methods are correctly and consistently applied as set forth. The staff finds that the methodology for selecting SSCs subject to ITAAC is appropriate for and properly applied to the LDS. The staff finds the applicant provided an acceptable level of information in the system DD by detailing the purpose and function of the LDS.

The staff reviewed FSAR Tier 1, Table 2.4.8-1 to ensure sufficient ITAAC were provided for the LDS. The staff finds the applicant included an ITAAC entry for the listed design description.

14.3.5.4.8 Process Automation System

In FSAR Tier 1, Section 2.4.9, "Process Automation System," there is no FSAR Tier 1 information specified for the process automation system (PAS). The staff finds this acceptable, because the PAS is not a safety-related system, is not relied upon in the safety analyses, and is not capable of adversely affecting other safety-related systems.

14.3.5.4.9 Process Information and Control System

The applicant provided DD and ITAAC verifying design features for the process information and control system (PICS) in FSAR Tier 1, Section 2.4.10, "Process Information and Control System." In this section, the applicant provided design information, including an associated table, in the manner described in FSAR Tier 2, Section 14.3, to identify necessary and sufficient

ITAAC for the U.S. EPR PICS. The staff reviewed the DD and ITAAC to ensure compliance with 10 CFR 52.47(b)(1).

FSAR Tier 1, Section 2.4.10, includes a system description which provides the PICS non-safety-related functions.

The following FSAR Tier 1 table is provided:

- Table 2.4.10-1, "Process Information and Control System ITAAC"

In FSAR Tier 2, Section 14.3, the applicant described the selection criteria and methods used to develop the DD and ITAAC. The staff reviewed the PICS DD to ensure the selection criteria and methods are correctly and consistently applied as set forth. The staff finds the methodology for selecting SSCs subject to ITAAC appropriate for and properly applied to the PICS. The staff finds the applicant provided an acceptable level of information in the system DD by detailing the purpose, functions, and isolation of the PICS.

The staff reviewed FSAR Tier 1, Table 2.4.10-1 to ensure sufficient ITAAC were provided for the PICS. The staff finds that the applicant included an ITAAC entry for the listed design description.

Additional evaluations of the ITAAC associated with the PICS are provided in Sections 7.6 and 7.7 of this report.

14.3.5.4.10 Boron Concentration Measurement System

The applicant provided DD and ITAAC verifying design features for the boron concentration measurement system (BCMS) in FSAR Tier 1, Section 2.4.11, "Boron Concentration Measurement System." In this section, the applicant provided design information, including associated tables, in the manner described in FSAR Tier 2, Section 14.3 to identify necessary and sufficient ITAAC for the BCMS. The staff reviewed the DD and ITAAC to ensure compliance with 10 CFR 52.47(b)(1).

FSAR Tier 1, Section 2.4.11 includes a system description which provides the BCMS safety-related function. FSAR Tier 1, Table 2.4.11-1, "Boron Concentration Measurement System Equipment," lists the location of the BCMS equipment, the seismic category, IEEE class, and the division which powers the components.

The BCMS provides the following safety-related function:

- Sends boron concentration measurement signals to the signal conditioning and distribution system (SCDS)

The following FSAR Tier 1 tables are provided:

- Table 2.4.11-1, "Boron Concentration Measurement System Equipment"
- Table 2.4.11-2, "Boron Concentration Measurement System Output Signals"
- Table 2.4.11-3, "Boron Concentration Measurement System ITAAC"

In FSAR Tier 2, Section 14.3, the applicant described the selection criteria and methods used to develop the DD and ITAAC. The staff reviewed the BCMS DD to ensure the selection criteria and methods are correctly and consistently applied as set forth. The staff finds the methodology for selecting SSCs subject to ITAAC appropriate for and properly applied to the BCMS. The staff finds the applicant provided an acceptable level of information in the system DD by detailing the purpose, functions, equipment quality, qualification, and design features of the BCMS.

The staff reviewed FSAR Tier 1, Table 2.4.11-3 to ensure sufficient ITAAC were provided for the BCMS. The staff finds that the applicant included ITAAC entries for all listed DD. However, the staff could not identify an ITAAC to verify single failure protection for the BCMS in FSAR Tier 1, Section 2.4. Therefore, in RAI 506, Question 14.03.05-39, the staff requested that the applicant provide an ITAAC to verify this design requirement. **RAI 506, Question 14.03.05-39 is being tracked as an open item**.

The staff could not identify an ITAAC to verify features that support control of access to cabinets for the SCDS in FSAR Tier 1, Section 2.4. Therefore, in RAI 506, Question 14.03.05-37, the staff requested that the applicant provide an ITAAC to verify this design requirement.

In a November 8, 2011, response to RAI 506, Question 14.03.05-37, the applicant stated that FSAR, Tier 1, Sections 2.4.2, 2.4.11, 2.4.17, 2.4.19, 2.4.22, 2.4.25, and 2.4.26, will each be revised to include an ITAAC item that verifies features that support control of access to cabinets of the SICS, BCMS, EIS, ICIS, RMS, SCDS and RPMS. The staff finds this acceptable and **RAI 506, Question 14.03.05-37 is being tracked as a confirmatory item** to ensure that the FSAR is revised accordingly.

Additional evaluations of the ITAAC associated with the BCMS are provided in Section 7.1 of this report.

14.3.5.4.11 Vibration Monitoring System

In FSAR Tier 1, Section 2.4.12, "Vibration Monitoring System," there is no FSAR Tier 1 information specified for the vibration monitoring system (VMS). The staff finds this acceptable, since the VMS is not a safety-related system and is not capable of adversely affecting other safety-related systems.

14.3.5.4.12 Control Rod Drive Control System

The applicant provided DD and ITAAC verifying design features for the control rod drive control system (CRDCS) in FSAR Tier 1, Section 2.4.13, "Control Rod Drive Control System." In this section, the applicant provided design information, including associated tables, in the manner described in FSAR Tier 2, Section 14.3 to identify necessary and sufficient ITAAC for the CRDCS. The staff reviewed the DD and ITAAC to ensure compliance with 10 CFR 52.47(b)(1).

FSAR Tier 1, Section 2.4.13, includes a system description which provides the CRDCS both safety and non-safety-related functions. FSAR Tier 1, Table 2.4.13-1, "Control Rod Drive Control System Equipment," lists the location, seismic category, and IEEE class of the reactor trip contactors.

The CRDCS has the following safety-related functions:

- Interrupts power to the CRDMs via the reactor trip contactors
- Provides signals that report the status of the reactor trip contactor modules to the SCDS

The CRDCS provides the following non-safety-related function:

- Actuates the rod control cluster assemblies through the CRDMs

The following FSAR Tier 1 tables are provided:

- Table 2.4.13-1, "Control Rod Drive Control System Equipment"
- Table 2.4.13-2, "Control Rod Drive Control System Input Signals"
- Table 2.4.13-3, "Control Rod Drive Control System ITAAC"

In FSAR Tier 2, Section 14.3, the applicant described the selection criteria and methods used to develop the DD and ITAAC. The staff reviewed the CRDCS DD to ensure the selection criteria and methods are correctly and consistently applied as set forth. The staff finds the methodology for selecting SSCs subject to ITAAC appropriate for and properly applied to the CRDCS. The staff finds the applicant provided an acceptable level of information in the system DD by detailing the purpose, functions, and design features of the CRDCS.

The staff reviewed FSAR Tier 1, Table 2.4.13-3 to ensure sufficient ITAAC were provided for the CRDCS. The staff finds that the applicant included ITAAC entries for all given design features, but it is unclear to the staff which ITAAC verify the safety function to provide signals that report the status of the reactor trip contactor modules to the SCDS. Therefore, in RAI 506, Question 14.03.05-31, the staff requested that the applicant clarify how the ITAAC verify the given safety-related functions.

In a November 8, 2011, response to RAI 506, Question 14.03.05-31, the applicant stated that the CRDCS safety-related function "Interrupts power to the CRDMs via the reactor trip contactors" is addressed by FSAR Tier 1, Section 2.4.13, Item 4.3, and CRDCS safety-related function "Provides signals that report the status of the reactor trip contactors to the Signal Conditioning and Distribution System (SCDS)" will be addressed by adding a new Item 4.5 and new Table 2.4.13-3 to FSAR Tier 1, Section 2.4.13 to provide output signals to the SCDS. FSAR Tier 1, Section 2.4.25 will be revised to add the CRDCS output signals. The applicant provided FSAR markups indicating these changes. The staff finds this response acceptable, and **RAI 506, Question 14.03.05-31 is being tracked as a confirmatory item** to ensure that the FSAR is revised accordingly.

Additional evaluations of the ITAAC associated with the CRDCS are provided in Section 7.7 of this report.

14.3.5.4.13 Hydrogen Monitoring System

The applicant provided DD and ITAAC verifying design features for the hydrogen monitoring system (HMS) in FSAR Tier 1, Section 2.4.14, "Hydrogen Monitoring System." In this section, the applicant provided design information, including associated tables, in the manner described

in FSAR Tier 2, Section 14.3 to identify necessary and sufficient ITAAC for the HMS. The staff reviewed the DD and ITAAC to ensure compliance with 10 CFR 52.47(b)(1).

FSAR Tier 1, Section 2.4.14 includes a system description which provides the HMS safety-related function. FSAR Tier 1, Table 2.4.14-1, "Hydrogen Monitoring System Equipment," lists the location of the HMS equipment, seismic category, IEEE class, environmental qualification, and the division which powers the components.

The HMS has the following safety-related function:

- Measures the hydrogen concentration in containment

The following FSAR Tier 1 tables are provided:

- Table 2.4.14-1, "Hydrogen Monitoring System Equipment"
- Table 2.4.14-2, "Hydrogen Monitoring System ITAAC"

In FSAR Tier 2, Section 14.3, the applicant described the selection criteria and methods used to develop the DD and ITAAC. The staff reviewed the HMS DD to ensure the selection criteria and methods are correctly and consistently applied as set forth. The staff finds the methodology for selecting SSCs subject to ITAAC appropriate for and properly applied to the HMS. The staff finds the applicant provided an acceptable level of information in the system DD by detailing the purpose, functions, equipment quality, qualification, and design features of the HMS.

The staff reviewed FSAR Tier 1, Table 2.4.14-2 to ensure sufficient ITAAC were provided for the HMS. The staff finds that the applicant included ITAAC entries for all listed design features, but it is unclear to the staff which ITAAC verify the given safety-related function. Therefore, in RAI 506, Question 14.03.05-33, the staff requested that the applicant clarify how the ITAAC verify that the HMS will perform its safety function.

In a November 8, 2011, response to RAI 506, Question 14.03.05-33, the applicant stated that the HMS safety-related function in FSAR Tier 1, Section 2.4.14 will be revised to add Table 2.4.14-2 to identify the correct output signals to be provided to the SCDS and add Item 4.2 to Table 2.4.14-3 to verify that the HMS provides these signals to the SCDS. The applicant provided FSAR markups indicating these changes. The staff finds this response acceptable, and **RAI 506, Question 14.03.05-33 is being tracked as a confirmatory item** to ensure that the FSAR will be revised accordingly.

The staff could not identify an ITAAC to verify single failure protection for the HMS in FSAR Tier 1, Section 2.4. Therefore, in RAI 506, Question 14.03.05-39, the staff requested that the applicant provide an ITAAC to verify this design requirement. **RAI 506, Question 14.03.05-39 is being tracked as an open item.**

Additional evaluations of the ITAAC associated with the HMS are provided in Section 7.1 of this report.

14.3.5.4.14 Reactor Control, Surveillance, and Limitation System

In FSAR Tier 1, Section 2.4.15, "Reactor Control, Surveillance, and Limitation System," there are no FSAR Tier 1 entries specified for the reactor control, surveillance, and limitation system.

The staff finds this acceptable, because the system is not safety-related system, is not relied upon in the safety analyses, and is not capable of adversely affecting other safety-related systems.

14.3.5.4.15 Reactor Pressure Vessel Level Measurement

In FSAR Tier 1, Section 2.4.16, "Reactor Pressure Vessel Level Measurement System," there is no FSAR Tier 1 information specified for the reactor pressure vessel level measurement system. The staff finds this acceptable, because the system is not a safety-related system, is not relied upon in the safety analyses, and is not capable of adversely affecting other safety-related systems.

14.3.5.4.16 Excore Instrumentation System

The applicant provided DD and ITAAC verifying design features for the excore instrumentation system (EIS) in FSAR Tier 1, Section 2.4.17, "Excore Instrumentation System." In this section, the applicant provided design information, including associated tables, in the manner described in FSAR Tier 2, Section 14.3 to identify necessary and sufficient ITAAC for the EIS. The staff reviewed the DD and ITAAC to ensure compliance with 10 CFR 52.47(b)(1).

FSAR Tier 1, Section 2.4.17, includes a system description which provides the EIS safety-related function. FSAR Tier 1, Table 2.4.17-1, "Excore Instrumentation System Equipment," lists the location of the EIS equipment, seismic category, IEEE, operating environment, and division which powers the components. The heading of Column 4 of this table, "Seismic Class" should be changed to "Seismic Category" to be consistent with FSAR Tier 1. Therefore, in RAI 506, Question 14.03.05-29, the staff requested that the applicant make this change.

In a November 29, 2011, response to RAI 506, Question 14.03.05-29, the applicant stated that FSAR Tier 1 will be revised such that "Seismic Class" will be changed to "Seismic Category" in FSAR Tier 1, Tables 2.4.17-1 and 2.4.19-1 to be consistent with other descriptions in FSAR Tier 1, and FSAR Tier 1, Tables 2.4.1-2 and 2.4.26-3, Item 1 will be revised to read "temperature compensated RCCA positions" to be consistent with other FSAR Tier 1 descriptions. The applicant provided FSAR markups indicating these changes. The staff finds this response acceptable, and **RAI 506, Question 14.03.05-29 is being tracked as a confirmatory item** to ensure that the FSAR will be revised accordingly.

The EIS has the following safety-related function:

- Provides neutron flux level signals to the SCDS

The following FSAR Tier 1 tables are provided:

- Table 2.4.17-1, "Excore Instrumentation System Equipment"
- Table 2.4.17-2, "Excore Instrumentation System Output Signals"
- Table 2.4.17-3, "Excore Instrumentation System ITAAC"

In FSAR Tier 2, Section 14.3, the applicant described the selection criteria and methods used to develop the DD and ITAAC. The staff reviewed the EIS DD to ensure the selection criteria and

methods are correctly and consistently applied as set forth. The staff finds the methodology for selecting SSCs subject to ITAAC appropriate for and properly applied to the EIS. The staff finds the applicant provided an acceptable level of information in the system DD by detailing the purpose, functions, equipment quality, qualification, and design features of the EIS.

The staff reviewed FSAR Tier 1, Table 2.4.17-3 to ensure sufficient ITAAC were provided for the EIS. The staff finds the applicant included ITAAC entries for all listed DD. However, the staff could not identify an ITAAC to verify single failure protection for the EIS in FSAR Tier 1, Section 2.4. Therefore, in RAI 506, Question 14.03.05-39, the staff requested that the applicant provide an ITAAC to verify this design requirement. **RAI 506, Question 14.03.05-39 is being tracked as an open item**.

Additional evaluations of the ITAAC associated with the EIS are provided in Section 7.1 of this report.

14.3.5.4.17 Fatigue Monitoring System

In FSAR Tier 1, Section 2.4.18, "Fatigue Monitoring System," there is no FSAR Tier 1 information specified for the fatigue monitoring system. The staff finds this acceptable, because the system is not a safety-related system, is not relied upon in the safety analyses, and is not capable of adversely affecting other safety systems.

14.3.5.4.18 Incore Instrumentation System

The applicant provided DD and ITAAC verifying design features for the incore instrumentation system (ICIS) in FSAR Tier 1, Section 2.4.19, "Incore Instrumentation System." In this section, the applicant provided design information, including associated tables, in the manner described in FSAR Tier 2, Section 14.3 to identify necessary and sufficient ITAAC for the ICIS. The staff reviewed the DD and ITAAC to ensure compliance with 10 CFR 52.47(b)(1).

FSAR Tier 1, Section 2.4.19, includes a system description which provides the ICIS safety-related functions. FSAR Tier 1, Table 2.4.19-1, "Incore Instrumentation System Equipment," identifies the ICIS equipment by location, seismic category, IEEE class, operating environment, and IEEE class 1E divisional power source. The heading of Column 4 of this table, "Seismic Class" should be changed to "Seismic Category" to be consistent with FSAR Tier 1. Therefore, in RAI 506, Question 14.03.05-29, the staff requested that the applicant make this change.

In a November 29, 2011, response to RAI 506, Question 14.03.05-29, the applicant stated that FSAR Tier 1 will be revised such that "Seismic Class" will be changed to "Seismic Category" in FSAR Tier 1, Tables 2.4.17-1 and 2.4.19-1 to be consistent with other descriptions in FSAR Tier 1 and FSAR Tier 1, Tables 2.4.1-2 and 2.4.26-3, Item 1 will be revised to read "temperature compensated RCCA positions" to be consistent with other FSAR Tier 1 descriptions. The applicant provided FSAR markups indicating these changes. The staff finds this response acceptable and **RAI 506, Question 14.03.05-29 is being tracked as a confirmatory item** to ensure that the FSAR is revised accordingly.

The ICIS has the following safety-related functions:

- Provides self-powered neutron detector output signals to the SCDS

- Provides a measurement of core outlet temperatures

The following FSAR Tier 1 tables are provided:

- Table 2.4.19-1, “Incore Instrumentation System Equipment”
- Table 2.4.19-2, “Incore Instrumentation System Output Signals”
- Table 2.4.19-3, “Incore Instrumentation System ITAAC”

In FSAR Tier 2, Section 14.3, the applicant described the selection criteria and methods used to develop the DD and ITAAC. The staff reviewed the ICIS DD to ensure the selection criteria and methods are correctly and consistently applied as set forth. The staff finds the methodology for selecting SSCs subject to ITAAC appropriate for and properly applied to the ICIS. The staff finds the applicant provided an acceptable level of information in the system DD by detailing the purpose, functions, equipment quality, qualification, and design features of the ICIS.

The staff reviewed FSAR Tier 1, Table 2.4.19-3 to ensure sufficient ITAAC were provided for the ICIS. The staff finds that the applicant included ITAAC entries for all given design features, but it is unclear to the staff which ITAAC verify the given safety-related function to provide a measurement of core outlet temperature. Therefore, in RAI 506, Question 14.03.05-32, the staff requested that the applicant clarify how the ITAAC verify the given safety-related function.

In a November 8, 2011, response to RAI 506, Question 14.03.05-32, the applicant stated that the ICIS safety-related function “Provides self powered neutron detector (SPND) output signals to signal conditioning and distribution system (SCDS)” is addressed by FSAR Tier 1, Section 2.4.19, Item 4.2 and ICIS safety-related function “Provides core outlet temperature signals to SCDS” will be addressed by adding the core outlet temperature signals to FSAR Tier 1 Section 2.4.19 and FSAR Tier 1 Table 2.4.19-2. FSAR Tier 1, Section 2.4.25 will be revised to add the ICIS output signals. The applicant provided FSAR markups indicating these changes. The staff finds this response acceptable, and **RAI 506, Question 14.03.05-32 is being tracked as a confirmatory item** to ensure that the FSAR is revised accordingly.

FSAR Tier 2, Table 7.1-2, “I&C System Requirements Matrix,” Sheet 3 of 9, lists the ICIS as one of the safety-related I&C systems that is designed to comply with GDC 21, “Protection System Reliability and Testability.” In addition, FSAR Tier 2, Table 7.1-2, Sheet 5 of 9, lists the ICIS as one of the safety I&C systems that is designed to conform to RG 1.53, “Application of the Single-Failure Criterion to Nuclear Power Plant Protection Systems,” Revision 2, November 2003. However, the staff could not identify ITAAC to verify single failure protection for the ICIS in FSAR Tier 1, Section 2.4. Therefore, in RAI 506, Question 14.03.05-39, the staff requested that the applicant provide an ITAAC to verify this design requirement. **RAI 506, Question 14.03.05-39 is being tracked as an open item**.

Additional evaluations of the ITAAC associated with the ICIS are provided in Section 7.1 of this report.

14.3.5.4.19 Loose Parts Monitoring System

In FSAR Tier 1, Section 2.4.20, “Loose Parts Monitoring System,” there is no FSAR Tier 1 information specified for the loose parts monitoring system. The staff finds this acceptable

because the system is not a safety-related system, is not relied upon in the safety analyses, and is not capable of adversely affecting other systems.

14.3.5.4.20 Radiation Monitoring System

The applicant provided DD and ITAAC verifying design features for the radiation monitoring system (RMS) in FSAR Tier 1, Section 2.4.22, "Radiation Monitoring System." In this section, the applicant provided design information, including associated tables, in the manner described in FSAR Tier 2, Section 14.3 to identify necessary and sufficient ITAAC for the RMS. The staff reviewed the DD and ITAAC to ensure compliance with 10 CFR 52.47(b)(1).

FSAR Tier 1, Section 2.4.22 includes a system description which provides the RMS functions. FSAR Tier 1, Table 2.4.22-1, "Radiation Monitoring System Equipment," lists the location of the RMS equipment, the equipment classification, and the division which powers the components.

The RMS has the following safety-related function:

- Provides safety-related signals to the SCDS

The RMS has the following non-safety-related function:

- Provides non-safety-related signals to the SCDS

The following FSAR Tier 1 tables are provided:

- Table 2.4.22-1, "Radiation Monitoring System Equipment"
- Table 2.4.22-2, "Radiation Monitoring System Output Signals"
- Table 2.4.22-3, "Radiation Monitoring System ITAAC"

In FSAR Tier 2, Section 14.3, the applicant described the selection criteria and methods used to develop the DD and ITAAC. The staff reviewed the RMS DD to ensure the selection criteria and methods are correctly and consistently applied as set forth. The staff finds the methodology for selecting SSCs subject to ITAAC appropriate for and properly applied to the RMS. The staff finds the applicant provided an acceptable level of information in the system DD by detailing the purpose, safety-related function, equipment quality, qualification, and design features of the RMS.

The staff reviewed FSAR Tier 1, Table 2.4.22-3, "Radiation Monitoring System ITAAC," to ensure sufficient ITAAC were provided for the RMS. The staff finds the applicant included ITAAC entries for all listed DD. However, the staff could not identify an ITAAC to verify single failure protection for the RMS in FSAR Tier 1, Section 2.4. Therefore, in RAI 506, Question 14.03.05-39, the staff requested that the applicant provide an ITAAC to verify this design requirement. **RAI 506, Question 14.03.05-39 is being tracked as an open item**.

FSAR Tier 1, Section 2.4, states that ICIS, EIS, BCMS, SCDS, and RPMS can perform their respective safety functions when subjected to engineering and manufacturing instruction (EMI), radio frequency interference (RFI), extension shaft disconnect (ESD), and power surges. FSAR Tier 1, Section 2.4 does not state this information for RMS. The ITAAC testing provided in Section 2.4 provides for verification of these environmental factors for all previously mentioned

safety systems in this section with the exception of RMS. Therefore in RAI 506, Question 14.03.05-40, the staff requested that the applicant address the discrepancy.

In a November 8, 2011, response to RAI 506, Question 14.03.05-40, the applicant stated that the FSAR Tier 1, Section 2.4.22 will be revised to add Item 4.4, which provides verification that the RMS can perform its safety function under the specified environmental conditions. The applicant provided FSAR markups indicating these changes. The staff finds this response acceptable, and **RAI 506, Question 14.03.05-40 is being tracked as a confirmatory item** to ensure that the FSAR will be revised accordingly.

Additional evaluations of the ITAAC associated with the RMS are provided in Section 7.1 of this report.

14.3.5.4.21 Turbine-Generator I&C

In FSAR Tier 1, Section 2.4.23, "Turbine-Generator I&C," there is no FSAR Tier 1 information specified for the turbine-generator I&C. The staff finds this acceptable because the system is not a safety-related system, is not relied upon in the safety analyses, and is not capable of adversely affecting other systems.

14.3.5.4.22 Diverse Actuation System

The applicant provided DD and ITAAC verifying design features for the diverse actuation system (DAS) in FSAR Tier 1, Section 2.4.24, "Diverse Actuation System." In this section, the applicant provided design information, including associated tables, in the manner described in FSAR Tier 2, Section 14.3 to identify necessary and sufficient ITAAC for the DAS. The staff reviewed the DD and ITAAC to ensure compliance with 10 CFR 52.47(b)(1).

FSAR Tier 1, Section 2.4.24 includes a system description which provides the DAS non-safety-related functions. FSAR Tier 1, Table 2.4.24-1, "Diverse Actuation System Equipment," lists the location of the DAS equipment for each division.

The DAS has the following non-safety-related function:

- Mitigate AOOs or PAs concurrent with software common-cause failure of the PS

The following FSAR Tier 1 tables are provided:

- Table 2.4.24-1, "Diverse Actuation System Equipment"
- Table 2.4.24-2, "Functions Automatically Actuated by the DAS"
- Table 2.4.24-3, "Functions Manually Actuated through the DAS"
- Table 2.4.24-4, "Diverse Actuation System ITAAC"

In FSAR Tier 2, Section 14.3, the applicant described the selection criteria and methods used to develop the DD and ITAAC. The staff reviewed the DAS DD to ensure the selection criteria and methods are correctly and consistently applied as set forth. The staff finds the methodology for selecting SSCs subject to ITAAC appropriate for and properly applied to the DAS. The staff

finds the applicant provided an acceptable level of information in the system DD by detailing the purpose, functions, and design features of the DAS.

The staff reviewed FSAR Tier 1, Table 2.4.24-4 to ensure sufficient ITAAC were provided for the DAS. The staff finds the applicant included ITAAC entries for all listed design features.

Additional evaluations of the ITAAC associated with the DAS are provided in Section 7.8 of this report.

14.3.5.4.23 Signal Conditioning and Distribution System

The applicant provided DD and ITAAC verifying design features for the SCDS in FSAR Tier 1, Section 2.4.25, "Signal Conditioning and Distribution System." In this section, the applicant provided design information, including associated tables, in the manner described in FSAR Tier 2, Section 14.3 to identify necessary and sufficient ITAAC for the SCDS. The staff reviewed the DD and ITAAC to ensure compliance with 10 CFR 52.47(b)(1).

FSAR Tier 1, Section 2.4.25, includes a system description which provides the SCDS safety-related functions. FSAR Tier 1, Table 2.4.25-1, "Signal Conditioning and Distribution System Equipment," identifies the SCDS cabinets by location, seismic category, IEEE class, and IEEE Class 1E divisional power source.

The SCDS has the following safety-related functions:

- Receives safety-related signals from Class 1E sensors or black boxes
- Sends safety-related signals to the PS and SAS
- Sends Type A, B, and C post-accident monitoring variable signals to the SICS

The following FSAR Tier 1 tables are provided:

- Table 2.4.25-1, "Signal Conditioning and Distribution System Equipment"
- Table 2.4.25-2, "Signal Conditioning and Distribution System Input Signals"
- Table 2.4.25-3, "Signal Conditioning and Distribution System Output Signals"
- Table 2.4.25-4, "Signal Conditioning and Distribution System ITAAC"

In FSAR Tier 2, Section 14.3, the applicant described the selection criteria and methods used to develop the DD and ITAAC. The staff reviewed the SCDS DD to ensure the selection criteria and methods are correctly and consistently applied as set forth. The staff finds the methodology for selecting SSCs subject to ITAAC appropriate for and properly applied to the SCDS. The staff finds the applicant provided an acceptable level of information in the system DD by detailing the purpose, safety-related functions, and design features of the SCDS.

The staff reviewed FSAR Tier 1, Table 2.4.25-4 to ensure sufficient ITAAC were provided for the SCDS. The staff finds the applicant included ITAAC entries for all listed DD. However, the staff could not identify an ITAAC to verify single failure protection for the SCDS in FSAR Tier 1, Section 2.4. Therefore, in RAI 506, Question 14.03.05-39, the staff requested that the applicant

provide an ITAAC to verify this design requirement. **RAI 506, Question 14.03.05-39 is being tracked as an open item**.

Additional evaluations of the ITAAC associated with the SCDS are provided in Section 7.1 of this report.

14.3.5.4.24 Rod Position Measurement System

The applicant provided DD and ITAAC verifying design features for the RPMS in FSAR Tier 1, Section 2.4.26, "Rod Position Measurement System." In this section, the applicant provided design information, including associated tables, in the manner described in FSAR Tier 2, Section 14.3 to identify necessary and sufficient ITAAC for the RPMS. The staff reviewed the DD and ITAAC to ensure compliance with 10 CFR 52.47(b)(1).

FSAR Tier 1, Section 2.4.26, includes a system description which provides the RPMS safety-related functions. FSAR Tier 1, Table 2.4.26-1, "Rod Position Measurement System Equipment," identifies the RPMS cabinets by location, seismic category, IEEE class, and IEEE Class 1E divisional power source.

The RPMS has the following safety-related functions:

- Receives safety-related rod cluster control assembly (RCCA) position signals and temperature compensation signals from the control rod drive mechanisms
- Sends safety-related temperature compensated analog RCCA position signals to the SCDS

The following FSAR Tier 1 tables are provided:

- Table 2.4.26-1, "Rod Position Measurement System Equipment"
- Table 2.4.26-2, "Rod Position Measurement System Input Signals"
- Table 2.4.26-3, "Rod Position Measurement System Output Signals"
- Table 2.4.26-4, "Rod Position Measurement System ITAAC"

In FSAR Tier 2, Section 14.3, the applicant described the selection criteria and methods used to develop the DD and ITAAC. The staff reviewed the RPMS DD to ensure the selection criteria and methods are correctly and consistently applied as set forth. The staff finds the methodology for selecting SSCs subject to ITAAC appropriate for and properly applied to the RPMS. The staff finds the applicant provided an acceptable level of information in the system DD by detailing the purpose, safety-related functions, and design features of the RPMS.

The staff reviewed FSAR Tier 1, Table 2.4.26-4 to ensure sufficient ITAAC were provided for the RPMS. The staff finds that the applicant included ITAAC entries for all listed DD. However, the applicant needs to change FSAR Tier 1, Table 2.4.26-3, Item 1 to read "temperature compensated RCCA positions" to maintain consistency within FSAR Tier 2. Once this change is made, the ITAAC is consistent with the listed safety functions. In RAI 506, Question 14.03.05-29, the staff requested that the applicant make this change.

In a November 29, 2011, response to RAI 506, Question 14.03.05-29, the applicant stated that FSAR Tier 1 will be revised such that "Seismic class" will be changed to "Seismic Category" in FSAR Tier 1, Tables 2.4.17-1 and 2.4.19-1 to be consistent with other descriptions in FSAR Tier 1 and FSAR Tier 1, Tables 2.4.1-2 and 2.4.26-3, Item 1 will be revised to read "temperature compensated RCCA positions" to be consistent with other Tier 1 descriptions. The applicant provided FSAR markups indicating these changes. The staff finds this response acceptable, and **RAI 506, Question 14.03.05-29 is being tracked as a confirmatory item** to ensure that the FSAR is revised accordingly.

The staff could not identify an ITAAC to verify single failure protection for the RPMS in FSAR Tier 1, Section 2.4. Therefore, in RAI 506, Question 14.03.05-39, the staff requested that the applicant provide an ITAAC to verify this design requirement. **RAI 506, Question 14.03.05-39 is being tracked as an open item**.

The staff identified the following ITACC items to verify that adequate logical control of access exists for safety equipment:

- FSAR Tier 1, Table 2.4.1-7, Item 4.21 to verify that CPU switches are provided at the PS cabinets to restrict modification to the PS software.

- FSAR Tier 1, Table 2.4.1-7, Item 4.25 to verify that hardwired disconnects exist between the SU and each divisional MSI of the PS. The hardwired disconnects prevent the connection of the SU to more than a single division of the PS.

- FSAR Tier 1, Table 2.4.4-6, Item 4.13 to verify that CPU switches are provided at the SAS cabinets to restrict modification to the SAS software.

- FSAR Tier 1, Table 2.4.4-6, Item 4.17 to verify that hardwired disconnects exists between the SU and each divisional MSI of the SAS. The hardwired disconnects prevent the connection of the SU to more than a single division of the SAS.

- FSAR Tier 1, Table 2.4.26-4, "Rod Position Measurement System ITAAC," Item 4.5 in to verify that hardwired disconnects exist between the SU and each divisional MSI of the RPMS. The hardwired disconnects prevent the connection of the SU to more than a single division of the RPMS.

The staff reviewed the ITAAC provided in FSAR Tier 1, and determined that additional information is required to verify that features for ensuring logical control of access exist in the as-built safety systems. Specifically, in RAI 506, Question 14.03.05-34, the staff requested that the applicant identify whether a CPU state switch is provided at the RPMS cabinet to restrict modification to the RPMS software and to provide an ITAAC to address this feature to meet the requirements of 10 CR 52.47(b)(1).

In a November 8, 2011, response to RAI 506, Question 14.03.05-34, the applicant stated that the RPMS function processors have different operational modes that are controlled by a CPU state switch similar to that of the PS and SAS function processors. The CPU state switches for the RPMS are implemented in a similar manner as those for the PS and SAS. FSAR Tier 2, Section 7.1.1.5.16 will be revised to include a discussion of the CPU state switch that controls the operational modes for the RPMS processors. FSAR Tier 1, Section 2.4.26 will be revised to include Item 4.6 to verify the CPU state switch feature of the RPMS. The applicant provided FSAR markups indicating these changes. The staff finds this response acceptable and

RAI 506, Question 14.03.05-34 is being tracked as a confirmatory item to ensure that the FSAR is revised accordingly.

In addition, the staff could not identify an ITAAC to verify communication independence between the RPMS and the SU. Therefore, in RAI 506, Question 14.03.05-35, the staff requested that the applicant address this issue.

In a January 13, 2012, response to RAI 506, Question 14.03.05-35, the applicant stated that FSAR Tier 1, Section 2.4.26 will be revised to include ITAAC item 4.7 to verify that communications independence exists between RPMS and non-Class 1E equipment. FSAR, Tier 1, Section 2.4.26 will be further revised to include ITAAC Items 4.11 and 4.12 to verify that communications messages are sent with a specific protocol and RPMS function processors receive only the pre-defined message. FSAR, Tier 2, Section 7.1.1.6.4 will be revised to address communications independence between RPMS and non-safety related equipment. The applicant provided FSAR markups indicating these changes. The staff finds this response acceptable, and **RAI 506, Question 14.03.05-35 is being tracked as a confirmatory item** to ensure the FSAR is revised accordingly.

The following ITAAC are provided in FSAR Tier 1, which were submitted as part of the applicant's June 22, 2011, response to RAI 452, Question 07.03-36, in order to verify adequate electrical isolation exists between safety and non-safety systems:

- FSAR Tier 1, Table 2.4.1-7, Item 4.8 verifies electrical isolation is provided on connections between PS equipment and non-Class 1E equipment.

- FSAR Tier 1, Table 2.4.2-2, Item 4.3 verifies electrical isolation is provided on connections between SICS equipment and non-Class 1E equipment.

- FSAR Tier 1, Table 2.4.4-6, Item 4.7 verifies electrical isolation is provided on connections between SAS equipment and non-Class 1E equipment.

- FSAR Tier 1, Table 2.4.5-3, Item 4.2 verifies electrical isolation is provided on connections between Class 1E PACS equipment and non-Class 1E equipment.

- FSAR Tier 1, Table 2.4.25-4, Item 4.4 verifies electrical isolation is provided on connections between SCDS Class 1E equipment and non-Class 1E equipment.

The acceptance criteria for these ITAAC include:

- A test plan exists that provides the test specification for determining whether a device is capable of preventing the propagation of credible electrical faults on connections between safety equipment and non-Class 1E equipment.

- A report exists and concludes that the Class 1E isolation devices used between PS equipment and non-Class 1E equipment prevent the propagation of credible electrical faults.

- Class 1E electrical isolation devices exist on connections between PS equipment and non-Class 1E equipment.

In addition, the applicant provided FSAR Tier 1, Table 2.4.5-3, Item 4.9 to require testing and analysis to verify that the communications module will not cause a failure of the PACS priority module when subjected to EMI, RFI, ESD, and power surges.

The staff finds the ITAAC provided to verify that adequate electrical isolation exists between the PS, SICS, SAS, PACS, SCDS and non-safety-related equipment acceptable by performing tests and analysis that verify that (1) Class 1E isolation devices are used between the Class 1E equipment of these systems and non-Class 1E equipment, and (2) that these isolation devices prevent the propagation of credible electrical faults from non-safety equipment to the Class 1E equipment. In addition, the staff finds ITAAC Item 4.9 in FSAR Tier 1, Table 2.4.5-3, provides adequate commitments and acceptance criteria to verify that failures in the non-safety-related communication module will not impact the priority module. Specifically, the staff finds that tests that subject the communication module to EMI, RFI, ESD, and power surges will determine that the priority module will be protected from any failures within the communication module as a result of these tests. The staff has reviewed the relevant sections of FSAR Tier 2 and finds that the applicant has adequately specified the nature of tests and analyses to be performed, and the content of reports to be submitted. However, the staff determined that the applicant has not provided an ITAAC to verify that electrical isolation exists between the RPMS and non-Class 1E equipment. Therefore, in RAI 506, Question 14.03.05-36, the staff requested that the applicant address this issue.

In a November 8, 2011, response to RAI 506, Question 14.03.05-36, the applicant stated that FSAR Tier 1, Section 2.4.26 will be revised to include Item 4.10 to verify that electrical isolation exists between Class 1E RPMS equipment and non-Class 1E equipment. The applicant provided FSAR markups indicating these changes. The staff finds this response acceptable and **RAI 506, Question 14.03.05-36 is being tracked as a confirmatory item** to ensure that the FSAR is revised accordingly.

The staff could not identify an ITAAC to verify features that support control of access to cabinets for the RPMS in FSAR Tier 1, Section 2.4. Therefore, in RAI 506, Question 14.03.05-37, the staff requested that the applicant provide an ITAAC to verify this design requirement.

In a November 8, 2011, response to RAI 506, Question 14.03.05-37, the applicant stated that FSAR, Tier 1, Sections 2.4.2, 2.4.11, 2.4.17, 2.4.19, 2.4.22, 2.4.25, and 2.4.26, will each be revised to include an ITAAC item that verifies features that support control of access to cabinets of the SICS, BCMS, EIS, ICIS, RMS, SCDS and RPMS. The staff finds this acceptable and **RAI 506, Question 14.03.05-37 is being tracked as a confirmatory item** to ensure that the FSAR is revised accordingly.

Additional evaluations of the ITAAC associated with the RPMS are provided in Section 7.1 of this report. Section 7.1.4.10.1.2 provides additional discussion on electrical isolation between safety divisions.

14.3.5.4.25 Communication System

The applicant provided DD and ITAAC verifying design features for the communication system (COMS) in FSAR Tier 1, Section 2.5.12, “Communication System.” In this section, the applicant provided design information, including associated tables, in the manner described in FSAR Tier 2, Section 14.3 to identify necessary and sufficient ITAAC for the COMS. The staff reviewed the DD and ITAAC to ensure compliance with 10 CFR 52.47(b)(1).

FSAR Tier 1, Section 2.5.12, includes a system description which provides the COMS functions.

The following FSAR Tier 1 tables are provided:

- Table 2.5.12-1, “Communication Equipment Locations”
- Table 2.5.12-2, “Communication System ITAAC”

In FSAR Tier 2, Section 14.3, the applicant described the selection criteria and methods used to develop the DD and ITAAC. The staff reviewed the COMS DD to ensure the selection criteria and methods are correctly and consistently applied as set forth. The staff finds the methodology for selecting SSCs subject to ITAAC appropriate for and properly applied to the COMS. The staff finds the applicant provided an acceptable level of information in the system DD by detailing the purpose and functions of the COMS.

The staff reviewed FSAR Tier 1, Table 2.5.12-2 to ensure sufficient ITAAC were provided for the COMS. The staff finds the applicant included ITAAC entries for all listed DD.

Additional evaluations of the ITAAC associated with the COMS are provided in Section 9.5.2 of this report.

14.3.5.4.26 Post-Accident Monitoring Instrumentation

The applicant provided DD and ITAAC verifying design features for the post-accident monitoring (PAM) instrumentation in FSAR Tier 1, Section 3.7, “Post-Accident Monitoring Instrumentation.” In this section, the applicant provided design information, including associated tables, in the manner described in FSAR Tier 2, Section 14.3 to identify necessary and sufficient ITAAC for the PAM instrumentation. The staff reviewed the DD and ITAAC to ensure compliance with 10 CFR 52.47(b)(1).

FSAR Tier 1, Section 3.7 includes a system description which provides PAM instrumentation functions.

The following FSAR Tier 1 table is provided:

- Table 3.7-1, “Post-Accident Monitoring Instrumentation ITAAC”

In FSAR Tier 2, Section 14.3, the applicant described the selection criteria and methods used to develop the DD and ITAAC. The staff reviewed the PAM instrumentation DD to ensure the selection criteria and methods are correctly and consistently applied as set forth. The staff finds the methodology for selecting SSCs subject to ITAAC appropriate for and properly applied to the PAM instrumentation. The staff finds the applicant provided an acceptable level of information in the system DD by detailing the purpose and functions of the PAM instrumentation.

The staff reviewed FSAR Tier 1, Table 3.7-1 to ensure sufficient ITAAC were provided for the PAM instrumentation. The staff finds the applicant included ITAAC entries for all listed DD.

Additional evaluations of the ITAAC associated with the PAM instrumentation are provided in Section 7.5 of this report.

14.3.5.5 *Combined License Information Items*

Section 14.3.1.5, Table 14.3.1-1 of this report provides a list of all ITAAC related COL information items and descriptions from FSAR Tier 2, Table 1.8-2 that are applicable to FSAR Tier 2, Section 14.3. The staff finds the list in Table 14.3.1-1 to be complete. Also, the list adequately describes actions necessary for the COL applicant or licensee. No additional COL information items need to be included in FSAR Tier 2, Table 1.8-2.

14.3.5.6 *Conclusions*

Based on the above discussion of I&C ITAAC, including the ITAAC discussions in Chapter 7 of this report, the staff finds the FSAR Tier 1 DD associated with the scope of SRP Section 14.3.5 for I&C system ITAAC acceptable, except for the I&C issues that are currently associated with open items. Except for the open items discussed above, the staff concludes that the I&C ITAAC discussed in FSAR Tier 1, Sections 2.4 and 3.7 meet 10 CFR 52.47(b)(1), such that, if the inspections, tests, and analyses are performed and the acceptance criteria met, then a facility referencing the U.S. EPR certified design has been constructed, and will be operated, in compliance with the design certification, the Atomic Energy Act of 1954, and applicable NRC regulations.

The final staff conclusion will be made upon completion of the staff's review of outstanding RAI responses from the applicant and successful resolution of concerns associated with open items.

14.3.6 Electrical Systems

14.3.6.1 *Introduction*

NUREG-0800, Section 14.3.6 addresses the review of ITAAC for electrical systems for the U.S. EPR. The staff reviewed the proposed ITAAC to determine whether a plant that incorporates the design certification can be built and operated in accordance with the design certification and NRC regulations.

The scope of electrical systems ITAAC review includes FSAR Tier 1 information on the entire station electrical system, including Class 1E portions of the system, equipment qualification (EQ), major portions of the non-Class 1E system, and portions of the plant lightning protection, grounding, and lighting systems.

14.3.6.2 *Summary of Application*

FSAR Tier 1: The applicant has provided design descriptions for major U.S. EPR electrical systems in FSAR Tier 1, Section 2.5, "Electrical Power." Additional design-related information for EQ was provided in the design descriptions for plant systems powered by the electrical systems, including systems described in FSAR Tier 1, Section 2.2, "Nuclear Island Systems," Section 2.3, "Severe Accident Systems," Section 2.4, "Instrumentation and Control Systems," Section 2.6, "HVAC Systems," Section 2.7, "Support Systems," Section 2.8, "Steam and Power Conversion Systems," Section 2.9.4, "Sampling Activity Monitoring System," and Section 3.5, "Containment Isolation." FSAR Tier 1, Chapter 1.0, "Introduction," provides definitions, general provisions, and a legend for figures, acronyms, and abbreviations.

FSAR Tier 2: Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria," provides a general description of the ITAAC including its relationship to other FSAR Tier 1 information, selection criteria, and content.

ITAAC: The applicant has provided ITAAC tables for each of the systems given in FSAR Tier 1, Section 2.5 for which FSAR Tier 1 design descriptions were provided. Additional ITAAC for electrical components were provided in FSAR Tier 1, Sections 2.2, 2.3, 2.4, 2.6, 2.7, 2.8, 2.9.4, and 3.5.

Technical Specifications: The applicant provided Technical Specifications for electrical power systems in FSAR Tier 2, Chapter 16, "Technical Specifications," Section 3.8, "Electrical Power Systems."

14.3.6.3 *Regulatory Basis*

The relevant requirements of NRC regulations for this area of review, and the associated acceptance criteria, are given in NUREG-0800, Section 14.3.6, "Electrical Systems - Inspections, Tests, Analyses, and Acceptance Criteria," and are summarized below. Review interfaces with other SRP sections also can be found in NUREG-0800, Section 14.3.6. (The requirements given in NUREG-0800, Section 14.3.6 related to the technical adequacy of the ITAAC are not included here, as they are addressed in other sections of this report.)

1. GDC 17, as it relates to the requirement that an onsite and offsite electric power system be provided to permit functioning of SSCs important to safety. GDC 17 further requires that the onsite electric power system have independence and redundancy and the electric power supplied by the offsite system be supplied by two physically independent circuits. Also, GDC 17 requires that provisions be included to minimize the likelihood of losing all electric power as a result of or coincident with, loss of power generated by the nuclear power unit, from the transmission network, or the onsite electric power supplies.

2. 10 CFR 52.47(b)(1), as it relates to the requirement that a design certification 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 plant that incorporates the design certification is built and will operate in accordance with the design certification, the provisions of the Atomic Energy Act of 1954, and NRC regulations.

3. 10 CFR 50.49, as it relates to EQ of electrical equipment important to safety for nuclear power plants. Applicants must ensure that safety-related, certain non-safety-related, and certain post-accident monitoring equipment can perform their intended functions in various anticipated environments.

4. 10 CFR 50.63, as it relates to the requirement that a nuclear power plant be able to withstand and recover from a station blackout event.

Acceptance criteria adequate to meet the above requirements include:

1. SRP 14.3.6 refers to SRP 14.3 for guidance on the content and format of ITAAC. Relevant portions of SRP Section 14.3 include:

    - SRP 14.3 Appendix A - Definitions (A) under FSAR Tier 1 Information (IV.1)

- SRP 14.3 Appendix A - General Provisions (IV.2)
- SRP 14.3 Appendix A - Legend for Figures and Acronyms and Abbreviations (IV.3)
- SRP 14.3 Appendix A - ITAAC (IV.4.B)- Defines three column format and explains ITAAC terminology
- SRP 14.3 Appendix C – Electrical Systems Review Checklist
- SRP 14.3 Appendix D – ITAAC Entries - Examples

2. For design certification applications, FSAR Tier 1 design descriptions and ITAAC design commitments should be based on and consistent with the FSAR Tier 2 material.

14.3.6.4 *Technical Evaluation*

The staff has reviewed FSAR Tier 1, Chapter 2, "System Based Design Descriptions of ITAAC," Section 2.5 that provides electrical system ITAAC information. U.S. EPR has addressed its ITAAC requirements for electrical systems in FSAR Tier 2, Chapter 14, "Initial Test Program and ITAAC," Section 14.3.6, "Design Acceptance Criteria," but FSAR Tier 1, Chapter 2 actually gives pertinent ITAAC information for the electrical system. The design-basis information in FSAR Tier 2 is used to develop FSAR Tier 1 information that supports ITAAC for a U.S. EPR application. Each ITAAC adopted the table entry format prescribed by the SRP Section 14.3 Appendix D, which consists of: (1) Commitment Wording; (2) Inspections, Tests, Analyses; and (3) Acceptance Criteria.

The scope of the electrical system ITAAC consists of: Class 1E electrical power distribution system, emergency diesel generators (EDGs), Class 1E (battery) uninterruptible power supply (UPS), and containment penetrations. In addition, it includes non-Class 1E systems that support a significant safety function such as offsite power, alternate ac power source (AAC), lightning protection, grounding, lighting, and 12-hour uninterruptible power supply (12UPS) systems.

In satisfying the requirements of 10 CFR 52.47(b)(1) for U.S. EPR design certification application, the acceptance criteria for electrical ITAAC are based on meeting the relevant requirements of NRC regulations on: GDC 17, "Electric Power Systems," 10 CFR 50.49, "Environmental qualification of electric equipment important to safety for nuclear power plants" (Equipment Qualification), and 10 CFR 50.63, "Loss of all alternating current power" (Station Blackout). The top-level design commitments for the Class 1E electrical systems include design aspects related to:

1. Redundancy and independence (GDC 17)
2. Capacity and capability (GDC 17)
3. Electrical protection features (GDC 17)
4. Displays/controls/alarms (GDC 17)
5. Equipment qualification for seismic and harsh environment (10 CFR 50.49)

6. Station blackout (10 CFR 50.63)

The staff has evaluated all relevant ITAAC for the electrical systems given under FSAR Tier 1 sections to determine its adequacy for NRC regulations on GDC 17, 10 CFR 50.49, and 10 CFR 50.63.

14.3.6.4.1 Compliance with GDC 17

14.3.6.4.1.1 *Class 1E Emergency Power Supply System (EPSS)*

The EPSS provides electrical power for systems that are essential to reactor shutdown, containment isolation and heat removal, reactor core cooling, and preventing a significant release of radioactive material to the environment. The EPSS distributes power to safety-related and selected non-safety-related plant loads during normal and abnormal operations. EPSS divisions are independent and physically separated during normal bus alignments. An alternate feed is provided between EPSS Divisions 1 and 2, and between Divisions 3 and 4 to provide the normal and standby source of power to required safety systems, safety support systems, or components that do not have the required redundancy when certain electrical components, including emergency diesel generators, are out of service.

In RAI 116, Question 14.03.06-1, the staff requested that the applicant identify actual equipment shown on their location according to EPSS buses in FSAR Tier 1, Table 2.5.1-1, "Class 1E Emergency Power Supply Electrical Equipment Location." The above equipment and its location are important to ensuring safety system divisional independence and its redundancy (assuming a single failure) for the normal and alternate feed electrical lineups. In an October 28, 2008, response to RAI 116, Question 14.03.06-1, the applicant referred to its October 15, 2008, response to RAI 11, Question 08.03.01-2, which provided the list of actual equipment (i.e., engineered safety feature loads) for their connections to Class 1E uninterruptible power supply (EUPS) buses. The staff has reviewed actual equipment and their location according to the EPSS buses shown in FSAR Tier 1, Table 2.5.1-1. The staff also reviewed EPSS system design that is based on four train redundancies in accordance with the N+2 philosophy (one train out of service for maintenance, one train lost to single failure, and the remaining trains are capable of completing the safety function). For equipment that has only two redundant trains (e.g., annulus ventilation, extra boration, and primary containment isolation), the divisional pair concept will be used to satisfy the safety function by using an alternate feed connection.

Based on the above information, the staff finds that the safety system division for EPSS is independent and redundant (assuming a single failure) via the use of the normal and alternate feed connections to necessary equipment. The staff finds the applicant's October 28, 2008, response to RAI 116, Question 14.03.06-1, acceptable and, therefore, considers RAI 116, Question 14.03.06-1 resolved.

In RAI 116, Question 14.03.06-5, the staff requested that the applicant clarify why commitment Item 5.2 of Section 2.5.1, "Class 1E Emergency Power Supply System," (FSAR Tier 1, Table 2.5.1-3, "Class 1 E Emergency Power Supply System ITAAC") does not have entries for testing: (1) An automatic power transfer scheme between normal and alternate power source if a loss of emergency auxiliary transformer (EAT) occurs; (2) of degraded and loss of voltage conditions for the Class 1E equipment; and (3) of isolation devices between Class 1E circuits and non-Class 1E circuits that prevent from degrading the Class 1E portion of the system. In a November 26, 2008, response to RAI 116, Question 14.03.06-5, the applicant stated: (1) The

automatic power transfer scheme will be tested by adding FSAR Tier 1, Table 2.5.1-3, Item 6.5, "Each EPSS division has a normal and alternate offsite power supply circuit connection"; (2) FSAR Tier 1, Table 2.5.1-3, Item 6.2 will be revised to include that each EPSS 6.9 kV offsite power supply circuit breaker is opened by a protection system LOOP signal. Additionally, FSAR Tier 1, Table 2.4.1-4, "Protection System Manually Actuated Functions," will be revised to include the conditions that generate the LOOP signal. The ESF signal generation is verified by a test in U.S. EPR FSAR Tier 1, Table 2.4.1-9, Item 4.2; (3) FSAR Tier 1, Table 2.5.1-3, Item 5.2 and FSAR Tier 1, Table 2.5.2-3, "Class 1E Uninterruptible Power Supply ITAAC," will be revised to perform type test and analyses of the isolation devices to prevent credible faults from propagating into the Class 1E system; and (4) FSAR Tier 1, Table 2.5.1-3, Item 5.13 will verify the interrupting devices coordination. The staff has reviewed the above changes to its Commitment Wording and finds that the applicant's revision to the above mentioned ITAAC entries incorporated the staff's concerns. Accordingly, the staff finds the applicant's November 26, 2008, response to RAI 116, Question 14.03.06-5, acceptable and, therefore, considers RAI 116, Question 14.03.06-5 resolved.

14.3.6.4.1.2 *Class 1E Uninterruptible Power Supply (EUPS)*

The EUPS system provides Class 1E power to safety-related U.S. EPR loads, and uninterruptible ac power to safety-related and select non-safety-related loads during normal and abnormal operations.

The staff notes that in FSAR Tier 1, Table 2.5.2-3, the applicant does not have a commitment entry for analyzing the as-built Class 1E U.S. EPR system to ensure the operating voltage remains within voltage ranges at the terminals of the safety-related equipment. Therefore, in RAI 116, Question 14.03.06-6, the staff requested that the applicant address this issue. In a November 26, 2008, response to RAI 116, Question 14.03.06-6, the applicant stated that FSAR Tier 2, Section 8.3.2.3.1, "Load Flow and Under/Overvoltage Studies," will be revised to add, "A U.S. EPR load flow analysis will be performed that verifies the EUPS U.S. EPR operating voltage remains within the terminal voltage range of the supplied safety-related equipment during the battery duty cycle." Subsequently, FSAR Tier 1, Section 2.5.2 has been revised to add new Commitment Wording Item 5.15 in Table 2.5.2-3 to address the above staff's concern. The staff has reviewed the new commitment entry for analyzing as-built Class 1E U.S. EPR system shown in FSAR Tier 1, Table 2.5.2-3 and finds the applicant's November 26, 2008, response to RAI 116, Question 14.03.06-6, acceptable and, therefore, considers RAI 116, Question 14.03.06-6 resolved.

14.3.6.4.1.3 *Station Blackout (SBO) Alternate AC Source*

Two station blackout diesel generators (SBODGs) are provided as the AAC source to provide power to station loads necessary to bring and maintain the plant in a safe shutdown condition during non-design basis accident station blackout conditions.

ITAAC that demonstrate compliance with 10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants," (Station Blackout) for SBODGs is addressed separately in Section 14.3.6.4.14 of this report.

14.3.6.4.1.4 *Emergency Diesel Generator*

The EDG provide a standby source of Class 1E power to safety-related and non-safety-related loads during conditions that result in a loss of preferred power to EPSS buses.

The staff notes that FSAR Tier 1, Table 2.5.4-3, "Emergency Diesel Generator Electrical Equipment Design," does not have commitment entries for EDG operability (i.e., analyses and testing) with loss of offsite power (LOOP), and LOOP concurrent with LOCA that demonstrate EDG capacity and capability. Therefore, in RAI 116, Question 14.03.03-8, the staff requested that the applicant address the above analyses and that testing be included under the alternate feed configurations (Table 2.5.4-3, Item 5.3). In addition, the staff requested that the applicant clarify why there is no commitment entry for load shedding and sequencer testing for EDG operation (to start and load) for the above EDG operating modes along with commitment entries for testing fuel tank capacity, fuel transfer capability, and various parameters monitoring for EDG operations.

In a November 26, 2008, response to RAI 116, Question 14.03.06-8, the applicant agreed to the changes for which FSAR Tier 1 will be revised: FSAR Tier 1, Section 2.5.4, Table 2.5.4-3 (EDG), and FSAR Tier 1, Section 2.5.1 (Class 1E EPSS), Table 2.5.1-3 were revised to verify the capability of the EDG to provide power to its respective EPSS division in a LOOP condition concurrent with LOCA condition. FSAR Tier 1, Table 2.5.1-3 was revised to include: (1) Item 6.4 for testing the capability of the PS to sequentially energize EPSS loads during a LOOP, LOCA, and LOOP/LOCA conditions; and (2) Item 6.6 that verifies the EPSS load shed function. FSAR Tier 1, Table 2.5.4-4, "Emergency Diesel Generator ITAAC," was revised to include: (1) Items 6.1, 6.2, and 6.3, where each EDG starts by a PS on LOOP, LOCA, and LOOP/LOCA signals; (2) Item 5.3 that includes an analysis for normal and alternate feed configurations; (3) Item 3.9 that verifies EDG fuel oil storage tank volume by analysis; (4) Item 3.11 that tests the capability of each fuel oil transfer pump; and (5) Item 4.1 in which displays listed in FSAR Tier 1, Table 2.5.2-2 are retrievable in the MCR and the RSS as listed in FSAR Tier 1, Table 2.5.2-2. Also, FSAR Tier 1, Table 2.5.4-3 was inserted by the applicant to provide the status of EDG parameters displayed in the MCR and RSS. The staff reviewed the revisions to all of the above items and finds the applicant has revised ITAAC that includes necessary inspections, tests, and analyses that verify availability of the standby power. The staff finds the applicant's November 26, 2008, response to RAI 116, Question 14.03.06-8, acceptable, and therefore, considers RAI 116, Question 14.03.06-8 resolved.

In RAI 275, Question 14.03.06-32, the staff requested that the applicant add Emergency Diesel Generator 30XKA20AG(2) in FSAR Tier 1, Table 2.5.4-3, "Emergency Diesel Generator Electrical Equipment Design," as only three EDGs were shown for the U.S. EPR.

In a September 21, 2009, response to RAI 275, Question 14.03.06-32, the applicant stated that the EDG was added in its September 4, 2009, response to RAI 260, Question 14.03-11. The staff reviewed FSAR Tier 1, Table 2.5.4-3 and finds that the table now has four EDGs. The staff finds the applicant's response acceptable and, therefore, considers RAI 275, Question 14.03.06-32 resolved.

The staff noted that the latest FSAR Tier 2, Section 8.3.1 has revised the EDG output voltages from (+/-10 percent) to (+/-5 percent). Thus, FSAR Tier 1, Table 2.5.4-4 should be revised to reflect this EDG output voltage change in analysis. Therefore, in RAI 275, Question 14.03.06-33, the staff requested that the applicant address this issue. In a September 21, 2009, response to RAI 275, Question 14.03.06-33, the applicant revised the EDG output voltage change in the Commitment Wording for Item 5.3 to make it consistent. The staff reviewed Commitment Wording for FSAR Tier 1, Table 2.5.4-4, Item 5.3 and finds that the applicant has corrected the EDG output voltage to +/- 5 percent. The applicant chose to perform a test, instead of analysis to verify the above EDG output voltage. Since the testing will

verify the acceptable voltage results obtained from the analysis, the staff considers Commitment Wording for FSAR Tier 1, Table 2.5.4-4, Item 5.3 acceptable and, therefore, considers RAI 275, Question 14.03.06-33 resolved.

14.3.6.4.1.5 *Preferred (Offsite) Power Supply System*

The preferred (offsite) power system (PPSS) provides the power to the Class 1E EPSS via the EATs and offsite power to the normal power supply system (NPSS) via the normal auxiliary transformers (NATs) during normal and abnormal operation.

In RAI 116, Question 14.03.06-3, the staff requested that the applicant clarify why electrical ITAAC tables shown in FSAR Tier 1, Sections 2.5.1 through 2.5.8, "Lightning Protection and Grounding," Section 2.5.11, "12-Hour Uninterruptible Power Supply System," and Section 3.5, "Containment Isolation," associated with FSAR Tier 1, Sections 2.5 and 3.5 rely mostly on inspection and test, but little or no analyses. Since the ITAAC is to verify "as built" facility complies with the approved plant design and applicable NRC regulations (e.g., GDC 17), the analyses must be included as a part of ITAAC evaluation. The staff also requested that the applicant include necessary analyses for electrical ITAAC tables in FSAR Tier 1, Sections 2.5 and 3.5, where applicable. In an October 29, 2008, response to RAI 116, Question 14.03.06-3, the applicant stated that FSAR Tier 1, Sections 2.5.1 through 2.5.8, 2.5.11, and 3.5, will be revised to include analyses as requested and provided the markups. On the basis of its review, the staff finds that the applicant has included necessary analyses that verify as-built facilities will comply with the approved plant design. However, the staff noticed analyses were being added, but some inspections and tests were deleted from the aforementioned tables.

Therefore, in follow-up RAI 275, Question 14.03.06-31, the staff requested that the applicant restore those tests or inspections that were deleted from the above electrical ITAAC tables, where applicable, or justify the exceptions. In an October 16, 2009, response to RAI 275, Question 14.03.06-31, the applicant issued a supplement to include analyses, tests, and inspections for FSAR Tier 1, ITAAC shown on FSAR Tier 1, Table 2.5.1-3, Table 2.5.2-3, Table 2.5.3-2, "Station Blackout Alternate AC Source ITAAC," Table 2.5.4-4, Table 2.5.5-1, "Preferred (Offsite) Power Supply System ITAAC," Table 2.5.6-1, "Power Transmission System ITAAC," Table 2.5.7-2, "Non-Class 1E Uninterruptible Power Supply Electrical Equipment Design," Table 2.5.8-1, "Lightning Protection and Grounding System ITAAC," and Table 2.5.11-1, "12-Hour Uninterruptible Power Supply System ITAAC." The staff reviewed the above revision to all of the above commitment items and finds the applicant's October 16, 2009, response to RAI 275, Question 14.03.06-31 acceptable and, therefore, and considers RAI 275, Question 14.03.06-31 resolved.

The staff noted that the Interface Requirements of FSAR Tier 1, Section 2.5.5, "Preferred (Offsite) Power Supply System," was incomplete. Therefore, in RAI 116, Question 14.03.06-9, the staff requested that the applicant address the following additional information:

- Voltage analysis at load terminals for all modes of plant operation and accident conditions based on the worst grid voltages

- Sizing analysis of the offsite transmission circuits from the transmission network through and including the main step-up (MSU) EAT and NAT during all design operating modes, of their respective Class 1E divisions and non-Class 1E load groups

- Interrupting capability analysis of the plant's circuits

- Separation and independence of power and I&C circuits
- Ability to retrieve the I&C information (displays and alarms) for analysis

In an October 29, 2008, response to RAI 116, Question 14.03.06-9, the applicant identified the following ITAAC changes to:

- FSAR Tier 1, Table 2.5.1-3, Item 6.3 to address voltage analysis at load terminals for normal operation and accident conditions based on worst case grid voltages
- FSAR Tier 1, Table 2.5.5-1, Items 4.3 and 4.4 to address size requirements of the offsite transmission circuits from the transmission network to the EAT and NAT
- FSAR Tier 1, Table 2.5.1-3, Items 5.14 and 5.15, and FSAR Tier 1, Table 2.5.2-3 Items 5.16 and 5.17, to address interrupting capability of the electrical distribution system circuits that will be verified within the equipment capability of the design certification scope by performing the analyses

For independence of power and I&C circuits and retrieval of I&C information, the FSAR Tier 1, Section 2.5.5 of ITAAC Interface Requirement (5.0) will be revised to add: (1) Item 5.6, "The offsite transmission power, instrumentation, and control circuits shall be independent"; and (2) Item 5.7, "The switchyard instrumentation for any MCR displays and alarms (e.g., circuit breaker position indication, control voltage) shall be compatible with the certified design I&C systems."

The staff has reviewed the above revisions to all of the above commitment items and finds the applicant has revised ITAAC to include analyses for grid voltages and the sizing of the offsite circuits, and interrupting duties. The staff finds that the applicant has adequately addressed the staff's concerns and, therefore, considers these issues resolved.

In RAI 275, Question 08.03.01-34, the staff requested that the applicant address the offsite power/switchyard lightning protection and grounding system grid as an interface item for FSAR Tier 1, Section 2.5.5. In a September 21, 2009, response to RAI 275, Question 08.03.01-34, the applicant agreed to revise FSAR Tier 1, Section 2.5.5 by adding Item 5.8, "Lightning protection and grounding is provided for the switchyard." The staff reviewed the above added sentence (5.8) under Interface Requirement (5.0) of Section 2.5.5 and finds that this interface requirement verifies lightning protection and grounding for the offsite power circuits and components located in the station switchyard. Accordingly, the staff considers the applicant's response acceptable and, therefore, considers RAI 275, Question 08.03.01-34 resolved.

In RAI 275, Question 14.3.6-34, the staff requested that the applicant include offsite power/switchyard lighting protection, and grounding system grid as an interface item in FSAR Tier 1, Section 2.5.5. In a September 21, 2009, response to RAI 275, Question 14.3.6-34, the applicant stated that FSAR Tier 1, Section 2.5.5 was revised by adding Item 5.8, "Lightning protection and grounding is provided for the switchyard." The staff finds the applicant's response acceptable and, therefore, considers RAI 275, Question 14.3.6-34 resolved.

14.3.6.4.1.6 *Power Transmission (Main Generator) System*

The power transmission system transmits main generator output to the transmission system via the MSU and provides power to the station auxiliary loads via the MSU and switchyard.

FSAR Tier 1, Table 2.5.6-1, "Power Transmission System ITAAC," of Section 2.5.6, "Power Transmission (Main Generator) System," Item 4.1 states that an inspection will be performed to verify that "MSUs are sized to support…." In RAI 116, Question 14.03.06-10, the staff requested that the applicant justify why this is an inspection, rather than an analysis. In an October 29, 2008, response to RAI 116, Question 14.03.06-10, the applicant stated that FSAR Tier 1, Section 2.5.6 will be revised to "MSUs and associated isophase bus are sized to support the main generator rated output at generator rated power factor," and FSAR Tier 1, Section 2.5.6 will include "an analysis." On the basis of its review, the staff finds the applicant has adequately addressed the issue and, therefore, considers RAI 116, Question 14.03.06-10 resolved.

14.3.6.4.1.7 *Non-Class 1E Uninterruptible Power Supply*

The non-Class 1E uninterruptible power supply system (NUPS) provides non-Class 1E uninterruptible power during normal and abnormal operation to non-safety-related Turbine Island and Nuclear Island loads which include the CRDM operating coils. Although NUPS is non-Class 1E system, interruption of power to the CRDM operating coils in a reactor trip condition is a safety-related function accomplished by opening the reactor trip breakers.

In RAI 116, Question 14.03.06-3, the staff requested that the applicant include NUPS electrical system analyses in FSAR Tier 1, Section 2.5.7, "Non-Class 1E Uninterruptible Power Supply." As a part of an October 29, 2008, response to RAI 116, Question 14.03.06-3, the applicant included FSAR Tier 1, Table 2.5.7-2, Items 5.1 and 5.3 for NUPS. The staff reviewed applicable items shown on the sections discussed above. The staff finds the applicant's revision includes all necessary analyses for its respective NUPS in ITAAC tables. On the basis of its review, the staff finds the applicant's response acceptable and, therefore, considers RAI 116, Question 14.03.06-6 resolved.

14.3.6.4.1.8 *Lightning Protection and Grounding*

The lightning protection is provided for MSU transformers, NATs, and EATs. Main generator, emergency diesel generator, and station blackout diesel generator neutrals are bonded to the station ground grid. The plant instrumentation and control system is connected to the station grounding grid.

In RAI 70, Question 08.03.01-17, the staff requested that the applicant demonstrate its adequacy of surge and lightning protection on insulation coordination and power quality limits as cited in RG 1.206. In a December 18, 2008, response to RAI 70, Question 08.03.01-17, the applicant added FSAR Tier 1, Table 2.5.8-1, Item 2.6 to include "Insulation coordination is achieved on surge arrestors on MSUs, NATs, and EATs and an analysis will be performed." The staff reviewed FSAR Tier 1, Table 2.5.8-1, Item 2.6, which will include analysis for surge arrestors and lightning protection. The staff finds the applicant has adequately addressed insulation coordination for the lightning protection and station grounding issue and, therefore, considers RAI 70, Question 08.03.01-17 resolved.

14.3.6.4.1.9 *Lighting System*

The lighting system includes the emergency lighting and special emergency lighting sub-systems. The non-safety-related functions provided by these two subsystems include providing MCR and RSS lighting for normal and off normal operation.

In RAI 373, Question 09.05.03-13, the staff requested that the applicant clarify whether U.S. EPR self-contained sealed-beam units provide illumination levels equal to or greater than those recommended by the Illuminating Engineering Society of North America (IESNA) for at least 8 hours. In an August 8, 2008, response to RAI 373, Question 09.05.03-13, the applicant stated that adequate lighting remains in service in the MCR if there is a loss of power from one division. Additionally, the applicant revised FSAR Tier 1, Table 2.5.9-1, "Lighting System ITAAC," to include Item 3.5, "Eight-hour battery pack emergency lighting fixtures provide illumination for post-fire shutdown activities performed by operators outside the MCR or RSS where EDG backed lighting is not credited," and a test will be performed. The staff reviewed the above response and finds the applicant has provided battery pack emergency lighting (i.e., U.S. EPR self-contained sealed-beam units) that does not depend on EDG. The staff considers this issue resolved.

Also, in RAI 373, Question 09.05.03-13, the staff requested that the applicant: (1) Address whether the control room emergency and special emergency lighting system is electrically independent and physically separated in FSAR Tier 1, Section 2.5.9, "Lighting System"; and (2) revise FSAR Tier 1, Table 2.5.9-1 to include the U.S. EPR self-contained sealed-beam units that provide illumination levels equal to or greater than those recommended in those areas of the plant required for power restoration and/or recovery from fire, for at least 8 hours.

In its August 8, 2008, response to RAI 373, Question 09.05.03-13, the applicant stated that approximately 50 percent of the overall lighting in the MCR from the emergency lighting and special emergency lighting systems is supplied from Division 2 EPSS and EUPS, respectively. The other 50 percent of the overall lighting in the MCR from the emergency lighting and special emergency lighting is supplied from Division 3 EPSS and EUPS, respectively. Electrical independence and physical separation is provided between the Division 2 and Division 3 components and circuits. Thus, adequate lighting remains in service in the MCR if there is a loss of power from one division. Subsequently, the applicant revised FSAR Tier 1, Table 2.5.9-1 by including the U.S. EPR self-contained sealed-beam units that provide illumination levels equal to or greater than those recommended in those areas of the plant required for power restoration and/or recovery from fire, for at least 8 hours as FSAR Tier 1, Table 2.5.9-1, Item 3.5. On the basis of its review, the staff finds the applicant adequately addressed the issue and, therefore, considers RAI 373, Question 09.05.03-13 resolved.

14.3.6.4.1.10 *Normal Power Supply System*

The normal power supply system provides non-Class 1E power to non-safety-related loads including RCPs during normal operation.

In RAI 116, Question 14.03.06-11, the staff requested that the applicant clarify why the list shown on FSAR Tier 1, Section 2.5.10, "Normal Power Supply System," includes four RCP circuit breakers, and does not include other major electrical equipment (e.g., emergency feedwater, residual heat removal (RHR), and condensate pumps) that will be installed on the onsite electrical distribution system for satisfying GDC 33, "Reactor Coolant Makeup," GDC 34, "Residual Heat Removal," GDC 35, "Emergency Core Cooling," GDC 38, " Containment Heat

Removal," GDC 41, "Containment Atmosphere Cleanup," and GDC 44, "Cooling Water," requirements. In an October 29, 2008, response to RAI 116, Question 14.03.06-11, the applicant stated that the NPSS is a non-Class 1E system, but the RCP has a safety-related feature to trip when conditions indicate a safety injection signal (SIS). The major electrical equipment components (such as emergency feedwater, residual heat removal, and condensate pumps) are provided in their respective system design description sections commensurate with the level of safety significance the system represents. For example, the condensate system does not have any safety significant features; therefore, there are no FSAR Tier 1 entries for that system. The applicant agreed to move the RCP design description in FSAR Tier 1, Section 2.5.10, "Normal Power Supply System," to FSAR Tier 1, Section 2.2.1, "Reactor Coolant System." The staff reviewed the applicant's basis for the RCP design description and concurs with the move to FSAR Tier 1, Section 2.2.1. The staff finds the applicant adequately addressed the safety system design consistency issue and, therefore, considers RAI 116, Question 14.03.06-11 resolved.

14.3.6.4.1.11 *12-Hour Uninterruptible Power Supply System*

The 12-hour uninterruptible power supply system provides non-Class 1E uninterruptible power during normal and abnormal operations to Nuclear Island and Turbine Island loads including AAC support features. For each 12UPS system, each battery should be able to provide power for starting and operating design loads for a minimum of 12 hours when the ac supply to the battery charger is lost, and each battery charger also supplies assigned 12UPS loads while maintaining the respective EUPS battery charged. Each 12UPS inverter is sized to power the 12UPS loads assigned to the respective supplied motor control center (MCC).

In RAI 116, Question 14.03.06-3, the staff requested that the applicant include all necessary analyses for electrical ITAAC Tables mentioned in FSAR Tier 1, Section 2.5, where applicable. In a November 26, 2008, response to RAI 116, Question 14.03.06-3, the applicant added FSAR Tier 1, Section 2.5.11, Items 3.1 and 3.3 to perform the following analyses: (1) For starting and operating design loads for a minimum of 12 hours for the 12UPS battery when the ac supply to the battery charger is lost; and (2) the 12UPS inverter are sized to power the loads assigned to the respective supplied MCC in FSAR Tier 1, Table 2.5.11-1. The staff finds the applicant adequately addressed this issue and, therefore, considers RAI 116, Question 14.03.06-3 resolved.

14.3.6.4.1.12 *Containment Electrical Penetrations*

The containment electrical penetrations for the U.S. EPR plant containing circuits and the capability of electric penetration assemblies are designed to withstand a LOCA without loss of mechanical integrity and the external circuit protection for such penetrations. In addition, dual primary overcurrent interrupting devices are provided for electrical circuits going through electrical penetration assemblies where the maximum available fault current exceeds the continuous rating of the penetration assembly.

In RAI 116, Question 14.03.06-2, the staff requested that the applicant clarify whether electrical circuits going through electrical penetration assemblies will include: (1) Analysis; (2) periodic testing; and (3) revision to FSAR Tier 2, Table 1.8-2 under "COL Information Item." In an October 29, 2008, response to RAI 116, Question 14.03.06-2, the applicant revised FSAR Tier 1, Table 3.5-3, "Containment Isolation ITAAC," Item 5.5 to state, "an analysis will be performed." As for the periodic testing program for containment penetration protective devices and assemblies, the applicant chose to revise FSAR Tier 2, Section 8.3.1.1.10, "Containment

Electrical Penetrations," (i.e., not as a COL information item for FSAR Tier 2, Table 1.8-2) to include once per 24 months select and functionally test a representative sample of at least 10 percent of circuit breakers of each type. The applicant justified that a 10 percent sample of circuit breakers is large enough to provide confidence that any failure mechanism that systematically affects circuit breakers of a given type will be detected. The applicant will also include periodic testing (Type B leakage rate tests according to 10 CFR Part 50, Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors,") of electrical penetration assemblies to FSAR Tier 2, Section 6.2.6.2, "Containment Penetration Leakage Rate Tests (Type B)." On the basis of its review, the staff finds the applicant's response acceptable and, therefore, considers RAI 116, Question 14.03.06-2 resolved.

The staff noted that FSAR Tier 2, Table 14.3-6, "PRA and Severe Accident Analysis," Items 6-16 through 6-19, on Page 14.3-21, provide no PRA values for electrical design features. Therefore, in RAI 116, Question 14.03.06-12, the staff requested that the applicant clarify whether those PRA values will be provided later, and by whom (i.e., COL applicants or U.S. EPR). In an October 29, 2008, response to RAI 116, Question 14.03.06-12, the applicant stated that FSAR Tier 2, Tables 14.3-1 through Table 14.3-7 contain the values that were judged to be safety-significant, but no additional values are expected to be added. To provide clarification, the applicant will revise FSAR Tier 2, Section 14.3.2 to include the statement, "If the value of the design feature was judged to be safety significant, then a value was provided in the tables." On the basis of its review, the staff finds that the applicant's response acceptable, and, therefore, considers RAI 116, Question 14.03.06-12 resolved.

14.3.6.4.2 Equipment Qualification (Compliance with 10 CFR 50.49)

The standard review plan acceptance criteria for FSAR Tier 2, Section 14.3.6, "Electrical System-ITAAC," identify EQ for harsh environment to ensure that the safety-related, certain non-safety-related, and certain post-accident monitoring equipment can perform their intended functions in various anticipated environments. The ITAAC information is contained in FSAR Tier 1 and it includes entire station electrical components for Class 1E portions of the system, EQ, and portions of non-Class 1E system. Table 14.3.6-1 below provides ITAAC information that identifies FSAR Tier 1 section numbers, table numbers, and Commitment Wording for EQ of mechanical, electrical, and instrumentation and control components.

Table 14.3.6-1 U.S. EPR Equipment Qualifications

FSAR Tier 1 Section Number	Table Number	Commitment Wording
2.2.1	2.2.1-2/3	6.1, 6.2
2.2.2	2.2.2-2	6.1
2.2.3	2.2.3-2	6.1
2.2.4	2.2.4-2	6.1
2.2.5	2.2.5-2	6.1
2.2.6	2.2.6-2	6.1

FSAR Tier 1 Section Number	Table Number	Commitment Wording
2.2.7	2.2.7-2	6.1
2.3.1	2.3.1-2	6.1
2.3.3	2.3.3-2	6.1
2.4.1	2.4.1-1	4.10
2.4.2	2.4.2-1	4.4
2.4.4	2.4.4-1	4.1
2.4.5	2.4.5-1	4.3
2.4.11	2.4.11-1	4.2
2.4.13	2.4.13-1	4.1
2.4.14	2.4.14-1	4.1
2.4.17	2.4.17-1	6.1
2.4.19	2.4.19-1	5.1
2.6.3	2.6.3-2	6.1
2.6.4	2.6.4-2	6.1
2.6.6	2.6.6-2	6.1
2.6.8	2.6.8-3	6.1
2.7.1	2.7.1-2	6.1
2.7.2	2.7.2-2	6.1
2.7.3	2.7.3-2	6.1
2.7.5	2.7.5-2	6.1
2.8.1	2.8.1-2	6.1
2.8.2	2.8.2-2	6.1
2.8.6	2.8.6-2	6.1
2.8.7	2.8.7-2	6.1

FSAR Tier 1 Section Number	Table Number	Commitment Wording
2.9.3	2.9.3-2	6.1
2.9.5	2.9.5-1	5.1
3.5	3.5-2	6.1, 6.2

In RAI 116, Question 14.03.06-4, the staff requested that the applicant clarify why FSAR Tier 2, Table 1.8-2, "U.S. EPR COL Information Items," COL Information Item 14.3-1 does not include EQ among emergency planning, physical security, and site-specific portions of the facility in the FSAR Tier 1. In an October 29, 2008, response to RAI 116, Question 14.03.06-4, the applicant stated that FSAR Tier 2, Section 13.4, "Operational Program Implementation," requires each COL applicant for the U.S. EPR design certification reference and include EQ as site-specific information for "operational programs and schedules for implementation"; therefore, there is no need to include EQ in FSAR Tier 2, Table 1.8-2, COL Information Item 14.3-1. On the basis of its review and the above ITAAC table includes EQ for those components located in harsh environments that are required to satisfy 10 CFR 50.49 requirements, the staff that the applicant's response acceptable and, therefore, considers RAI 116, Question 14.03.06-4 resolved.

In RAI 275, Question 14.03.06-34, the staff requested that the applicant provide or identify the location of ITAAC for the electrical and I&C components that are located in harsh environments. In a September 21, 2009, response to RAI 275, Question 14.03.06-34, the applicant stated that the electrical and I&C EQ components are located in its applicable mechanical system FSAR Tier 1. The staff finds that the ITAAC items discussed above for EQ pertaining to the electrical power system components are provided in FSAR Tier 1, Sections 2.2, 2.3, 2.4, 2.6, 2.7, 2.8, 2.9, and 3.5. The staff finds the applicant has correctively identified where all ITAAC EQ items are located and, therefore, considers RAI 275, Question 14.03.06-34 resolved.

14.3.6.4.3 Station Blackout (Compliance with 10 CFR 50.65)

Two SBODGs are provided as the AAC source to provide power to station loads necessary to bring and maintain the plant in a safe shutdown condition during non-design basis accident station blackout conditions.

In RAI 116, Question 14.03.06-7, the staff requested that the applicant clarify why FSAR Tier 1, Table 2.5.3-2 of ITAAC Section 2.5.3, "Station Blackout Alternate AC Source," does not have commitment entries for: (1) Starting SBODGs and manually aligning to their respective buses from the MCR within 10 minutes for an SBO; and (2) demonstrating fuel tank capacity and fuel transfer capability between tanks. In a November 26, 2008, response to RAI 116, Question 14.03.06-7, the applicant stated that in FSAR Tier 1, Table 2.5.3-2: (1) Items 4.2 and 4.3 will be revised to start SBODGs (Item 4.2 for SBODG #1 and Item 4.3 for SBODG #2) by manually aligning to their respective buses from the MCR within 10 minutes for simulated or actual SBO event; and (2) Items 3.2, 3.3, and 3.4 will be revised to demonstrate that each SBODG fuel oil storage tank capacity is greater than the volume of fuel oil consumed by the SBODG operating at the continuous rating for 24 hours (Item 3.2), each SBODG day tank capacity is greater than the volume of fuel oil consumed by the SBODG operating at the continuous rating for two hours (Item 3.3), and each fuel oil transfer pump capacity is greater

than SBODG fuel oil consumption at the continuous rating (Item 3.4). The staff has confirmed the above revision to all of the above commitment items and finds that the applicant has adequately addressed the staff's concerns and, therefore, considers RAI 116, Question 14.03.06-7 resolved.

14.3.6.5 *Combined License Information Items*

Section 14.3.1.5, Table 14.3.1-1 of this report provides a list of all ITAAC related COL information items and descriptions from FSAR Tier 2, Table 1.8-2 that are applicable to FSAR Tier 2, Section 14.3. The staff finds the list in Section 14.3.1.5, Table 14.3.1-1 to be complete. Also, the list adequately describes actions necessary for the COL applicant. No additional COL information items need to be included in FSAR Tier 2, Table 1.8-2.

14.3.6.6 *Conclusions*

The staff reviewed all relevant ITAAC information that is applicable to the electrical power system design and evaluated its compliance with GDC 17, 10 CFR 50.49, and 10 CFR 50.63. The staff finds that FSAR Tier 1 has provided necessary and sufficient information to satisfy FSAR Tier 2, Section 14.3 of this report for ITAAC design certification. Therefore, the staff concludes that the ITAAC provides reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, then a facility referencing the certified design can be constructed and operated in compliance with the design certification, the Atomic Energy Act of 1954, and applicable NRC regulations.

14.3.7 Plant Systems - Inspections, Tests, Analyses, and Acceptance Criteria

14.3.7.1 *Introduction*

SRP Section 14.3.7 addresses the review of ITAAC for plant systems for the U.S. EPR design. The staff reviewed the proposed ITAAC to determine whether a plant that incorporates the design certification can be built and operated in accordance with the design certification and NRC regulations.

14.3.7.2 *Summary of Application*

FSAR Tier 1 includes the ITAAC for plant systems. The scope of plant systems ITAAC includes FSAR Tier 1 information on new and spent fuel handling systems, power generation systems, air systems, cooling water systems, emergency diesel generator support systems, radioactive waste systems, and HVAC systems. The scope of review also includes issues which affect multiple SSCs such as equipment qualification, and protection from fires, floods, and tornado missiles.

14.3.7.3 *Regulatory Basis*

10 CFR 52.47(b)(1) requires that a U.S. EPR 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 plant that incorporates the design certification is built and will operate in accordance with the design certification, the provisions of the Atomic Energy Act of 1954, as amended, and NRC regulations.

SRP Section 14.3 provides general guidance for the staff's review of ITAAC. SRP Section 14.3.7, "Plant Systems - Inspections, Tests, Analyses, and Acceptance Criteria," provides guidance for the staff's review of ITAAC for plant systems. The staff reviewed the proposed ITAAC to determine whether a plant that incorporates the design certification can be built and operated in accordance with the design certification and NRC regulations.

14.3.7.4 *Technical Evaluation*

The staff reviewed the design description, system ITAAC, and functional arrangement to confirm completeness and consistency with the system design basis as described in FSAR Tier 2 sections. The staff verified that key performance characteristics and safety functions of SSCs were based on their safety significance. ASME Code III-related ITAAC and equipment qualifications are discussed in Sections 14.3.3 and 14.3.6 of this report, respectively.

The staff's review of the plant systems ITAAC are included in the review of the individual plant system sections in this report. Table 14.3.7-1 of this report provides a list of all the plant systems ITAAC and associated FSAR Tier 2 sections. Not all of the systems listed in Table 14.3.7-1 have an ITAAC. If there are no ITAAC for a system, the staff verified that no ITAAC was needed for the system. For the systems that do have ITAAC, the reviews of the ITAAC, including discussions of noteworthy RAI questions, and applicant RAI responses, are included in the section of this report corresponding to the applicable FSAR Tier 2 sections for that system.

14.3.7.5 *Combined License Information Items*

Section 14.3.1.5, Table 14.3.1-1 of this report provides a list of all ITAAC related COL information items and descriptions from FSAR Tier 2, Table 1.8-2 that are applicable to FSAR Tier 2, Section 14.3. The staff finds the list in Section 14.3.1.5, Table 14.3.1-1 to be complete. Also, the list adequately describes actions necessary for the COL applicant. No additional COL information items need to be included in FSAR Tier 2, Table 1.8-2.

14.3.7.6 *Conclusions*

The final staff conclusion will be made upon completion of the staff's review of the applicant's outstanding RAI responses from the sections referenced in the table below and successful resolution of concerns associated with open items. Except for the open items, the staff concludes that if the ITAAC, for these systems identified in Section 14.3.7 of this report are performed and the acceptance criteria met, then a facility referencing the certified design can be constructed and operated in compliance with the design certification, the Atomic Energy Act of 1954, and applicable NRC regulations.

Table 14.3.7-1 Plant Systems ITAAC

Description of FSAR Tier 1 Sections	FSAR Tier 1 Section Numbers	Related FSAR Tier 2 Section Numbers
Nuclear Island	2.1.1	3.4.1
Emergency Power	2.1.2	3.4.1

Description of FSAR Tier 1 Sections	FSAR Tier 1 Section Numbers	Related FSAR Tier 2 Section Numbers
Generating Buildings		
Essential Service Water Building	2.1.5	3.4.1
Emergency Feedwater System	2.2.4	10.4.9
Fuel Pool Cooling and Purification System	2.2.5	9.1.3
Fuel Handling System	2.2.8	9.1.4 and 9.1.5
Plant Fire Alarm System	2.4.6	9.5.1
Leak Detection System	2.4.8, 2.9.4, 2.9.5	5.2.5
Turbine-Generator I&C	2.4.23	10.2
Emergency Diesel Generator Support Systems	2.5.4	9.5.4 through 9.5.8
HVAC Systems	2.6	9.4
Component Cooling Water System	2.7.1	9.2.2
Safety Chilled Water System	2.7.2	9.2.8
Sprinkler System	2.7.3	9.5.1
Fire Water Distribution System	2.7.5	9.5.1
Gaseous Fire Extinguishing System	2.7.6	9.5.1
Demineralized Water Distribution System	2.7.9	9.2.3
Potable and Sanitary Water System	2.7.10	9.2.4
Essential Service Water System (includes the ultimate heat sink-UHS)	2.7.11	9.2.1 and 9.2.5
Compressed Air System	2.7.12	9.3.1

Description of FSAR Tier 1 Sections	FSAR Tier 1 Section Numbers	Related FSAR Tier 2 Section Numbers
Turbine-Generator System	2.8.1	10.2
Main Steam System	2.8.2	10.3
Turbine Seal System	2.8.3	10.4.3
Condensate System	2.8.5	10.4.7
Main Feedwater System	2.8.6	10.4.7
Main Condenser Evacuation	2.8.10	10.4.2
Circulating Water Supply System	2.8.11	10.4.5
Liquid Waste Management System	2.9.1	11.2
Solid Water Management System	2.9.2	11.3
Gaseous Waste Processing System	2.9.3	11.4
Cranes	2.10.1	9.1.4 and 9.1.5
Pipe Break Hazards	3.8	3.6.1

14.3.8 Radiation Protection

14.3.8.1 *Introduction*

SRP Section 14.3.8, "Radiation Protection - Inspections, Tests, Analyses, and Acceptance Criteria," addresses the review of ITAAC for Radiation Protection for the U.S. EPR. The staff reviewed the proposed ITAAC to determine whether a plant that incorporates the design certification can be built and operated in accordance with the design certification and NRC regulations.

The scope of Radiation Protection ITAAC review includes:

- Area radiation monitoring systems
- Airborne radioactivity monitoring systems
- Radiation shielding provided by structures and components
- Design processes for radiation protection and their related design acceptance criteria

- Other ITAAC which addresses plant radiation protection design

14.3.8.2 *Summary of Application*

FSAR Tier 1: The applicant provided design descriptions for Radiation Protection in FSAR Tier 1, Sections 2.1.1, "Nuclear Island," 2.4.22, "Radiation Monitoring System," 2.6.1, "Main Control Room Air Conditioning System," 2.6.4, "Fuel Building Ventilation System," 2.6.6, "Safeguards Building Controlled-Area Ventilation System," and 2.9.4, "Sampling Activity Monitoring System." FSAR Tier 1, Chapter 1, "Introduction," provides definitions, general provisions, and a legend for figures, acronyms, and abbreviations.

FSAR Tier 2: FSAR Tier 2, Section 14.3, "Inspection, Test, Analysis, and Acceptance Criteria," provides a general description of the U.S. EPR ITAAC including its relationship to other FSAR Tier 1 information, the selection criteria, and content.

ITAAC: The applicant provided ITAAC for Radiation Protection in FSAR Tier 1, Sections 2.1.1, 2.4.22, 2.6.1, 2.6.4, 2.6.6, and 2.9.4.

Technical Specifications: There are no technical specifications for this area of review.

14.3.8.3 *Regulatory Basis*

The relevant requirements of NRC regulations for this area of review, and the associated acceptance criteria, are specified in NUREG-0800, Sections 14.3.8 and 12.1, "Assuring that Occupational Radiation Exposures Are As Low As Is Reasonably Achievable," through 12.5, "Operational Radiation Protection Program," and are summarized below. Review interfaces with other SRP sections also can be found in NUREG-0800, Section 14.3.8.

SRP Section 14.3.8 refers to SRP Section 14.3 for guidance on the content and format of ITAAC. Relevant portions of SRP 14.3 include:

1. SRP Section 14.3, Appendix A, "Information on Prior Design Certification Reviews," IV.1.A, "Definitions"

2. SRP Section 14.3, Appendix A, IV.2, "General Provisions"

3. SRP Section 14.3 Appendix A, IV.3, "Legend for Figures and Acronyms and Abbreviations"

4. SRP Section 14.3, Appendix A, IV.4.B, "ITAAC," Defines three column format and explains ITAAC terminology

5. SRP Section 14.3, Appendix C, "Fluid Systems Review Checklist," II.C, "Style Guidelines for ITAAC"

6. SRP Section 14.3, Appendix C, "Instrumentation and Control Systems Review Checklist," III, "Reviewer Check Lists"

7. SRP Section 14.3, Appendix D, "ITAAC Entries"

8. GDC 19, “Control Room,” as it relates to the requirement, in part, that adequate radiation protection be provided to permit access and occupancy of the control room under accident conditions without personnel receiving radiation exposures in excess of 0.05 sieverts (5 rem) whole body, or its equivalent to any part of the body, for the duration of the accident.

9. GDC 61, “Fuel Storage and Handling and Radioactivity Control,” as it relates to the requirement that occupational radiation protection aspects of fuel storage, fuel handling, radioactive waste, and other systems that may contain radioactivity, be designed such that they ensure adequate safety during normal and postulated accident conditions, with suitable shielding and appropriate containment and filtering systems.

10. GDC 63, “Monitoring Fuel and Waste Storage,” as it relates to the requirement, in part, that appropriate systems be provided for the fuel storage and radioactive waste systems and associated handling areas to detect conditions that may result in loss of residual heat removal capability and excessive radiation levels.

11. GDC 64, “Monitoring Radioactivity Releases,” as it relates to the requirement that the containment atmosphere, spaces containing components for recirculation of loss-of-coolant accident fluids, effluent discharge paths, and the plant environs be monitored for radioactivity that may be released from normal operations, including anticipated operational occurrences, and from postulated accidents.

12. 10 CFR 20.1101, “Radiation protection programs,” as it relates to the requirement that the licensee shall use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA).

13. 10 CFR 20.1201, “Occupational dose limits for adults,” as it relates to the requirement, in part, that with the exception of planned special exposures that the annual dose limit for adults is equal to a total effective dose equivalent of 5 rems, or the sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 50 rems.

14. 10 CFR 20.1501, “General,” as it relates to the requirement, in part, that licensees make surveys that are reasonable under the circumstances to evaluate, the magnitude and extent of radiation levels, the concentrations or quantities of radioactive material, and the potential radiological hazards.

15. 10 CFR 20.1701, “Use of process or other engineering controls,” as it relates to the requirement that the applicant shall use, to the extent practical, process or other engineering controls to control the concentration of radioactive material in air.

16. 10 CFR 50.34(f)(2)(xvii), “Contents of applications; technical information,” as it relates to the requirement, in part, that instrumentation be provided, that can measure, record and readout in the main control room containment radiation intensity (high level).

17. 10 CFR 52.47(b)(1), as it relates to the requirement that an U.S. EPR 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 plant that incorporates the design certification is built and will operate in

accordance with the design certification, the provisions of the Atomic Energy Act of 1954, and NRC regulations.

14.3.8.4 *Technical Evaluation*

The applicant provided design-basis information, including associated tables and figures, in accordance with the selection criteria and methodology for developing FSAR Tier 1 information, as described in FSAR Tier 2, Section 14.3, to support ITAAC for U.S. EPR SSCs. The applicant organized the FSAR Tier 1 information in the systems, structures, and topical areas format shown in the FSAR Tier 1, Table of Contents. The staff reviewed the FSAR Tier 1 information provided by the applicant in accordance with SRP Section 14.3.8.

The documents that contain the supporting information for verification of the radiation protection aspects of the U.S. EPR design are FSAR Tier 1, Section 2.1.1 for nuclear island radiation barriers, FSAR Tier 1, Section 2.9.4 for the MCR ventilation intake radioactivity monitors, FSAR Tier 1, Section 2.4.22 for the radiation monitoring system, and FSAR Tier 1, Section 2.6 for the nuclear island ventilation system. FSAR Tier 1, Section 2.1.1 describes the nuclear island structures, including wall and slab thicknesses and associated ITAAC for those walls and slabs that serve as safety-related radiation shields during post-accident vital area access. FSAR Tier 1, Section 2.9.4 provides ITAAC for the ventilation radiation monitors in the MCR ventilation intake that serve the safety-related function of providing a radioactivity indication which initiates isolation of the MCR ventilation intake both during and after an accident; and complies with the requirements of GDC 19. FSAR Tier 1, Section 2.4.22 describes and proposes ITAAC for the safety-related containment post-accident high range radiation monitors, which are required by 10 CFR 50.34(f)(2)(xvii). Finally, FSAR Tier 1, Section 2.6 describes at a high level the safety-related nuclear island ventilation systems for the Fuel Building, the main control room, the Safeguard Buildings and containment. FSAR Tier 1, Section 2.6 also contains proposed ITAAC for each safety-related ventilation system.

Areas of the staff's review included implementation of the selection criteria and methodology for developing FSAR Tier 1 information, as discussed in FSAR Tier 2, Section 14.3, and the resultant FSAR Tier 1 information associated with the area radiation monitoring systems, airborne radioactivity monitoring systems, nuclear island ventilation system, and radiation shielding provided by structures and components for normal and accident conditions. The applicant's screening criteria in FSAR Tier 2, Section 14.3, stated that only those radiation protection SSCs which are safety-related would be included in FSAR Tier 1 and have ITAAC. However, 10 CFR 52.47(b)(1) states, in part, that all design certifications must contain sufficient ITAAC to provide reasonable assurance that a facility that incorporates the design certification will be constructed and will be operated to comply with NRC regulations. Therefore, in RAI 43, Question 14.03.08-1, the staff requested that the applicant demonstrate compliance with 10 CFR 52.47(b)(1) by expanding FSAR Tier 1 and ITAAC beyond safety-related SSCs, such that non-safety-related SSCs which demonstrate compliance with 10 CFR Part 20 and 10 CFR Part 50, Appendix A would also be included. Specifically, RAI 43, Question 14.03.08-1 addressed the lack of FSAR Tier 1 description and ITAAC for radiation area and airborne monitors, shielding, and ventilation critical to ensuring that the dose limits of 10 CFR Part 20, "Standards for Protection Against Radiation," are met; and that occupational radiation exposures are maintained as low as reasonably achievable (ALARA) in accordance with 10 CFR 20.1101, "Radiation Protection Programs." In RAI 43, Question 14.03.08-1, the staff requested that the applicant add FSAR Tier 1 information and ITAAC to the application for those SSCs that provide radiation shielding, confinement or containment of radioactivity, ventilation of

airborne contamination, and monitoring of radiation (or radioactivity concentrations) for normal operations and during accidents.

In November 7, 2008, and April 7, 2009, responses to RAI 43, Question 14.03.08-1, the applicant provided pointers to the FSAR Tier 1, sections which describe the safety-related ventilation systems, and also expanded their criteria for including shielding walls in FSAR Tier 1 to encompass walls and floors which provide shielding between frequently accessed areas (2.5×10^{-5} sieverts/hr (2.5 mrem/hr) or less) and locked high radiation areas (0.05 sieverts/hr (5 rem/hr) or more). The applicant also revised FSAR Tier 1 so that Section 2.4.22 provided design detail and ITAAC for the containment high range dose rate monitors. Additional detail was added to FSAR Tier 1, Section 2.9.4 regarding the radiation measuring function of the safety-related MCR ventilation intake radioactivity monitor. However, in addition to the SSC information described above, further detail is needed to provide assurance of compliance with the radiation protection regulations of 10 CFR 20.1201, "Occupational Dose Limits for Adults," 10 CFR 20.1101, "Radiation Protection Programs," 10 CFR 20.1501, "General," 10 CFR 20.1701, "Use of Process or other Engineering Controls," 10 CFR 50.34(f)(2)(xvii), GDC 19, GDC 61, GDC 63, and GDC 64. Therefore, the staff closed RAI 43, Question 14.03.08-1, and in follow-up RAI 386, Questions 14.03.08-2 and 14.03.08-3, the staff requested that the applicant address this issue.

In RAI 386, Question 14.03.08-2, the staff requested that the applicant revise FSAR Tier 1 to include more detail on the non-safety-related radiation monitoring system, including the area monitors located around the plant and the airborne radioactivity monitors located in the ventilation systems within the Nuclear Island and the Radioactive Waste Building. These radioactivity monitors provide warning of significant changes in radioactivity levels in accordance with 10 CFR 20.1501, as well as alert workers to releases of airborne radioactivity, allowing for containment and decontamination in accordance with 10 CFR 20.1701 and GDC 64. The installation of functional fixed area and airborne radiation monitors also supports compliance with 10 CFR 20.1201 and 20.1101, which require that licensees maintain worker doses below 0.05 sieverts (5 rem) and ALARA, even when radiation levels may be rapidly changing such as during plant evolutions. The installation of fixed radiation monitors demonstrates compliance with GDC 63 and GDC 64 in that applicants for a reactor license are also required to have appropriate systems for detecting unsafe conditions where fuel and waste are stored, as well as appropriate systems to monitor for radioactivity in areas where post-accident fluids may circulate (outside of containment).

In RAI 386, Question 14.03.08-3, the staff requested that the applicant revise FSAR Tier 1, Table 2.4.22-1, "Radiation Monitoring System Equipment Mechanical Design," and FSAR Tier 1, Table 2.4.22-2, "Radiation Monitoring System Equipment I&C and Electrical Design." Both of these tables state that the containment high range dose rate monitors are located inside the Reactor Building. However, the Reactor Building is actually made up of the Containment Building, the outer Shield Building and the annulus space between the two. Therefore, as indicated by the monitor name, the actual location of the monitor must be inside containment. The staff requested that this change be made in FSAR Tier 1, Tables 2.4.22-1 and 2.4.22-2.

As stated before, the ITAAC reviewed by the staff in accordance with SRP Section 14.3.8 should also include systems that, while not safety-related, ensure compliance with the regulatory requirements of 10 CFR 20.1101, 10 CFR 20.1201, 10 CFR 20.1501, 10 CFR 20.1701, and 10 CFR Part 50, Appendix A, GDC 19, GDC 61, GDC 63, and GDC 64. Programs that will be mandated by license conditions govern the operation of these systems to

demonstrate compliance with the above regulatory requirements. These operational programs include the Radiation Protection Program, which addresses plant management policy, organization, facilities, instrumentation, and equipment, and procedures sufficient to ensure that occupational doses and doses to public areas remain ALARA. FSAR Tier 2, Section 13.4, "Operational Program Implementation," addresses, as a COL license condition, the milestones for developing and implementing the Operational Radiation Protection Program. The proposed ITAAC, in conjunction with the implementation of these operational programs, once performed by a COL applicant and having met their respective acceptance criteria, should provide reasonable assurance that a plant incorporating the design certification will operate in accordance with the U.S. EPR design certification and the provisions of the Atomic Energy Act of 1954 and NRC regulations.

RAI 386, Questions 14.03.08-2 and 14.03.08-3 are being tracked as open items.

14.3.8.5 *Combined License Information Items*

Section 14.3.1.5, Table 14.3.1-1 of this report provides a list of all ITAAC related COL information items and descriptions from FSAR Tier 2, Table 1.8-2 that are applicable to FSAR Tier 2, Section 14.3. The staff finds the list in Table 14.3.1-1 to be complete. Also, the list adequately describes actions necessary for the COL applicant or licensee. No additional COL information items need to be included in FSAR Tier 2, Table 1.8-2.

14.3.8.6 *Conclusions*

The applicant provided FSAR Tier 1 and ITAAC for safety-related radiation protection SSCs which they credited for demonstrating that a plant incorporating the U.S. EPR design certification will be built and operated in accordance with 10 CFR Part 20 and 10 CFR Part 50, Appendix A. However, the staff notes that based on the guidance of SRP Section 14.3.8, the level of detail provided for the RMS in FSAR Tier 1 and ITAAC of the application is not sufficient to provide the staff with reasonable assurance of compliance with 10 CFR 52.47(b)(1), 10 CFR 50.34(f)(2)(xvii), 10 CFR Part 20, and 10 CFR Part 50, Appendix A. Therefore, in RAI 386, Questions 14.03.08-2 and 14.3.8-3, which are being tracked as open items, the staff has requested that the applicant provide additional FSAR Tier 1 and ITAAC for the area and airborne radiation monitoring systems to demonstrate compliance with 10 CFR Part 20, 10 CFR Part 50, Appendix A, and 10 CFR 50.34(f)(2)(xvii).

Based on the staff's review, and on the above discussions, as well as on the applicant's implementation of the selection criteria and methodology for the development of FSAR Tier 1 information and ITAAC in FSAR Tier 2, Section 14.3, and except for the open items discussed above, the staff concludes that the radiation protection ITAAC discussed in FSAR Tier 1 meet the applicable acceptance criteria in SRP Section 14.3.8; such that, if the inspections, tests, and analyses are performed and the acceptance criteria met, then a facility referencing the U.S. EPR certified design has been constructed, and will be operated, in compliance with the design certification, the Atomic Energy Act of 1954, and applicable NRC regulations.

The final staff conclusion will be made upon completion of the staff's review of outstanding RAI responses from the applicant and successful resolution of concerns associated with open items.

14.3.9 Human Factors Engineering

14.3.9.1 *Introduction*

SRP Section 14.3.9 addresses the review of human factors engineering ITAAC for the U.S. EPR. The staff reviewed the proposed ITAAC to determine whether a plant that incorporates the design certification can be built and operated in accordance with the design certification and NRC regulations.

The scope of HFE ITAAC review includes the high level commitments to the human factors principles and program elements described in SRP Chapter 18, "Human Factors Engineering," and included in FSAR Tier 1. The scope of the HFE program, as it pertains to human-system interfaces, includes the main control room, remote shutdown facility, local control stations, technical support center, and emergency operations center.

14.3.9.2 *Summary of Application*

FSAR Tier 1: The applicant has provided commitments for HFE in FSAR Tier 1, Section 3.4, "Human Factors Engineering." FSAR Tier 1, Chapter 1, "Introduction," provided definitions, general provisions, and a legend for figures, acronyms, and abbreviations.

FSAR Tier 2: FSAR Tier 2, Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria," provides a general description of the U.S. EPR ITAAC including its relationship to other FSAR Tier 1 information, the selection criteria, and content.

ITAAC: The applicant has provided ITAAC for human factors engineering in FSAR Tier 1, Table 3.4-1, "Human Factors Engineering ITAAC," in support of HFE ITAAC.

Technical Specifications: There are no technical specifications for this area of review.

14.3.9.3 *Regulatory Basis*

The relevant requirements of the NRC regulations for this area of review, and the associated acceptance criteria, are given in NUREG-0800, Section 14.3.9, "Human Factors Engineering - Inspections, Tests, Analyses, and Acceptance Criteria," and are summarized below. Review interfaces with other SRP sections also can be found in NUREG-0800, Section 14.3.9. These review interfaces are addressed in other sections of this report.

10 CFR 52.47(b)(1) requires that a design certification application contain the ITAAC that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification is built and will operate in accordance with the design certification, the provisions of the Atomic Energy Act of 1954, and NRC regulations.

Acceptance criteria adequate to meet the above requirements include:

1. SRP 14.3.9, HFE – Inspections, Tests, Analyses, and Acceptance Criteria, Section II contains specific acceptance criteria used in the following staff's technical evaluation.

2. SRP 14.3.9 refers to SRP 14.3 for guidance on the content and format of ITAAC. Relevant portions of SRP 14.3 include:

- SRP 14.3 App. A IV.1.A -Definitions
- SRP 14.3 App. A IV.2 -General Provisions
- SRP 14.3 App. A IV.3 - Legend for Figures and Acronyms and Abbreviations
- SRP 14.3 App. A IV.4.B, ITAAC - Defines three column format and explains ITAAC terminology
- SRP 14.3 App. D – ITAAC Entries

3. For U.S. EPR applications, FSAR Tier 1 design descriptions and ITAAC design commitments should be based on and consistent with the FSAR Tier 2 material.

4. SRP Chapter 18 provides guidance for the staff to use in determining whether an applicant has proposed an acceptable HFE design. The applicant's HFE program will be evaluated in accordance with the review criteria of SRP Chapter 18 and NUREG-0711, "Human Factors Engineering Program Review Model." As indicated in SRP Chapter 18, the HFE program technical information for the design certification or COL review may be based on a design and implementation process plan. Therefore, the design certification or COL ITAAC may be based on a design and implementation process plan.

14.3.9.4 *Technical Evaluation*

The staff reviewed FSAR Tier 1, Section 3.4, Revision 3, "Human Factors Engineering," and Table 3.4-1, "Human Factors Engineering ITAAC," which addresses the FSAR Tier 1 ITAAC for human factors engineering.

Acceptance Criterion 1

The applicant's HFE program will be evaluated in accordance with the review criteria of SRP Chapter 18 and NUREG-0711, "Human Factors Engineering Program Review Model." As indicated in SRP Chapter 18, the HFE program technical information for the U.S. EPR design or COL review may be based on a design and implementation process plan. Therefore, the U.S. EPR or COL ITAAC may be based on a design and implementation process plan. For example, acceptance criteria for the task analysis program element may be stated as "a report exists and concludes that function-based task analyses were conducted in conformance with the task analysis implementation plan and include the following functions …."

As described in NUREG-0711, which the applicant identifies as the "Output Summary Report" in the Acceptance Criteria column of FSAR Tier 1, Table 3.4-1, the report gives the results of the applicant's efforts related to each NUREG-0711 element that is an ITAAC and summarizes the results of the activity (e.g., task analysis). The report also includes a description of how the activity was completed in accordance with the specific NRC-approved implementation plan (implementation plans are part of the applicant's FSAR) and the results or product that exists from completing the activity (e.g., the task analysis).

Staff Evaluation of Acceptance Criterion 1

For each NUREG-0711 program element directly supporting HFE design development and design verification and validation, the applicant submitted an implementation plan describing the

process for completing each element. These plans are included by reference in the applicant's FSAR. The staff's review and acceptance of these plans is documented in Chapter 18 of this report. Each element that has an implementation plan represents design work yet to be completed and has a "DAC ITAAC" to track completion of the work. This strategy is acceptable, since HFE design is an area approved for the application of HFE "DAC ITAAC."

SRP 14.3.9, Section III.2 states that the staff will ensure that all FSAR Tier 1 information is consistent with FSAR Tier 2 information. In RAI 516, Question 14.03.09-19, the staff requested that the applicant clarify why the Emergency Operating Facility was omitted from the FSAR Tier 1 description of HFE program scope. **RAI 516, Question 14.03.09-19 is being tracked as an open item.**

Acceptance Criterion 2

If an implementation plan, rather than a completed HFE element, was accepted as part of the design certification process, then ITAAC should address the completion of the HFE program element.

Staff Evaluation of Acceptance Criterion 2

NUREG-0711 describes 12 elements comprising the HFE design process. Two elements (HFE Program Management Plan and Human Performance Monitoring) have been submitted as completed program elements. Two other elements (Procedures and Training) are operational programs and are addressed in Chapter 13 of this report. For the Staffing and Qualification element, the applicant submitted a technical report explaining that the task analysis implementation plan establishes the process used to develop the bases for drawing a conclusion on the adequacy of staffing and qualifications. Implementation plans were submitted for the remaining elements. FSAR Tier 1, Table 3.4-1 contains "DAC ITAAC" for these elements, each of which contains a commitment (Column 1 of the ITAAC) to complete the HFE program element in accordance with the implementation plan. The implementation plans describe the design process that is used to produce the design product associated with each of the incomplete program elements and contain the prescribed limits, parameters, procedures, and attributes upon which the staff relies in making a final safety determination in support of the design certification.

The staff concludes that the proposed ITAAC conform to this criterion, because they address the completion of all remaining HFE program elements that are not operating programs. Procedures and training are addressed as COL action items in Chapter 13 of this report.

Acceptance Criterion 3

If an implementation plan was not reviewed and approved as part of the design certification, then the ITAAC should address both the development of the plan, as well as Acceptance Criterion 2 above.

Staff Evaluation of Acceptance Criterion 3

This criterion is not applicable, because implementation plans have been reviewed.

Acceptance Criterion 4

The reviewer will verify that HFE-related ITAAC information is provided based on accepted HFE principles and program elements as discussed in SRP Chapter 18 and incorporated into the plant's design.

Staff Evaluation of Acceptance Criterion 4

Two ITAAC are included in FSAR Tier 1, Table 3.4-1 to verify the as-built configuration. The first provides for a verification that the main control room and remote shutdown station contain the minimum inventory of alarms, controls, and displays needed for the operator to perform emergency operating plan (EOP) actions and PRA critical actions to bring the reactor to a safe-shutdown condition and to maintain it in that condition. The second is more general and provides a verification that the as-built design conforms to the standard design resulting from the HFE verification and validation process. Both these ITAAC have acceptance criteria that are directly associated with the human-system interface (HSI) design and the verification and validation elements of the HFE design process.

As discussed in the previous criteria, the remaining ITAAC are directly related to approved implementation plans.

The staff concludes the proposed ITAAC conform to this criterion, because ITAAC exist to verify that the HFE design process used as the basis for safety conclusions in Chapter 18 of this report is satisfactorily implemented and that the final HFE design is accurately captured in the as-built plant configuration. All ITAAC are derived from accepted HFE principles and program elements described in Chapter 18 of this report.

Acceptance Criterion 5

HFE-related ITAAC should primarily address verification of products (e.g., the control room, the human-system interfaces, etc.) or results reports from implementing the HFE program element implementation plan.

Staff Evaluation of Acceptance Criterion 5

The applicant has identified HFE design as an area subject to "DAC ITAAC." These specialized ITAAC fulfill two functions. First, they verify the design process described in the implementation plan is followed, and second, they verify the design product from the respective HFE program element is complete. The applicant has addressed both of these functions within the acceptance criteria for each ITAAC. The first function is accomplished by stating the output summary report exists and demonstrates that the design activity is performed in accordance with the applicable implementation plan or the "prescribed process." Since the prescribed process is contained in the implementation plan, the staff believes the two sets of words are comparable, but clarity could be improved by being consistent in the ITAAC wording. Therefore, in RAI 516, Question 14.03.09-17, the staff requested that the applicant adjust the ITAAC so "Implementation Plan" is consistently used. **RAI 516, Question 14.03.09-17 is being tracked as an open item.**

The second function is accomplished by stating that an output summary report exists and includes (or accomplishes) the design products (or functions). The products (or functions) are given making it clear what must be addressed in the results summary report. The list conforms

to the products identified in NUREG-0711. This part of the output summary report is equivalent to the results summary report identified in NUREG-0711.

The ITAAC associated with the Operating Experience Review program element is an exception to the paragraph above. The "DAC ITAAC" did not accomplish the two functions described above. The following RAIs address this ITAAC:

1. In RAI 369, Question 18-135, the staff requested that the ITAAC acceptance criteria be changed to address the specific design products that would be included in the output summary report. In an April 5, 2010, response to RAI 369, Question 18-135, the applicant provided a revised ITAAC that satisfactorily addressed the scope and results of the operating experience review (OER) process. The acceptance criteria were changed to say that the output summary report addresses:

    - A list of databases used for searching
    - A list of analyzed documents
    - A list of significant issues found along with their implementation status at the time of the report

The staff confirmed that FSAR Tier 2 contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 369, Question 18-135 resolved.

2. The ITAAC associated with the Operating Experience program element does not address the first function of a "DAC ITAAC," which is to verify the design process described in the implementation plan is followed. In RAI 516, Question 14.03.09-18, the staff requested that the applicant adjust the ITAAC so it specifically addresses compliance with the implementation plan. **RAI 516, Question 14.03.09-18 is being tracked as an open item.**

Several ITAAC were changed during reviews of the various FSAR Revisions. The RAIs associated with these changes are described below.

1. The ITAAC associated with the Staffing and Qualification program element did not address the first function of a "DAC ITAAC" which is to verify the design process described in the implementation plan is followed. Therefore, in RAI 369, Question 18-138, the staff requested that the applicant adjust the ITAAC to specifically address implementation plan compliance. In an April 5, 2010, response to RAI 369, Question 18-138, the applicant provided a revised ITAAC with acceptance criteria that stated the output summary report includes documentation that shows the staffing and qualification design process was conducted in accordance with the task analysis implementation plan. In this case, it is the task analysis implementation plan that demonstrates that the HSI design supports the number, roles, and responsibilities of the plant operating staff.

The staff confirmed that FSAR Tier 2 contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 369, Question 18-138 resolved.

2. FSAR Revisions 1 and 2 contained procedure and training-related ITAAC. In RAI 472, Question 18-238, the staff noted that these areas are operational programs addressed in Chapter 13 and requested that the applicant delete the ITAAC. In a February 2, 2010, response to RAI 472, Question 18-238, the applicant removed FSAR Tier 1 references to and ITAAC associated with procedures and training.

The staff confirmed that FSAR Tier 2 contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 472, Question 18-238 resolved.

3. The ITAAC associated with the functional requirements analysis and functional allocation program elements did not address the first function of a "DAC ITAAC" – to verify the design process described in the implementation plan is followed. Therefore, in RAI 374, Question 18-158, the staff requested that the applicant adjust the ITAAC to specifically address implementation plan compliance. In a May 17, 2010, response to RAI 374, Question 18-158, the applicant provided a revised ITAAC with acceptance criteria that stated the output summary report includes documentation showing that the functional requirements analysis and the functional allocation program elements are conducted in accordance with the Functional Requirements Analysis and Functional Allocation Implementation Plan.

The staff confirmed that FSAR Tier 2 contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 374, Question 18-158 resolved.

4. The ITAAC associated with the task analysis program element did not address either function of a "DAC ITAAC." In RAI 369, Question 18-137, the staff requested that the applicant adjust the ITAAC to specifically address implementation plan compliance and verification of the completed HFE design product. In an April 5, 2010, response to RAI 369, Question 18-137, the applicant provided a revised ITAAC which satisfactorily addressed both "DAC ITAAC" functions.

The staff confirmed that FSAR Tier 2 contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 369, Question 18-137 resolved.

5. The ITAAC associated with the Human Reliability Analysis (HRA) program element did not address the first function of a "DAC ITAAC" to verify the design process described in the implementation plan is followed. Therefore, in RAI 369, Question 18-139, the staff requested that the applicant adjust the ITAAC to specifically address implementation plan compliance. In an April 5, 2010, response to RAI 369, Question 18-139, the applicant provided a revised ITAAC with acceptance criteria stating the output summary report includes documentation showing that the HRA program element is conducted in accordance with the HRA Implementation Plan.

The staff confirmed that FSAR Tier 2 contains the changes committed to in the RAI response. Accordingly, the staff finds the applicant has adequately addressed this issue and, therefore, considers RAI 369, Question 18-139 resolved.

The staff's conclusion on this criterion is pending satisfactory resolution of the open items.

Acceptance Criterion 6

Minimum Inventory of Displays, Alarms and Controls

FSAR Tier 1 includes a minimum inventory of displays, controls, and alarms that are necessary to carry out the vendor's emergency procedure guidelines (i.e., Owners Groups' Generic Technical Guidelines) and critical actions identified from the applicant's PRA and task analysis of operator actions.

Staff Evaluation of Acceptance Criterion 6

FSAR Tier 1 does not contain a list of the minimum inventory (MI) of displays, alarms, and controls. This is in accord with the staff's position, because for U.S. EPR the MI is specifically developed within the task analysis element which has a DAC; doing so would result in redundant work at best and, at worst, identification of minimum inventory using undefined processes dissociated from the HFE design process described in NUREG-0711. By identifying minimum inventory within the approved HFE design process, a top down approach is maintained where functional requirements analysis and functional allocation (deciding on whether automatic versus manual control will be used for a function) define a structure in which the task analysis must then demonstrate how each function is met. This provides a direct correlation between safety function and the tasks the operator must perform. The emergency operating procedures and critical actions are a fundamental piece of the task analysis, but instead of being the starting point for identifying the minimum inventory, they are integrated in a process that demonstrates safety functions are satisfactorily maintained.

The functional requirements analysis, functional allocation, and task analysis have not been completed for the U.S. EPR design (which is acceptable, because HFE design is approved as a "DAC ITAAC" area), and so the minimum inventory is not yet identified. The applicant has included a "DAC ITAAC" to verify that minimum inventory is developed and designed in accordance with the HSI Design Implementation Plan and is documented for the control room and remote shutdown station.

The staff concludes that the "DAC ITAAC" is acceptable because it addresses the two functions described above. The strategy used to identify the minimum inventory is acceptable (and preferred, because the relationship between safety functions and operator tasks is maintained. The staff is processing a change to NUREG-0711 and the SRP to reflect this position.

14.3.9.5 *Combined License Information Items*

Section 14.3.1.5, Table 14.3.1-1 of this report provides a list of all ITAAC related COL information items and descriptions from FSAR Tier 2, Table 1.8-2 that are applicable to FSAR Tier 2, Section 14.3. The staff finds the list in Table 14.3.1-1 to be complete. Also, the list adequately describes actions necessary for the COL applicant. No additional COL information items need to be included in FSAR Tier 2, Table 1.8-2.

14.3.9.6 *Conclusions*

Except for the open items and based on the staff's review discussed above, as well as the applicant's implementation of the selection criteria and methodology for the development of the FSAR Tier 1 information in FSAR Tier 2, Section 14.3, the staff concludes that FSAR Tier 1 describes the top-level design features and performance characteristics of the structures,

systems, and components; and that the FSAR Tier 1 information meet the acceptance criteria in SRP Section 14.3.9, and is therefore acceptable.

Furthermore, except for the open items, the staff concludes that the FSAR Tier 1 design descriptions within the scope of SRP Section 14.3.9 can be verified adequately by ITAAC. Therefore, the staff concludes that the U.S. EPR ITAAC within the scope of SRP Section 14.3.9 are necessary and sufficient to assure that with respect to these ITAAC, if the inspections, tests, and analyses are performed and the acceptance criteria are met, a facility that incorporates the certified U.S. EPR design has been constructed and will be operated in conformity with the design certification, the provisions of the Atomic Energy Act of 1954, and NRC regulations.

14.3.10 Emergency Planning

The design certification applicant did not provide emergency planning ITAAC in FSAR Tier 1. As discussed in FSAR Tier 2, Section 14.3.1, the COL applicant is responsible for providing the emergency planning ITAAC, and this requirement is consistent with the guidance provided in RG 1.206. In addition, in FSAR Tier 2, Section 14.3.1, the design certification applicant provided a COL information item (COL Information Item 14.3.1) specifying that the COL applicant shall provide emergency planning ITAAC. The staff finds the inclusion of COL Information Item 14.3.1 in FSAR Tier 2, Section 14.3.1, and the absence of ITAAC for emergency planning in FSAR Tier 1, acceptable and consistent with NRC guidance provided in RG 1.206.

14.3.11 Containment Systems

14.3.11.1 *Introduction*

NUREG-0800, Section 14.3.11, "Containment Systems – Inspections, Tests, Analyses, and Acceptance Criteria," addresses the review of ITAAC related to the containment and associated systems for the U.S. EPR design certification. The staff reviews the proposed ITAAC to determine whether a plant that incorporates the design certification can be built and operated in accordance with the design certification and the NRC regulations.

14.3.11.2 *Summary of Application*

FSAR Tier 1 is the portion of the design related information contained in a generic FSAR that is approved and certified by the design certification rule, 10 CFR Part 52, "Licenses, Certifications, and Approvals For Nuclear Power Plants." The design descriptions and interface requirements are derived from FSAR Tier 2 information.

The staff reviewed FSAR Tier 2, Section 14.3 for containment systems, FSAR Tier 1, Chapter 2, "System Based Design Descriptions of ITAAC," and FSAR Tier 1, Section 3.5, "Containment Isolation," in accordance with the regulatory guidance and acceptance criteria provided in SRP Sections 14.3 and 14.3.11.

14.3.11.3 *Regulatory Basis*

The relevant requirements of the NRC regulations for this area of review, and the associated acceptance criteria, are provided in SRP Section 14.3.11 and are summarized below. The applicant states that the U.S. EPR containment systems ITAAC meet the provisions of the Atomic Energy Act and the requirements of 10 CFR 52.47(a)(26) and 10 CFR 52.47(b)(1).

1. 10 CFR 52.47(b)(1), "Contents of applications: technical information," as it relates to the requirement that a U.S. EPR 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 plant that incorporates the design certification is built and should operate in accordance with the design certification, the provisions of the Atomic Energy Act of 1954, and NRC regulations.

2. 10 CFR 52.47(a)(26), as it relates to the requirement that a U.S. EPR application contain justification that compliance with the interface requirements of Paragraph (a)(25) of this section is verifiable through inspections, tests, or analyses. The method to be used for verification of interface requirements should be included as part of the proposed ITAAC required by Paragraph (b)(1) of this section.

14.3.11.4 *Technical Evaluation*

14.3.11.4.1 Summary of Technical Information

FSAR Tier 2, Section 14.3

As stated in FSAR Tier 2, Section 14.3, the Containment Systems ITAAC was developed to verify the following:

- Key parameters and analytical input from containment safety analyses, such as LOCA, main steamline break, main feedline break, and subcompartment analyses
- Safety significant input for radiological analyses
- Safety significant input from the PRA insights report and the severe accident analyses
- Safety significant design features from GSIs and identified in FSAR Tier 2, Table 14.3-7, "Licensing (Safety-Significant Features)"

FSAR Tier 1, Chapter 2 and Chapter 3

FSAR Tier 1, Chapter 2, "System Based Design Descriptions and ITAAC," and Chapter 3, "Nonsystem Based Design Description and ITAAC," provide documentation of U.S. EPR descriptions, figures, and associated ITAAC were reviewed by the staff for the following:

- Section 2.1.1 Nuclear Island
- Section 2.2.2 In-Containment Refueling Water Storage Tank
- Section 2.2.3 Safety Injection System and Residual Heat Removal System
- Section 2.2.4 Emergency Feedwater System
- Section 2.2.5 Fuel Pool Cooling and Purification System
- Section 2.2.6 Chemical and Volume Control System
- Section 2.2.7 Extra Borating System

- Section 2.3.1 Combustible Gas Control System
- Section 2.3.3 Severe Accident Heat Removal System
- Section 2.4.14 Hydrogen Monitoring System
- Section 2.6.3 Annulus Ventilation System
- Section 3.3 Initial Test Program
- Section 3.5 Containment Isolation

System design descriptions include relevant information for the ITAAC. They include key design features, seismic and ASME Code classifications used in design and construction, system operation, alarms, displays, controls, logic for system actuation, interlocks, ASME Code Class 1E power sources and divisions, equipment to be qualified for harsh environment, interface requirements, and numeric performance values. The design description contains tables and figures that are referenced in the Acceptance Criteria column of the ITAAC.

The ITAAC are presented in three parts. The first part identifies the commitment to be verified. The second part identifies the proposed method (inspection, testing, analysis, or some combination of the three) by which the licensee will verify the design requirement/commitment described in Column 1. The third part of the ITAAC identifies the proposed specific acceptance criteria for the ITAAC in that the second part, that if met, demonstrates the licensee has met the design commitment in part 1.

The applicant used the convention followed by other U.S. EPR applicants in submitting an FSAR that is contained in FSAR Tier 2 of the application and by submitting an FSAR Tier 1 document containing the ITAAC. In evaluating the ITAAC for the containment systems, the staff first evaluated the safety analyses contained in FSAR Tier 2, Section 6.2, "Containment Systems," concerning the containment functional design and FSAR Tier 2, Chapter 19, "Probabilistic Risk Assessment and Severe Accident Evaluation," concerning the design of the containment to withstand severe accidents.

14.3.11.4.2 Containment Functional Design and Design of Containment Subcompartments to Withstand High Energy Line Breaks

FSAR Tier 2, Table 6.2.1-5, "Containment Initial and Boundary Conditions," states the containment volume used in containment overpressure evaluations by the applicant is 77,991.31 m^3 (2,754,237 ft^3). In FSAR Tier 1, Table 2.1.1-8, "Reactor Building ITAAC," the applicant states that the minimum containment volume of the as-built plant will be verified by analysis is 78,012.91 m^3 (2,755,000 ft^3). Since the applicant will use the smaller more conservative volume in safety analysis, the staff finds this ITAAC acceptable.

FSAR Tier 2, Section 6.2.1.1.2, "Design Features," states that the containment design pressure will be 528,828 Pa (62 psig). This will be verified by inspections of construction records and by a pressure test as required by ASME Code, Section III. These are described in FSAR Tier 1, Table 2.1.1-8, Item 2.5.

The Containment Building is separated into a central portion containing the reactor system and a peripheral lower temperature portion containing equipment. Separation is accomplished by

compartment walls, foils, doors, and dampers. The foils are located above the steam generator compartments and are designed to open at a fraction of a psi. The dampers are located at lower elevations and must also open to avoid stratification so that steam flowing to the containment dome can circulate down the containment walls to reach the heat structures at the containment lower elevations. The pressurizer compartment is vented by six safety-related doors which are designed to open in the event of a break in the pressurizer space. In a May 22, 2009, response to RAI 82, Question 06.02.01-12c.3-2, the applicant stated that a testing program is being conducted by which the opening characteristics of the foils, doors, and dampers assumed in the analyses will be verified. Furthermore, the applicant stated that the design of the doors and their opening characteristics will be specified later in the design process. An appropriate qualification program will be established to verify the analyses and design assumptions. In RAI 104, Question 14.03-1.a.2, the staff requested that the opening characteristics of the foils, doors, and dampers be verified for the as-built plant as an ITAAC.

In an April 28, 2011, response to RAI 104, Question 14.03-1.a.2, the applicant stated that FSAR Tier 2, Section 6.2.1, "Containment Functional Design," will be revised to provide the opening characteristics of the foils, doors, and dampers assumed in the analyses. This revision discusses the containment design feature of transforming the two-room containment into a one-room containment to support the post-accident pressure and temperature response. To support the two-room to one-room design feature in the containment, the identified foils, dampers, and listing of the safety-related doors credited in the analyses and their opening characteristics are provided. FSAR Tier 2, Table 3.2.2-1, "Classification Summary," Section 3.8.3, "Concrete and Steel Internal Structures of Concrete Containment," FSAR Tier 2, Table 3.8-18, and FSAR Tier 2, Figures 3.8-137 through 3.8-144 will be revised to identify the safety classification and seismic category of the containment doors and to provide their location at the applicable elevation in containment. FSAR Tier 1, Section 2.1.1.1, "Reactor Building," Table 2.1.1-6 (a), Table 2.1.1-8, ITAAC Item 2.16 through Item 2.19 for containment doors, Section 2.3.1, "Combustible Gas Control System," Table 2.3.1-1, "CGCS Equipment Design," and Table 2.3.1-2, ITAAC Item 2.1 through Item 5.6 for foils and dampers will be revised to provide ITAAC requirement verification for the opening characteristics of the foils, dampers, and safety-related doors credited in the containment analysis for supporting the large break loss-of-coolant accident (LBLOCA) and subcompartment analyses. The staff finds the response acceptable, and **RAI 104, Question 14.03-1.a.2 is being tracked as a confirmatory item** to ensure that the FSAR is revised accordingly.

In RAI 104, Question 14.03-1.a.3, the staff requested that the applicant provide an ITAAC dealing with the flow areas of vent openings which will ensure that the vent openings are consistent with the values assumed in the safety analyses for containment mixing and for the evaluation of containment subcompartment short term pressurization following a high energy line break as described in FSAR Tier 2, Section 6.2.1.2, "Containment Subcompartments."

In an April 28, 2011, response to RAI 104, Question 14.03-1.a.3, the applicant stated that FSAR Tier 2, Section 6.2.1 will be revised to provide the vent opening size (area) and flow area vent paths with connecting rooms credited in the subcompartment analyses where the pressure increase is greater than 5 psi in FSAR Tier 2, Table 6.2.1-17. FSAR Tier 2, Table 6.2.1-13 will be revised to identify the vent opening size (area) and flow area vent paths with connecting rooms credited in the LBLOCA for pressure relief resulting from pressurizer surge line breaks. FSAR Tier 2, Table 3.8-18 will be revised to identify the vent area of the containment doors. FSAR Tier 1, Section 2.1.1.1, "Reactor Building," Table 2.1.1-6 (b), Table 2.1.1-8, ITAAC Item 2.20 for vent path area for pressure relief will be revised to provide ITAAC requirement

verification for the total vent path area credited in the containment analysis for supporting the safety analyses for containment mixing, short-term subcompartment pressure analysis, and LBLOCA pressure relief resulting from pressurizer surge line breaks. **RAI 104, Question 14.03-1.a.3 is being tracked as a confirmatory** item to ensure that the FSAR is revised accordingly.

The staff observed discrepancies in the compartment volumes in various data sets submitted by the applicant, as discussed in RAI 437, Question 06.02.01-99 and RAI 466, Question 06.02.01.02-10. The staff notes that the discrepancies are the result of compartment boundaries being independently determined by different analyses. The compartment size may affect the pressures obtained in subcompartment analyses. Therefore, In RAI 479, Question 06.02.01-102(1), the staff requested that the applicant provide an ITAAC by which the compartment volumes used in subcompartment analyses will be verified for the as-built plant so that the results from the FSAR subcompartment analyses can be concluded to be valid for the as-built plant. In a August 31, 2011, response to RAI 479, Question 06.02.01-102(1), the applicant responded that the requested ITAAC information was not necessary. The staff finds the response acceptable because the more sensitive information like vent area to the room pressure response than the volume has been proposed as ITAAC (See April 28, 2011, response to RAI 104 Question 14.03-1.a2). According to SRP 14.3, only the most safety significant features should be in Tier 1 and have ITAAC. **RAI 104, Question 14.03-1.a.2 is being tracked as a confirmatory item**. **RAI 479, Question 06.02.01-102(1) is being tracked as a open item** in Section 6.2.1 of this report.

Although the applicant completed the subcompartment analyses, the staff notes that safety-related doors will be added to the design to mitigate pressure for some of the subcompartments following potential high energy line breaks. These safety-related doors will be in addition to the six safety-related doors designed to vent the pressurizer compartment. Therefore, in RAI 457, Question 06.02.01-5(i), the staff requested that the applicant submit ITAAC relating to the subcompartment analyses as needed.

In a June 3, 2011, response to RAI 457, Question 06.02.01-5(i), the applicant stated that the requested ITAAC information had been addressed in the April 28, 2011, response to RAI 104, Question 14.03-1.a.3. The staff finds the ITAAC information provided in response to RAI 104, Question 14.03-1.a.3 acceptable, because the proposed ITAAC will verify that the doors will function as designed. **RAI 104, Question 14.03-1.a.3 is being tracked as a confirmatory item** to ensure the FSAR is revised accordingly.

In the absence of containment atmospheric sprays and fan coolers, the containment internal heat structures (heat sinks) play a vital role in removing steam from the containment atmosphere following a high energy line break within containment. The heat sink inventory used in containment overpressure analyses from LOCA and main steamline break (MSLB) are provided in FSAR Tier 2, Table 6.2.1-5. For containment overpressure analysis, assumptions are made to conservatively maximize containment pressure. The applicant has also described containment pressure calculations which are designed to conservatively minimize containment for the purpose of evaluating ECCS performance. For the minimum containment pressure calculation, the applicant used the estimated heat sink formulation of SRP, BTP 6-2, “Minimum Containment Pressure Model for PWR ECCS Performance Evaluation.” The applicant’s containment overpressure analyses are described in FSAR Tier 2, Section 6.2.1.1, “Containment Structure.” The applicant’s minimum containment pressure analysis is described in FSAR Tier 2, Section 6.2.1.5, “Minimum Containment Pressure Analysis for Performance

Capability Studies on Emergency Core Cooling System." In RAI 82, Question 06.02.01-12c.3-2, the staff requested that the applicant establish pre-operational inspections which will be performed to ensure that the heat sinks given in FSAR Tier 2, Table 6.2.1.5 are present in the as-built plant.

In a May 22, 2009, response to RAI 82, Question 06.02.01-12c.3-2, the applicant prepared an ITAAC to confirm the minimum heat sink surface area value after construction. FSAR Tier 1, Section 2.1.1.1, Item 2.14 and Table 2.1.1-8, Item 2.14 were added to require that deviations between as-built construction drawings and dimensions used in the containment analyses are reconciled. The staff finds the information in the May 22, 2009, response to RAI 82, Question 06.02.01-12c.3-2 acceptable, because the ITAAC will adequately verify the presence of the necessary heat sinks. **RAI 82, Question 06.02.01-12c.3-2 is being tracked as a confirmatory item** in Section 6.2.1.1 of this report.

One of the main mechanisms for containment heat removal is the concrete heat structures within the Containment Building. The amount of heat transferred to these structures depends on the assumed thermal conductivity and heat capacity of the concrete. Structural concrete used at different sites differs in properties which may change as the concrete ages. Therefore, in RAI 389, Question 06.02.02-50, the staff requested that the applicant establish inspections and tests to ensure that the containment concrete for each site will absorb at least as much heat as described in the FSAR. In an August 15, 2011, response to RAI 389, Question 06.02.02-50, the applicant prepared an ITAAC Item 2.26 in FSAR Tier 1, Section 2.1.1 and Table 2.1.1-8 to address the required concrete thermal properties. The staff finds the information in the August 15, 2011, response to RAI 389, Question 06.02.02-50, acceptable, because the ITAAC will test the concrete mix to meet the thermal properties as specified. **RAI 389, Question 06.02.02-50 is being tracked as a confirmatory item.**

14.3.11.4.3 Containment Heat Removal Systems

The U.S. EPR does not credit containment heat removal and cooling by fan coolers or sprays during a postulated LOCA. The containment heat removal function following a design-basis LOCA is carried out by cooling the water in the IRWST via heat exchangers of the low-head safety injection (LHSI) system which takes suction from the IRWST pool. The cooled water is pumped back into the RCS by the LHSI system.

FSAR Tier 1, Section 2.2.2, "In-Containment Refueling Water Storage Tank System," describes the ITAAC for the IRWST. The ITAAC include provisions for inspecting the as-built IRWST to ensure that the as-built design is consistent with that assumed in the safety analysis. Included with the ITAAC is verification that a debris screen exists in the suction line for each safety system division with appropriate screen area and screen hole size acceptance criteria. In addition, FSAR Tier 1, Section 2.2.2 ITAAC contains ITAAC verifying the installation of retaining baskets, with an appropriate screen area and screen hole size acceptance criteria, and installation of trash racks at the heavy floor openings.

To ensure the required water volume is available to support the containment heat removal function, in RAI 340, Question 06.02.01-57j, the staff requested that the applicant propose an ITAAC for inspection of the as-built containment. The purpose of the inspection is to confirm that water retention locations have been identified and the amount of water retention has been conservatively estimated for each potential location. In a December 15, 2011, response to RAI 340 Question 06.02.01-57j, the applicant provided ITAAC requirements that address water retention in the as-built containment in FSAR Tier 1, Section 2.1.1.1, "Reactor Building,"

Table 2.1.1-8, "Reactor Building ITAAC." The staff finds the response acceptable, and **RAI 340, Question 06.02.01-57j is being tracked as a confirmatory item** to ensure that the FSAR is revised accordingly.

ITAAC related to the debris source term used to assess sump screen clogging issues which directly impacts the containment heat removal function is located in FSAR Tier 1, Section 2.1.1.1. The ITAAC includes provisions to inspect for wall and floor openings to allow water flow to the IRWST and includes provisions to inspect reactor coolant system piping and components to ensure that they are insulated with reflective metallic insulation. In RAI 429, Question 06.02.02-67, the staff requested that the applicant evaluate ITAAC for other insulation and debris generated during a postulated LOCA within the containment that subsequently transports to and accumulates on the sump screens. In an October 24, 2011, response to RAI 429 Question 06.02.02-67, the applicant provided ITAAC requirements that include Microtherm insulation and coatings in FSAR Tier 1, Section 2.1.1.1, Table 2.1.1-8. The staff finds the response acceptable and **RAI 429, Question 06.02.02-67 is being tracked as a confirmatory item** to ensure that the FSAR is revised accordingly.

As discussed in Section 6.2.2.3 of this report, the applicant takes credit for the effect of hot leg injection into the reactor system in reducing the steam flow rate into the Containment Building. This is accomplished by directing a fraction of the low-pressure safety injection (LPSI) water from the cold legs into the hot legs. The cooled LHSI water that is injected into the hot legs condenses steam and is itself heated before returning to the IRWST. The LHSI system is designed so that the required fraction of LHSI water is directed into the hot legs by the reactor operators. In RAI 221, Question 06.02.01-38b, the staff requested that the applicant provide ITAAC requirements to ensure that the required LPSI flow split will be established for the as-built plant. In a March 24, 2010, response to RAI 212, Question 06.03-11, the applicant provided ITAAC requirements that include a minimum hot leg injection acceptance criterion in FSAR Tier 1, Section 2.2.3, "Safety Injection System and Residual Heat Removal System," and Table 2.2.3-3, "Safety Injection System and Residual Heat Removal System ITAAC." **RAI 212, Question 06.03-11 is being tracked as a confirmatory item**.

14.3.11.4.4 Secondary Containment Building Design

The containment shield building is part of nuclear island with nuclear island ITAAC criteria provided in FSAR Tier 1, Table 2.1.1-7, "RBA Penetrations that Contain High Energy Pipelines."

FSAR Tier 2, Table 14.3-2, "Radiological Analysis (Safety-Significant Features)," describes that the annulus ventilation system provides at least -0.25 inches. H_2O in ≤305 seconds from initiation of signal. It is included as annulus ventilation system ITAAC in FSAR Tier 1, Table 2.6.3-3, "Annulus Ventilation System ITAAC," Reference Section Number 7.1. This ventilation draw down performance is required to satisfy Radiological Consequences of Design Basis Accidents described in FSAR Tier 2, Section 15.0.3.11, "Loss of Coolant Accident." To ensure that the secondary containment performs as designed to capture all leakage that bypasses secondary containment, in RAI 511, Question 06.04-9, the staff requested the applicant clarify the definition of the structures, systems, and components that function as part of the secondary containment. The staff also requested that the applicant propose appropriate ITAAC for the Fuel Building and Safeguard Building Controlled Areas to verify that the Fuel Building and the Safeguard Buildings are capable of being drawn down to the required negative pressure using the systems and the time frames assumed in the radiological analyses. **RAI 511, Question 06.04-9 is being tracked as an open item** in Section 6.2.3 of this report.

14.3.11.4.5 Containment Isolation System

The function of containment isolation is to isolate fluid system piping which penetrates the containment to prevent the discharge of radioactivity from the containment following postulated accidents and to maintain containment integrity. Containment isolation barriers are components of the penetrating systems and are given in FSAR Tier 2, Table 6.2.4-1, "Containment Penetration, Isolation Valve, and Actuator Data," with design criteria such as functional arrangements, containment isolation signal, and valve closure time.

The containment isolation valve (CIV) closure times which are input parameters to safety analysis are identified in FSAR Tier 2, Table 14.3-2 and Table 15.0-50, "LOCA Inputs." The low flow purge valves are credited with closing in less than or equal to 10 seconds. The remaining CIVs which receive a containment isolation signal are credited with closing in 60 seconds.

The ITAAC for CIV closure times which receive containment isolation signals are identified in FSAR Tier 1, either in the ITAAC table in the specific system descriptions in Chapter 2 or in Section 3.5, Table 3.5-3, "Containment Isolation ITAAC." These staff finds the ITAAC for CIV closure time meet the closure time assumed in the safety analyses in FSAR Tier 2, Chapter 15, "Transient and Accident Analyses."

The functional arrangement of the containment isolation valves is as shown on FSAR Tier 1, Figure 3.5-1, "Representative Containment Isolation Valve Arrangement," and as given in FSAR Tier 1, Table 3.5-1, "Containment Isolation Equipment Mechanical Design," or the respective FSAR Tier 1 system equipment design tables. The ITAAC for the functional arrangement of the CIVs is described in their respective FSAR Tier 1 ITAAC tables.

The ITAAC for the design, including equipment qualification, for the CIVs is described in their respective FSAR Tier 1 tables. These ITAAC verify that the containment isolation system functions as designed and as credited in the safety analyses. This meets the guidance of RG 1.206, Section C.II.1.2.11, "ITAAC for Containment Systems."

10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," GDC 55, "Reactor Coolant Pressure Boundary Penetrating Containment," GDC 56, "Primary Containment Isolation," and GDC 57, "Closed Systems Isolation Valves," require that isolation valves outside containment be located as close to the containment as practical. FSAR Tier 2, Section 6.2.4.2.1, "General System Design," requires that isolation valves outside containment be located as close as practical to the containment or shield building walls. FSAR Tier 2 provides general criteria associated with this requirement and does not provide any maximum distances from the containment. In RAI 479, Question 06.02.04-11, the staff requested that the applicant provide the specifications and criteria for the location of CIVs outside containment and describe how the criteria support the GDC requirements. The staff also requested that the applicant revise FSAR Tier 2, Table 6.2.4-1 to include the maximum distance from the containment wall to the first CIV outside containment. Additionally, the staff requested that the applicant provide an ITAAC for the CIVs outside containment that would verify the location of the CIV does not exceed the maximum allowable distance from the containment wall to the first outside CIV in the affected sections of FSAR Tier 1, Chapter 2 and FSAR Tier 1, Section 3.5. **RAI 479, Question 06.02.04-11 is being tracked as an open item** in Section 6.2.4 of this report.

14.3.11.4.6 Hydrogen Generation and Control

The combustible gas control system (CGCS) mitigates the consequences of postulated accidents by mixing, monitoring, preventing, or removing combustible gas concentrations that may be released into the containment atmosphere in the event of a design-basis accident or a significant beyond-design-basis accident. Combustible gas is predominantly generated within the containment as a result of reactions between fuel-cladding and the reactor coolant and also by interactions between the molten core and concrete for beyond-design-basis accidents. Significant amounts of hydrogen gas can be generated which must be mixed with the other gases in containment. The concentration of combustible gases in any part of the containment must be maintained below a level that supports combustion or detonation that could cause loss of containment integrity.

The CGCS must safely accommodate the hydrogen generated by an equivalent of a 100 percent fuel clad-coolant reaction, while limiting containment hydrogen concentration, uniformly distributed, to less than 10 percent (by volume), and by providing the capability for ensuring a mixed atmosphere in the containment in order to comply with 10 CFR 50.44(c), "Combustible Gas Control for Nuclear Power Reactors."

Mixing of the containment atmosphere is accomplished by the CGCS which consists of (1) the opening of rupture foils and convection foils installed in the ceiling of the steam generator compartments, (2) the opening of mixing dampers placed between the refueling water storage tank and the annular compartments of the containment, and (3) passive autocatalytic recombiners (PARs) distributed throughout containment. The foils and dampers are intended to provide global convection and mixing in case of accidents. The PARs are intended to reduce hydrogen concentration and enhance the global convection.

The major CGCS equipment and their associated locations are addressed in FSAR Tier 1, Table 2.3.1-1, "CGCS Equipment Design." In RAI 471, Questions 06.02.05-20 and 06.02.05-21, the staff requested that the applicant provide the number, size, and location of the rupture foils, convection foils, and mixing dampers needed for successful mixing of the containment atmosphere. The staff also requested that the applicant provide the number and location of the PARs required for successful hydrogen recombination and containment mixing. In RAI 471, Question 06.02.05-22, the staff requested that the applicant provide the PAR recombination curves designed to meet the requirements of 10 CFR 50.44(c). In RAI 471, Question 06.02.05-23, the staff requested that the applicant provide the number, location and design of the doors in containment required for containment. **RAI 471, Questions 06.02.05-20, 06.02.05-21, 06.02.05-22, and 06.02.05-23 are being tracked as open items** in Section 6.2.5 of this report.

After these open items are resolved, the CGCS related ITAAC will be addressed in FSAR Tier 1, Section 2.3.1 and FSAR Tier 1, Table 2.3.1-2, "Combustible Gas Control System ITAAC." The staff notes that the location of the PARs, rupture and convection foils, and the PAR recombination rates will be verified. An ITAAC to verify the performance of the mixing dampers will be provided. An RAI will be prepared for the CGCS ITAAC following successful resolution of the RAI 471, Questions 06.02.05-20, 06.02.05-21, 06.02.05-22, 06.02.05-23 which are being tracked as open items in Section 6.2.5 of this report.

14.3.11.4.7 Hydrogen Monitoring System

The hydrogen monitoring system (HMS) provides indication of hydrogen concentrations in the containment atmosphere during design-basis accidents, and monitors both hydrogen concentration and steam content in the containment atmosphere during beyond-design-basis accidents. The HMS consists of two subsystems: the low range for hydrogen monitoring during design-basis accidents, and the high range for monitoring hydrogen and steam during beyond-design-basis accidents.

FSAR Tier 2, Section 6.2.5.2.2, "Hydrogen Monitoring System," describes both the low range HMS system and the high range HMS system which provide hydrogen concentration displays and alarms in the MCR. The low range indicates a release of hydrogen into the containment during normal operation and alarms if the flammability limit in air is reached. The high range alarms indicate if the hydrogen concentration required for flammable mixtures in containment has been reached. Hydrogen concentration in containment is identified as a safety-significant feature in FSAR Tier 2, Table 14.3-7, indicating that there should be an associated ITAAC for this HMS instrumentation.

The HMS related ITAAC is addressed in FSAR Tier 1, Section 2.4.14, "Hydrogen Monitoring System," and FSAR Tier 1, Table 2.4.14-1, "Hydrogen Monitoring System Equipment," and Table 2.4.14-2, "Hydrogen Monitoring System ITAAC." FSAR Tier 1, Table 2.4.14-1 lists only the low range HMS equipment. Therefore, in RAI 411, Question 14.03.11-4, the staff requested that the applicant add the high range equipment to FSAR Tier 1, Table 2.4.14-1, so that the HMS ITAAC will verify the installation of both the low range and the high range HMS equipment. The staff also requested that the applicant add the low range and the high range HMS monitors to FSAR Tier 1, Table 2.4.14-2, providing an ITAAC that will confirm that they both alarm and display in the MCR. **RAI 411, Question 14.03.11-4 is being tracked as an open item.**

14.3.11.4.8 Containment Leak Rate Testing

Containment leakage testing assures that: (1) leakage through the primary reactor containment and systems and components penetrating primary containment shall not exceed the allowable leakage rate values specified in the technical specifications or associated bases; and (2) periodic surveillances of reactor containment penetrations and isolation valves are performed so that proper maintenance and repairs are made during the service life of the containment and the penetrating systems and components. In FSAR Tier 2, Section 6.2.6, "Containment Leakage Testing," the applicant states that the containment leakage testing program complies with 10 CFR Part 50, Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors," Option B and follows the guidance of RG 1.163, "Performance-Based Containment Leak-Test Program."

According to the SRM to SECY-02-0067, "Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) for Operational Programs (Programmatic ITAAC)," an ITAAC for a program should not be necessary if the program and its implementation are fully described in the application and found acceptable by the NRC at the COL stage. The containment leakage testing program as described in FSAR Tier 2, Section 6.2.6, provides the leakage rate testing acceptance criteria as 0.25 percent of containment air mass per day at a containment pressure of 55 psig. This is addressed in FSAR Tier 2, Chapter 16, "Technical Specifications," Section 5.5.15, "Containment Leakage Rate Testing Program." The pre-operational containment leakage rate testing (CLRT) is performed according to Tests #024 - #029 in FSAR Tier 2, Section 14.2.12.3, "Engineered Components." CLRT is performed periodically at

defined intervals according to 10 CFR Part 50, Appendix J as described in FSAR Tier 2, Chapter 6.2.6.

In FSAR Tier 2, Table 1.8-2, "U.S. EPR Combined License Information Items," COL Information Item 6.2-1, states that the COL applicant that references the U.S. EPR design certification will identify the implementation milestones for the CLRT program described under 10 CFR Part 50, Appendix J. Therefore, the staff concludes that the CLRT program and its implementation are fully described in the FSAR and an ITAAC for this program is not required.

14.3.11.4.9 Accident Response Instrumentation

FSAR Tier 2, Table 14.3-7 describes safety-significant containment instrumentation as containment pressure, containment water level, containment hydrogen concentration, and containment radiation intensity. In RAI 104, Question 14.03-1b, the staff requested that the applicant justify that this instrumentation is sufficient for operators to deal with design and beyond-design-basis containment related events and to identify the ITAAC for this instrumentation.

In a February 11, 2009, response to RAI 104, Question 14.03-1b, the applicant stated that the information provided in FSAR Tier 2, Table 14.3-7 is the result of reviewing TMI action items and high-priority other generic safety issues:

The applicant stated that TMI items from 10 CFR 50.34(f) and high-priority GSI items from NUREG-0933, "Resolution of Generic Safety Issues,", Appendix B, "Applicability of NUREG-0933 Issues to Operating and Future Reactor Plants," were reviewed for safety-significant design features relevant to the U.S. EPR design. The items were then compared to the other FSAR Tier 2, Section 14.3 tables for redundancy. Items not already addressed by another FSAR Tier 2, Section 14.3 table or not already addressed by other FSAR Tier 1 criteria are provided in FSAR Tier 2, Table 14.3-7—Licensing (Safety-Significant Features).

Instrumentation provided in FSAR Tier 2, Table 14.3-7 is addressed in FSAR Tier 1 as follows:

- FSAR Tier 1, Section 2.2.2 contains ITAAC requirements for containment water level instrumentation.
- FSAR Tier 1, Section 2.4.14 contains ITAAC requirements for the containment hydrogen concentration monitors.
- FSAR Tier 1, Section 2.6.8, "Containment Building Ventilation System," contains ITAAC for containment pressure instrumentation.
- FSAR Tier 1, Section 3.5, and Section 2.0, "System Based Design Descriptions of ITAAC," contain ITAAC for CIV position indication and controls in the MCR.

The staff concludes that ITAAC requirements have been adequately provided for the containment accident monitoring instrumentation.

14.3.11.4.10 Accident Analysis Input and Insight Cross Reference

SRP Section 14.3, Acceptance Criterion 2 states that FSAR Tier 1 should be reviewed to verify that key parameters and insights from containment safety analyses are adequately addressed. Applicants should also provide cross references in FSAR Tier 2, Section 14.3 to show how the important input parameters used in the transient and accident analyses are verified by the ITAAC. Appropriate treatment of severe accident design features and containment design should be included in FSAR Tier 1. Applicants should also provide cross references in FSAR Tier 2 to show how the important parameters from PRA and severe accident analyses are verified by the ITAAC.

FSAR Tier 2, Tables 14.3-1, "List of Initial Tests for the U.S. EPR," through 14.3-8, "ITAAC Screening Summary," include many key parameters and insights from design basis and severe accident analyses. ITAAC have been provided to verify these parameters.

14.3.11.5 *Combined License Information Items*

Section 14.3.1.5, Table 14.3.1-1 of this report provides a list of all ITAAC related COL information items and descriptions from FSAR Tier 2, Table 1.8-2 that are applicable to FSAR Tier 2, Section 14.3. The staff finds the list in Table 14.3.1-1 to be complete. Also, the list adequately describes actions necessary for the COL applicant or licensee. No additional COL information items need to be included in FSAR Tier 2, Table 1.8-2.

14.3.11.6 *Conclusions*

The staff reviewed the information contained in FSAR Tier 2, Section 14.3.11 and the relevant sections of FSAR Tier 1 containing the ITAAC. The staff has requested that additional information be provided. Following submission of the requested material, the staff will review and evaluate the acceptability of those sections of the ITAAC dealing with the reactor containment and associated systems.

14.3.12 Physical Security Hardware

14.3.12.1 *Introduction*

In FSAR Tier 2, Chapter 14, "Initial Test Program and ITAAC," Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria," the applicant describes the methods for verifying design commitments for physical security incorporated in the U.S. EPR standard design. The FSAR describes the physical security systems (PSS) and features that are within the scope of the U.S. EPR design certification to establish a design standard that will provide, in part, the detection, assessment, communications, delay, and response functions of a physical protection system (PPS) and physical protection programs that will protect against potential acts of radiological sabotage and theft of special nuclear material.

Specifically, the applicant provides the design descriptions for PSS and credited design features (e.g., structural walls, floors, and ceilings; configuration of vital island and structures; etc.), descriptions of intended security functions and performance requirements, assumptions for detailed design, and supporting technical bases that a COL applicant will incorporate by reference as a part of the design and licensing bases. The U.S. EPR design, along with site-specific design of PSS, and performance requirements, physical protection programs, and a security organization that are described by a COL applicant, demonstrates, in part, how a COL

applicant will meet the performance and prescriptive requirements of 10 CFR Part 73, "Physical Protection of Plants and Materials."

The design bases, analyses, and assumptions for the design of PSS, including plant layout and building configurations of the U.S. EPR design, are described in AREVA Technical Report (TR) ANP-10295, "U.S. EPR Security Features," and TR ANP-10296, "U.S. EPR Design Features that Enhance Security." The scope of the PSS described in the U.S. EPR is limited to those related to the vital islands and vital structures. FSAR Tier 2, Chapter 13, "Conduct of Operation," Section 13.6, "Security," identifies COL Information Items 13.6-1 and 13.6-3 that require the COL applicant to provide a security assessment that compliments TR ANP-10295 and addresses the design of PSS that are outside the scope of the U.S. EPR standard design and descriptions of the COL applicant's physical protection programs, respectively.

The PSS that are not within the scope of the certified design, beyond or not related to the vital islands and structures, are to be addressed by the COL applicant that references the U.S. EPR design certification. The COL applicant will address COL Information Item No. 14.3-1 by describing ITAAC required for site-specific physical protection systems or features credited for performing physical protection functions based on the proposed design of a physical protection program.

14.3.12.2 *Summary of Application*

The following portions of the U.S. EPR FSAR and referenced TRs contained the applicant's design descriptions and information related to PPS:

FSAR Tier 1: FSAR Tier 1, Chapter 3, "Non-Safety Based Design Description and ITAAC," Section 3.1, "Security," describes the design features and ITAAC for the U.S. EPR standard design. Table 3.1-1, "Security ITAAC," describes the design commitments for PSS that are included in the scope of the standard design.

FSAR Tier 2: FSAR Tier 2, Chapter 1, "Introduction and General Description of the Plant," Section 1.2, "General Plant Description," and Section 1.2.3, "Plant Description," provide descriptions of the plant that are within the scope of the U.S. EPR standard design. Section 1.8.1, "COL Information Items," Tables 1.8-1, "Summary of U.S. EPR Plant Interfaces with Remainder of Plant," and Table 1.8-2, "U.S. EPR Combined License Information Items," include descriptions of related PSS ITAAC.

FSAR Tier 2, Section13.6, "Security," describes PSS incorporated as a part of the U.S. EPR standard design. Elements of a physical protection program such as the organization structure, training, operational programs, plant procedures, target sets, performance assessments, response requirements, design features for physical protection, and fitness for duty program are to be described by the COL applicant, along with an implementation schedule.

FSAR Tier 2, Chapter 14 establishes the physical security ITAAC for design commitments that will be verified to satisfy the acceptance criteria using inspections, tests, or analyses (ITA), for the PSS. The following sections discuss the ITAAC that are within the scope of the U.S. EPR design: FSAR Tier 2, Section 14.2, "Initial Plant Test Program"; FSAR Tier 2, Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria"; and FSAR Tier 2, Table 14.3-8, "ITAAC Screening Summary." In addition, FSAR Tier 2, Section 14.2.10.1, "Initial Fuel Loading," describes the minimum initial conditions for fuel load that include establishing PSS that must be verified as ITAAC before the finding for loading fuel is made, pursuant to

10 CFR 52.103(g). FSAR Tier 2, Section 14.2.12.10.6, "Normal Lighting System (Test #113)," Section 14.2.12.10.8, "Emergency Lighting System (Test #115)," and Section 14.2.12.11.7 (subsequently renumbered as FSAR Tier 2, Section 14.2.12.10.5), "Communications System (Test #130)," and associated FSAR Tier 2, Table 14.2-1, "List of Initial Tests for U.S. EPR," address components of plant's lighting and intra-plant communications that fulfill security functions (e.g., a part of PSS).

Referenced Technical Reports or Safeguard Information Related Submittals

The applicant submitted Technical Report (TR) ANP-10296, which describes the considerations of security in the U.S. EPR design. In a November 30, 2008, letter, the applicant submitted the "U.S. EPR Vital Equipment List," that describes the evaluations and listing of vital equipment and the identification of vital areas for the U.S. EPR. The information was subsequently incorporated into TR ANP-10295. TR ANP-10295 is incorporated by reference in FSAR Tier 2, Chapter 13, Section 13.6. The vital equipment is required to be located within vital areas in accordance with 10 CFR 73.55(b)(9), "Requirements for physical protection of licensed activities in nuclear power reactors against radiological sabotage," and are verified as security-related ITAAC. The information contained in TR ANP-10295 are safeguards information or proprietary information, and therefore protected in accordance with 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements," 10 CFR 2.390, "Public inspections, exemptions, requests for withholding," respectively.

TR ANP-10292, "U.S. EPR Conformance with Standard Review Plan (NUREG-0800)," discusses application of guidance provided in the staff's standard review plans for submission of COL applications.

Combined License Information Items

COL Information Item 14.3-1 requires a COL applicant that references the U.S. EPR design certification to provide ITAAC for emergency planning, physical security, and site-specific portions of the facility that are not included in the descriptions of ITAAC associated with the certified design (10 CFR 52.80(a)) in FSAR Tier 1.

COL Information Item 13.6-1 requires a COL applicant that references the U.S. EPR design certification to describe the designs of PSS and how performance requirements of 10 CFR 73.55(a) and (b) are met for the implementation of the security programs. Two additional COL information items are identified: COL Information Item 13.6-2, which requires an applicant that references the U.S. EPR design certification to provide a security plan to the NRC to fulfill the requirements of 10 CFR 52.79(a)(35); and COL Information Item 13.6-3, which states that "[a] COL applicant that references the U.S. EPR will provide a security program, through the PSP [physical security plan] and supporting documents such as the vital equipment list and the vital area list, that incorporate the security features listed in the U.S. EPR FSAR Tier 2, Section 13.6." The COL information items identified in FSAR Tier 2, Section 13.6 are relied on to identify key design commitments and acceptance criteria that must be verified through ITA to determine and conclude that the PSS and hardware, as constructed and installed, perform their intended security functions as designed and can be relied on to implement elements of physical protection programs.

14.3.12.3 *Regulatory Basis*

10 CFR Part 52.47, "Contents of applications; technical information," requires that information submitted for a U.S. EPR design certification must include performance requirements and design information sufficiently detailed to permit the preparation of acceptance and inspection requirements by the NRC, as well as procurement specifications and construction and installation specifications by an applicant. 10 CFR 52.47(b)(1) requires a U.S. EPR application to 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 are met, a plant that incorporates the U.S. EPR is built and will operate in accordance with the U.S. EPR certified design.

The NRC security regulations include performance and prescriptive requirements that, when adequately met and implemented, provide protection against acts of radiological sabotage, prevent the theft or diversion of special nuclear material, and protect safeguards information.

In accordance with requirements of 10 CFR 73.55(b), the COL applicant must establish and maintain a PPS and security organization which will have as its objective to provide high assurance that activities involving special nuclear material are not inimical to the common defense and security and do not constitute an unreasonable risk to the public health and safety. A PPS (i.e., detection, assessment, communications, and response) shall be designed to protect against the design basis threat of radiological sabotage.

10 CFR 73.55(b)(2) establishes the performance requirements to protect a nuclear power plant against the design-basis threat (DBT) for radiological sabotage as described in 10 CFR 73.1(a)(1), "Radiological Sabotage." The COL applicant is required to describe how it will meet regulatory requirements, including a high assurance objective for the protection against the DBT of radiological sabotage. 10 CFR 73.54, "Protection of digital computer and communication systems and networks," 10 CFR 73.55, "Requirements for physical protection of licensed activities in nuclear power reactors against radiological sabotage," 10 CFR 73.56, "Personnel access authorization requirements for nuclear power plants," 10 CFR 73.58, "Safety/security interface requirements for nuclear power reactors," Appendix B, "General Criteria for Security Personnel," and Appendix C, "Nuclear Power Plant Safeguards Contingency Plans," establish performance and prescriptive requirements that are applicable to the designs of PPS and hardware, the required PSS, operational security requirements, management processes, and programs. 10 CFR Part 52, Appendix B, regarding certification of design, limit the application of regulatory requirements that are specific to PSS and hardware that are within the scope of the U.S. EPR design. According to 10 CFR Party 73, the operational or administrative controls, programs, and processes (e.g., management systems or controls) are addressed by the COL applicant and are not in the scope for certification of the U.S. EPR design.

An applicant may apply the latest revision of the following regulatory guidance documents, TRs, and accepted industry codes, standard, or guidance, to meet regulatory requirements on ITAAC:

1. RG 1.68, "Initial Test Programs for Water-Cooled Nuclear Power Plants," Revision 3, 2007.

2. RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," Revision 0, 2007

3. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," March 2007.

4. NUREG-0800, Standard Review Plan, Section 14.3.12, "Physical Security Hardware – Inspections, Tests, Analyses, and Acceptance Criteria (PS – ITAAC)," Revision 1, May 2010.

The NRC guidance, approaches, and examples described above and in other guidance for methods of compliance are not regulatory requirements and are not intended to be all inclusive. The applicant may employ other methods or approaches for implementing NRC regulations other than those discussed in NRC guidance, provided that such measures satisfy the relevant and applicable NRC regulatory requirements.

14.3.12.4 *Technical Evaluation*

The staff technical review consists of determining whether the applicant adequately described and proposed physical security ITAAC that provide reasonable assurance that, if the ITA are performed and the acceptance criteria are met, a plant that incorporates the U.S. EPR standard design will be built and operate in accordance with the U.S. EPR design certification. The staff review determined whether the applicant adequately described appropriate ITA needed for verification and the appropriate acceptance criteria capturing the intended security functions, reliability and availability, and/or performances of selected PSS for ITAAC verification and closure, in accordance with 10 CFR 52.47(b)(1).

The PSS described in the U.S. EPR design (and those specific to a COL application) must be reliable and available in order to ensure performances and meeting intended security functions. The PSS are required to meet applicable performance and prescriptive requirements of 10 CFR Part 73. Within this context, the applicant addressed PSS that are within the scope of the U.S. EPR design certification. The design and technical bases for PSS within the scope of the U.S. EPR design certification are described in FSAR Tier 2, Chapter 13, Section 13.6 and TR ANP-10295. These documents provide the systems designs and performance requirements supporting the identified ITAAC design commitments and acceptance criteria.

The staff's review also includes the following AREVA responses submitted to address the staff's RAIs (and resulting revisions to the FSAR or referenced technical reports):

- AREVA NP to the NRC, "Response to Request for Additional Information No. 42, Revision 0," August 7, 2008

- AREVA NP to the NRC, "Response to Request for Additional Information No. 42, Supplement 1," December 9, 2008

- AREVA NP to the NRC, "Response to Request for Additional Information No. 253," July 14, 2009

- AREVA NP to the NRC, "Response to Request for Additional Information No. 253, Supplement 1," October 28, 2009

- AREVA NP to the NRC, "Response to Request for Additional Information No. 447, Revision 1, Supplement 1," December 8, 2010

14.3.12.4.1 Design Commitments, Inspections, Tests, Analyses, and Acceptance Criteria

In FSAR Tier 1, Section 3.1, the applicant described the design features and ITAAC for PSS included in the U.S. EPR design. FSAR Tier 1, Table 3.1-1 described the specific design commitments for PSS that are within the scope of the U.S. EPR design certification. TR ANP-10295, Appendix G, Table G-1, "Tier 1 Security Requirements Cross-Reference," and Table G-2, "Tier 2 Security Requirements Cross-Reference," are provided by the applicant to describe how specific physical security ITAAC are supported by test abstracts (or protocol) described in Appendix G.

The applicant described the following in FSAR Tier 2, Section 14.3:

- ITAAC tables for the U.S. EPR use the standard format in Appendix D of SRP 14.3. The ITAAC tables contained the commitments for inspection, test, or analysis, and acceptance criteria. The specific commitment extracted from the system design descriptions features for physical protection systems are described in Column 1. Column 2 (Inspection, Test, or Analysis) defines the specific methods a COL licensee will use to demonstrate that the specific design commitment in Column 1 has been met.

- The applicant's methods for ITA or a combination are described below:

    - "Inspections" are used when verification can be completed by visual observations, physical examinations, walkdowns, or by reviewing records that are based on observations or examinations. The inspections required for basic configuration walkdown follow the general provisions in FSAR Tier 1, Section 1.2, "General Provisions."

    - "Tests" mean either operating or establishing specified conditions to evaluate the performance of the as-built structures, systems, or components. In addition to testing final and installed equipment, examples of alternative testing methods include factory testing, test facility testing, and laboratory testing. Testing can also include type testing such as might be performed to demonstrate qualification to meet environmental requirements.

    - "Analysis" is used when verification can be done by calculation or engineering evaluation of the as-built structures, systems, and components. FSAR Tier 2 provides the supporting details for the methods used to demonstrate commitment satisfaction. FSAR Tier 2, Section 14.2 describes the initial test program which covers both visual inspections and tests. The details in FSAR Tier 2 are not referenced in FSAR Tier 1 and are not part of the certified design.

- The acceptance criteria (identified in ITAAC Tables, Column 3) depend upon the design feature to be verified and the method used for the verification. Acceptance criteria are objective and clear to avoid confusion over whether or not acceptance criteria have been satisfied. Some acceptance criteria contain numerical values that are not specifically identified in the Tier 1 design description or the ITAAC table commitments column. The applicant indicated that this is acceptable, because the design descriptions define the important design features that need to be included in the certified design material

(CDM); whereas, the numerical value is a measurement standard that determines if the feature has been provided.

FSAR Tier 1, Section 3.1.3, "Inspections, Tests, Analyses, and Acceptance Criteria," Table 3.1-1 listed the security ITAAC in accordance with the descriptions of design commitments, and ITAAC. The table identified design commitments related to the PSS, including physical configurations. The applicant listed design commitments related to vital areas and vital area barriers, protected area barriers; isolation zones, protected area intrusion detection; illumination; bullet resistant barriers; personnel; vehicles, and material access controls; personnel identification system; vital area access controls; alarm stations; secondary power supply; intrusion detection system alarm indications, display, and recording; vital area exits; and security communications. The staff identified that FSAR Tier 1, Table 3.1-1, including the standard security ITAAC design commitments and ITA did not conform to descriptions of NUREG-0800, Section 14.3.12, May 2010. Therefore, in RAI 42, Question 14.03.12-6, the staff requested that the applicant address this issue. In an August 7, 2008, response to RAI 42, Question 14.03.12-6, the applicant incorporated the standard security ITAAC at that time. However, the standard security ITAAC guidance had been revised and is superseded by ITAAC described in SRP Section 14.3.12, May 2010. Therefore, in RAI 491, Question 14.03.12-58, the staff requested that the applicant update FSAR Tier 1, Table 3.1-1 to capture descriptions of security ITAAC within the scope of the FSAR that comply with SRP Section 14.3.12, May 2010. RAI 42, Question 14.03.12-6 is closed and **RAI 491, Question 14.03.12-58 is being tracked as an open item.**

In FSAR Tier 2, Section 14.3.2, "Tier 1, Chapter 2, System Based Design Descriptions and ITAAC," the applicant indicated that the commitments given in FSAR Tier 1 ITAAC tables will be verified to satisfy the acceptance criteria using ITA. The applicant stated that if the as-built item satisfies the acceptance criteria, then the ITAAC is considered complete. For items not satisfying the acceptance criteria, corrective actions will be taken to resolve the identified issues.

Except for the open item discussed above, the staff finds the applicant has described ITAAC for verifying attributes of systems and associated components, hardware, or configurations to meet design bases and security functions of providing detection, assessment, communications, delays, and facilitating response. FSAR Tier 1 identified design commitments, inspections, tests, analyses, and acceptance criteria within the scope of the U.S. EPR design certification. The descriptions that comply with NRC guidance in SRP Section 14.3.12 (e.g., addressing vital areas and vital area barriers; protected area barriers; isolation zones; PA intrusion detection; illumination; bullet resistant barriers; personnel, vehicles, and material access controls; personnel identification system; vital area access controls; alarm stations; secondary power supply; intrusion detection system alarm indications, display, and recording; vital area exits; and security communications) are identified as an open item.

14.3.12.4.2 Verification Programs and System Acceptance Process

The applicant stated the following in FSAR Tier 2, Chapter 14:

> Verification programs include the initial test program for structures, systems, components (SSC), and design features for both the nuclear portion of the facility and the balance of the plant. The initial test program addresses major phases of testing including preoperational tests, initial fuel loading, initial criticality, low-power tests, and power-ascension tests. This program verifies that the

as-built facility configurations and operations comply with the approved plant design and applicable regulations. The initial test program is described in Section 14.1 and Section 14.2. Verification programs also include inspections, tests, analyses, and acceptance criteria (ITAAC). The process and criteria for developing ITAAC are described in Section 14.3.

The applicant stated in TR ANP-10295, Appendix G: "a system acceptance process shall be employed by the COL Holder (licensee) that incorporates requirement identification, construction verification, and compliance determination." In an October 28, 2009, response to RAI 253, Question 14.03.12-51, the applicant further clarified and stated: "this system acceptance process is included as a prerequisite to the tests in TR ANP-10295, Appendix G." The TR ANP-10295, Appendix G, "Security System Test Abstracts," described a PSS acceptance process that will include the following:

- Requirements Identification - review system documents (e.g., FSAR, license conditions, physical security plans, cyber security plan, plant technical requirements documents, systems design requirements, system design documents, security assessment, supporting calculations – blast calculations, equipment manufacturer requirements).

- Construction Verification - review the "as constructed" systems against each identified requirement.

- Compliance Determination - document compliance with "as designed" requirements or document the "as constructed" acceptability subject to compliance with: FSAR, license conditions, PSP, cyber security plan, security assessment, aecurity assessment Appendix D Conceptual Design Criteria, and functional needs of PSS that deviate from one or more design details.

The staff finds the following:

- The applicant adequately described a system acceptance process (i.e., requirement identification, construction verification, and compliance determination) that will be established by a COL applicant referencing the U.S. EPR design certification. The acceptance process, if adequately captured into implementing procedures and implemented, would verify and demonstrate through acceptance testing (e.g., applying test methods described for ITAAC) that all structures, systems, or components credited for physical protection performed as designed and will be available and reliable.

- The staff concludes that the applicant has appropriately established in the FSAR the process that a COL applicant referencing the U.S. EPR design certification verifies PSS installation, constructions, and performance that are not specifically identified and verified as ITAAC.

14.3.12.4.3 Test Abstracts for Physical Protection Systems ITAAC

The applicant described test abstracts in TR ANP-10295 (FSAR Tier 2) Appendix G to support ITA for verifying identified physical security system ITAAC in FSAR Tier 1. The applicant stated that the test abstracts provided the framework for the development of the detail test procedures for the conducting the ITA and the acceptance criteria, if met, will demonstrate that the plant incorporated the U.S. EPR design and the identified PSS will operate in accordance with the design performances and requirements of the U.S. EPR design. In an October 28, 2009,

response to RAI 253, Question 14.03.12-21, the applicant stated that the details of design and specifications for physical protection systems are developed after licensing, along with selections of security hardware vendors. The test abstract provided the framework for completing detail inspection procedures. The Construction Inspection Program will verify that these activities are performed.

TR ANP-10295, Appendix G described test abstracts consisting of objectives, prerequisites, test methods, data required, and acceptance criteria for the verification of the following physical protection systems:

- Vital area inspections
- Locking devices
- Protected area perimeter and intrusion detection
- Bullet resistance
- Vehicle barrier systems
- Access controls and searches
- Alarm testing
- Security communications
- Security power systems
- Security lighting systems
- Single failure analysis for the central and secondary alarm station

TR ANP-10295, Appendix G, Table G-2 provided a matrix identifying the FSAR Tier 2 requirements for design commitments with FSAR Tier 1, Section 3.1.1, "Design Features," and FSAR Tier 1, Section 3.1.2, "Interface Requirements," with the Appendix G descriptions test abstracts for verification of PSS.

The staff finds the following:

The applicant's descriptions of the test abstracts for PSS (e.g., objectives, prerequisites, test methods, data required, and acceptance criteria) are adequate and support the FSAR Tier 1 descriptions of ITAAC that are within the scope of the U.S. EPR design certification for meeting regulatory requirement of 10 CFR 52.47(b)(1). The staff finds that the descriptions of test abstracts within the scope of the U.S. EPR design comply with NRC guidance provided in NUREG-0800, Section 14.3.12, and are acceptable.

14.3.12.4.3.1 *Inspections, Tests, and Analyses for Vital Areas and Vital Equipment*

In TR ANP-10295, Appendix G, the applicant described the ITA protocol for verifications of design commitments for meeting regulatory requirements for the vital areas. The applicant indicated that the objectives are to demonstrate that vital equipment are located within the vital

areas that structures or rooms containing specific plant operations functions are designated as vital areas that the access to these areas requires passage through two physical barriers, and verify that the PA barrier is separate or not a part of the vital area. The verification methods include inspections of walls, floors, and ceilings, openings, access denial devices, intrusion detection or surveillance systems, access control devices, locations of vital equipment, secondary power supply systems, and PA barrier. The applicant described prerequisites and data required (e.g., vital equipment list, list of physical barriers credited as vital area barriers, and list of physical barrier credited as the protected area barriers) for conducting the inspection. Specific acceptance criteria for the inspections are identified in TR ANP-10295, Appendix G.1, Section 5.0. These criteria include the following: (1) All vital areas have no opening greater than a small size, as specified, that do not meet one or more conditions from TR ANP-10295, Appendix G.1, Section 3.2; (2) vital equipment, secondary power, spent fuel pool, MCR, CAS, and SAS are located within a vital area listed in TR ANP-10295, Appendix G.1, Section 3.1 (barrier 1); and (3) vital area is located within a protected area (barrier 2).

The staff finds the applicant has provided adequate and reasonable descriptions of the test objectives, prerequisites, test methods, required data, and acceptance criteria, in TR ANP-10295, Appendix G that are of sufficient detail and support the identified ITAAC related to the vital equipment and vital areas in FSAR Tier 1, Chapter 3, Table 3.1-1.

14.3.12.4.3.2 *Inspections, Tests, and Analyses for Verifying Detection and Assessment*

14.3.12.4.3.2.1 Protected area perimeter and intrusion detection

The applicant stated that the objectives are to demonstrate that: (1) the interim decay storage (IDS) detects penetrations or attempted penetration of the PA barrier and annunciates in the CAS and SAS; (2) the isolation zones exist adjacent to the PA barrier for observations on either side of the barrier; (3) the IDS detects intrusion vital areas and annunciates at alarm stations; and (4) the protected area fence provides required standoff and delay that exceed the minimum delay time assumed in the security assessment. The verification methods include tests, inspections, or both. The inspections include the verification of the protection of openings in the PA, access denial devices, access control devices, intrusion detection or surveillance, the verification of isolation zone configuration and distances between the protected area perimeter, and the vital areas and constructed delay systems. The testing of IDS includes performance tests of each zone using guidance in RG 5.44, “Perimeter Intrusion Alarm Systems.” The acceptance criteria stated in RG 5.44, include successful tests under varying times of day (dawn-noon, noon-dusk, dusk-dawn) and verification of each delay time calculated from the total of (1) distance required to be traveled and (2) delay features encountered during transit meet or exceed minimum delay time value assumed in the Security Assessment.

The applicant did not specifically address regulatory requirements of 10 CFR 73.55(e)(7)(i)(C), which require monitoring with assessment equipment designed to satisfy the requirements of 10 CFR 73.55(i) and provide real-time and play-back/recorded video images of the detected activities before and after each alarm annunciation. The commitment in SRP Section 14.3.12, PS-ITAAC Item 4(b) identifies that video image recording with real-time and play-back capabilities can provide assessment, activities before and after each alarm annunciation within the perimeter barrier, and Item No. 4(a) requires subsequent alarms annunciate and display concurrently in at least two continuously manned onsite alarms stations (central and secondary alarm stations). The test abstracts for ITA for the security assessment capabilities described in the TR ANP-10295, Appendix G did not address how to verify that a PSS meets the regulatory requirements of 10 CFR 73.55(e)(7)(i)(C).

Therefore, in RAI 253, Question 14.03.12-54, the staff requested that the applicant identify video image recording with real-time and play-back capabilities, ITAAC, associated specific ITA, and test abstracts for PSS that are within the scope of the U.S. EPR design certification. In a October 28, 2009, response to RAI 253, Question 14.03.12-54, the applicant clarified and confirmed that the COL applicant that references the U.S. EPR design certification will address as site-specific security ITAAC, the verification of the capabilities of PSS meeting the requirements of 10 CFR 73.55(e)(7)(i)(C) and 73.55(i).

The staff finds that the applicant has provided adequate and reasonable descriptions of the test objectives, prerequisites, test methods, required data, and acceptance criteria, in TR ANP-1029, Appendix G. The descriptions are of sufficient detail and support the identified ITAAC related to the PA intrusion detection and annunciation at the central alarm system and secondary alarm system that are within the scope of the U.S. EPR design certification.

14.3.12.4.3.2.2 Alarm Testing

The applicant stated that the objectives are to demonstrate that: (1) visual and audible alarms annunciate appropriately at the central alarm system and secondary alarm system; (2) tamper and system supervisory capabilities are appropriate; (3) alarms on exits in vital areas or protected areas exist: (4) each alarm is recorded with specific information needed for response; and (5) alarm status cannot be changed independently or by a single action. The verification methods include inspections and tests that involve initiation of alarm, tamper, supervisor and trouble conditions of the alarm systems to verify the functions of alarm indications and recording at the CAS and SAS, and testing to verify that changes of alarm status require two actions independently initiated by alarm operator from the CAS and SAS. Appendix G, Section G.7 described data required and specific acceptance criteria for meeting the objectives. The applicant included the following as acceptance criteria: (1) Alarm and tamper indications, and self-checking, alarm and system troubles annunciate at CAS and redundancy of functions at the SAS; (2) alarm system records alarm, alarm check, and tamper alarms and alarm information; (3) emergency exits alarms in CAS and SAS; and (4) alarm stations cannot change status of detection independently without knowledge and concurrence of each other.

The staff finds the applicant adequately addressed requirements of equal and redundant CAS and SAS in accordance with 10 CFR 73.55(i)(4)(iii) and reasonably identifies ITA for security systems for alarm annunciation, monitoring, communications, assessment, and line supervision and tamper alarms that include capabilities of PSS.

The staff identified that the test abstract did not specifically address the verification requirement of 10 CFR 73.55(i)(2) that intrusion detection, video assessment, equipment shall display concurrently, in at least two continuously staffed onsite alarm stations. The ITAAC currently described also stated that an alarm station is “not necessarily onsite.” The applicant did not address specific ITA in TR ANP-10295, Appendix G, Section G.7, for verifying the requirements of 10 CFR 73.55(i)(2). Therefore, in RAI 447, Question 14.03.12-55, the staff requested that the applicant provide descriptions of appropriate ITA of systems and performances to comply with the requirements of 10 CFR 73.55(i)(2).

In an April 18, 2011, response to RAI 447, Question 14.03.12-55, the applicant adequately addressed this RAI and included a proposed revision of TR ANP-10295, Appendix G, Section G.7 to provide test abstracts for verifying that alarm systems meet the prescriptive requirements of 10 CFR 73.55(i)(2). The proposed revision included the test abstract for inspection and test to provide verification that both annunciation and display of video

assessment information occur within the CAS and SAS. The applicant stated that the requirements of "continuously staffed" requirements are beyond the scope of the ITA for ITAAC verification of design and system performances and are to be addressed as programmatic staffing by the COL applicant referencing the U.S. EPR design certification. **RAI 447, Question 14.3.12-55 is being tracked as a confirmatory item** to ensure that TR ANP-10295, Appendix G, is revised as indicated in the RAI response.

The staff finds the applicant has provided adequate and reasonable descriptions of the test objectives, prerequisites, test methods, required data, and acceptance criteria in TR ANP-10295, Appendix G. The staff finds the descriptions are of sufficient detail and support the identified ITAAC related to the visual and audible alarms, annunciate appropriately at the CAS and SAS; demonstrate tamper and system supervisory capabilities; demonstrate alarms on exits in vital areas and protected areas; demonstrate each alarm is recorded with specific information needed for response; and also demonstrate that alarm status cannot be changed independently or by a single action.

14.3.12.4.3.2.3 Security Communications, Power Systems, Lighting Systems, and CAS and SAS Equal and Redundancies and Single Failure Analysis

The applicant describes the following:

- Security Communications: The applicant described the objectives to demonstrate that alarm stations have at least two means of communications with offsite assistance from a local law enforcement agency (LLEA) and to demonstrate that alarm stations have capability of continuous communications capabilities with security personnel. The verification methods included performance tests of communications systems to verify availability of voice communications with offsite LLEA, communications connectivity, and intelligibility with each defensive position from the central alarm station and secondary alarm station. TR ANP-10295, Appendix G, Section G.8 described data required and specific acceptance criteria for meeting the objectives. Acceptance criteria described are that a primary and a secondary means of communications connect successfully with offsite LLEA from both the central alarm station and secondary alarm station, and that the primary and backup means of communications are reliable and available and perform successfully to contact each defensive position from the central alarm station and secondary alarm station.

- Security Power Systems: The applicant indicated that the objectives are to demonstrate that: (1) security primary (i.e., normal) power systems provide power for security systems and equipment described in FSAR Tier 1, Section 2.1.6.1.2; (2) security power systems switch to secondary (backup) power systems upon loss of primary security power for systems and equipment described in FSAR Tier 1, Section 2.1.6.1.3; and (3) systems and equipment described in FSAR Tier 1, Section 2.1.6 are powered by divisional uninterruptable power supply (UPS) during transfer from primary to secondary power. The verification methods included disabling primary power supplies for security systems to verify availability of continued security functions. TR ANP-10295, Appendix G, Section G.9 describes data required and specific acceptance criteria for meeting the objectives. The acceptance criteria included demonstration that, with primary power disabled, either CAS or SAS has sufficient power to continue equipment operability and provide required security functions (e.g., detection, assessment, and communications).

- Security Lighting Systems: The applicant indicated that the objective is to demonstrate that isolation zones and exterior areas within the PA are provided with adequate illumination for surveillance and assessment. The normal lighting systems, including batteries supplied emergency lighting systems, provide interior illumination. FSAR Tier 1, Section 2.6.6, "Plant Lighting Systems," provides design descriptions for the plant's normal and emergency lighting systems. The normal and emergency lighting systems are not specifically designed for security purposes, but are relied on to provide illumination for security functions. The applicant did not describe how interior lighting will be verified. The testing methods included verification of illumination levels and loss-of-normal power conditions that activate secondary power for continued illumination. TR ANP-10295, Appendix G, Section G.10 describes data required and specific acceptance criteria for meeting the objectives. The applicant stated that the acceptance criteria are: (1) illumination levels are at least 0.2 foot-candles in external areas within the PA and isolations; and (2) loss of normal power results in activation of security lighting in outdoor areas within the plant's protected area perimeter and isolation zones, as designed.

  10 CFR 73.55(i)(6)(ii) requires that all areas of the facility are provided with illumination necessary to satisfy the design requirements of 10 CFR 73.55(b) and implement the protective strategy. In TR ANP-10295, the applicant described the design and performance requirements of security lighting within the facility. However, the ITA described did not specifically address verification of indoor security lighting. Therefore, in RAI 447, Question 14.03.12-56, associated with the descriptions of appropriate ITA of systems and performances intended to meet the regulatory requirements of 10 CFR 73.55(i)(6)(ii), the staff requested that the applicant address this issue. In an April 18, 2011, response to RAI 447, Question 14.03.12-56, the applicant stated that the security lighting will be verified to demonstrate that illumination levels comply with 10 CFR 73.55(i)(6)(ii). The response includes proposed revisions to TR ANP-10295, Appendix G, Section G.10 to include verification of illumination indoor, interior areas designated in TR ANP-10295, Appendix I, are provided with adequate illumination to permit observation of abnormal presence or activity of persons, and addition of indoor areas for inspection and test requirements for illumination of at least 0.2 foot-candles in interior areas. The staff finds the applicant's April 18, 2011, response to RAI 447, Question 14.03.12-56 acceptable. **RAI 447, Question 14.03.12-56 is being tracked as a confirmatory item** to ensure that TR ANP-10295, is revised as indicated in the response.

- Central Alarm System and Secondary Alarm System Equal and Redundancies and Single Failure Analysis: The applicant described the objectives are to demonstrate that CAS and SAS are designed, equipped, and constructed to address a single act in accordance with the design-basis threat of radiological sabotage. Specifically, the design enables the survivability of equipment needed to maintain the functional capability of either alarm station to provide security functions of detection, assessments, initiate response, communications offsite, and command and control and to demonstrate that the security computer system, in the event of a single act. The verification requires the demonstration of the PSS capabilities to interface with other security equipment and subsystems (including individual video components and the security data system), to provide information to support the command and control from an alarm station to fulfill security functions. TR ANP-10295, Appendix G, Section G.11 describes the data required and specific acceptance criteria that the central alarm station and secondary

alarm station cannot, by a single act, within the adversary characteristics of the DBT, be disabled and lose the capability to perform security functions for detection, assessment, communications, and command and control of security response.

10 CFR 73.55(i)(4)(iii) requires that both alarm stations shall be equal and redundant, such that all functions needed to satisfy requirements of this section can be performed at both alarm stations. Therefore, in RAI 253, Questions 14.03.12-46 and 14.03.12-47, the staff requested that the applicant describe the ITA for verifying equal and redundant CAS and SAS functions, including the primary and secondary power supplies for continuity of redundant security functions. In October 28, 2009, responses to RAI 253, Questions 14.03.12-46 and 14.03.12-47, the applicant provided plans to revise TR ANP-10295, Appendix G.7, Section 1.1, to indicate that both the central alarm station and secondary alarm station requirements apply to both facilities, and to revise TR ANP-10295, Appendix G.9 to address the test abstracts for verifying security power system redundancy for complying with the requirements of 10 CFR 73.55(i)(4)(iii). **RAI 253, Questions 14.03.12-46 and 14.03-12-47 are being tracked as confirmatory items** to ensure that TR ANP-10295, Appendix G, is revised as stated in the RAI responses.

From the review of ITAAC within the scope of the U.S. EPR as described in FSAR Tier 1, Chapter 3 and the proposed revisions to the COL applicant-specific ITAAC information described in a December 9, 2008, response to RAI 42, Question 14.03.12-5, the staff determined that neither the FSAR nor the COL application contained specific ITAAC with design commitments that captured SRP Section 14.3.12, PS-ITAAC No. 11(b), 11(c), and 11(d) to verify that alarm stations are not visible from the PA, that no single act can simultaneously remove the ability of both the CAS and SAS to perform their intended functions, and that CAS and SAS are equal and redundant, respectively. The test abstract description in TR ANP-10295, Appendix G, Section G.11 does not specifically address the need to verify that the central alarm system and secondary alarm system locations are not visible from the protected area and the verification that both the central alarm system and secondary alarm system are equal and redundant.

Therefore, in RAI 447, Question 14.03.12-57, the staff requested that the applicant provided specific ITAAC descriptions (design commitment, ITA, and acceptance criteria) in FSAR Tier 1, Chapter 3, Section 3.1, “Security,” and Table 3.1-1, that specifically addressed 10 CFR 73.55(i)(4)(i) through (i)(4)(iii). In an April 18, 2011, response to RAI 447, Question 14.03.12-57, the applicant stated that the Items 11(b), 11(d), and 11(e) of NUREG-0800, Section 14.3.12 (May 2010) will be added to Table 3.1-1 (security ITAAC), in FSAR Tier 1, and TR ANP-10295, Appendix G, Sections G.11 and G.7, test abstracts will be revised to describe the verification and demonstrate that the central alarm system and secondary alarm system comply with the requirements of 10 CFR 73.55(i)(4)(i) through (i)(4)(iii). The revisions will demonstrate that the central alarm system and secondary alarm system are not visible from the perimeter of the protected area, the status of a detection point is not allowed to be changed without the knowledge and concurrence of alarm station operator in the other alarm station, no single act can simultaneously remove the ability of both the central alarm system and secondary alarm system to perform their intended functions, and that the central alarm system and secondary alarm system have redundant capabilities. The staff finds the applicant’s April 18, 2011, response to RAI 447, Question 14.03.12-57 acceptable. **RAI 447, Question 14.03.12-57 is being tracked as a confirmatory item** to ensure that TR ANP-10295, Appendix G, Sections G.11 and G.7 is revised as indicated in the response.

The staff finds the applicant provided an adequate and reasonable description of the test objectives, prerequisites, test methods, required data, and acceptance criteria, in TR ANP-10295, Appendix G, and the description is sufficiently detailed and supports the identified ITAAC related to protected area intrusion detection, alarm testing, communications, normal and backup electrical power systems, and security lighting. The descriptions of ITA within TR ANP-10295, Appendix G.7 address the central alarm system and secondary alarm system redundancy of functions and verify that the design of the central alarm system and secondary alarm system are not subject to a single point failure supporting FSAR Tier 1, Chapter 3, Table 3.1-1, descriptions for commitments and ITAAC.

However, the verifications of revisions as stated in responses to RAI 253, Questions 14.03.12-46 and 14.03.12-47, and RAI 447, Question 14.03.12-57 are identified as confirmatory items for the staff to verify that the applicant incorporated RAI responses into the FSAR Tier 1 and reference TR ANP-10295, which are provided on the docket to describe the standard ITAAC and test abstracts for verifying performances and intended security functions meeting regulatory requirements.

14.3.12.4.3.3 *Inspections, Tests, and Analyses for Verifying Physical Barriers - Locking Devices, Bullet Resistance, and Vehicle Barrier Systems*

- Locking Devices: The applicant described the objectives are to demonstrate that locks used to secure openings through the vital area boundaries are manipulative resistant and openings to unoccupied vital areas are equipped with manipulative-resistant locks. The verification methods include inspections of each opening through the vital area boundary requiring locking, openings are protected with approved manipulative-resistant locking device, and opening will lock. The applicant also described prerequisites, data required, and acceptance criteria in TR ANP-10295, Appendix G.2. The acceptance criteria identified is that each opening through the vital area boundary capable of passage by personnel is protected by a manipulative-resistant lock that will lock.

- Bullet Resistance: The applicant indicated that the objectives are to demonstrate that the walls, doors, ceilings, floors, and other openings into the MCR, CAS, SAS, and last access control into the PA are bullet resistant to a minimum Underwriter Laboratories (UL) standard for performance. The verification methods include inspections and/or analyses that verify the structure thickness of external walls, ceilings, and floors, and inspections of doors for bullet resistance construction and installation of protection of opening to prevent linear paths of bullet trajectory into the bullet resistant enclosure. The applicant referenced details of TR ANP-10295, Section 3.0 for design and performance requirements for bullet resistant as the basis for adequate bullet resistant enclosure. The applicant identified acceptance criteria as: (1) structural thickness exceeds the minimum value established in TR ANP-10295, Section 3 for each external wall, floor, and ceiling in the MCR, SAS, CAS, and last access control function for access to the PA; (2) each door on the structural walls are bullet resistant to a minimum UL standard as stated; and (3) each opening (e.g., HVAC ducts) includes a labyrinth design to ensure bullet pathways intersect material of construction that is bullet resistant.

- Vehicle Barrier System: The applicant stated that the objective is to demonstrate that the vehicle barrier system (VBS) is installed and located at the necessary stand-off distance to protect against the DBT vehicle bombs. The verification method is inspection (including measuring) of the distance from each vital structure to the nearest

point of the VBS. The applicant also described prerequisites, data required, and acceptance criteria in TR ANP-10295, Appendix G.5. The acceptance criterion that must be met is the distance measured exceeds the safe stand-off distances required in TR ANP-10295.

The staff finds that the applicant provided adequate descriptions of the test objectives, prerequisites, test methods, required data, and acceptance criteria in TR ANP-10295, Appendix G. The staff concludes that test abstracts are of sufficient detail and support the identified ITAAC related to locking devices, bullet resistance, and vehicle barriers systems in FSAR Tier 1, Chapter 3, Table 3.1-1.

14.3.12.4.3.4 *Inspections, Tests, and Analyses for Verifying Access Control and Search System*

The applicant stated that the objectives are to demonstrate that access points provide control of personnel and vehicles into the PA; the PA access points are capable of detecting firearms, explosives, and incendiary devices; and an access control system with numbered picture badges or acceptable technology provides control of PA access. The verification methods included inspections of access control facility for controlling access of personnel and vehicles and identifying openings capable of personnel passage. Performance tests include verification of capabilities to detect weapons, explosives, incendiary devices, and other contrabands and performance tests of access control systems. TR ANP-10295, Appendix G, Section G.6 described the required data and specific acceptance criteria for meeting the objectives. The acceptance criteria are: (1) Personnel and vehicle access other than the designated access portals requires breaching of barrier or lock; (2) access control system can identify and authorize access of authorized personnel; (3) personnel search equipment meets detection of fire arms based on standards described in RG 5.7, “Entry/Exit Control for Protected Areas, Vital Areas, and Material Access Areas,” Revision 1, May 1980; and (4) personnel search equipment meets explosive detection performance standard of RG 5.7.

The staff finds that the applicant provided an adequate and reasonable description of the test objectives, prerequisites, test methods, required data, and acceptance criteria in TR ANP-10295, Appendix G. The description is sufficiently detailed to support the identified ITAAC related to access control of personnel, vehicles, and material in FSAR Tier 1, Chapter 3, Table 3.1-1, “Security ITAAC,” and the verification of the design features that will be incorporated for physical protection in the U.S. EPR standard design or addressed by a COL applicant referencing the FSAR (e.g., PSS outside of the scope of the standard design).

14.3.12.5 *Combined License Information Items*

Section 14.3.1.5, Table 14.3.1-1 of this report provides a list of all ITAAC related COL information items and descriptions from FSAR Tier 2, Table 1.8-2 that are applicable to FSAR Tier 2, Section 14.3. The staff finds the list in Table 14.3.1-1 to be complete and describes the management controls and processes for the organization, staffing, and procedures for the verification program that include ITAAC and acceptance tests for physical protection systems in the U.S. EPR design certification. Also, the list adequately describes actions necessary for the COL applicant. No additional COL information items need to be included in FSAR Tier 2, Table 1.8-2.

14.3.12.6 *Conclusions*

Except for the open items, the staff finds the following:

- The applicant has proposed and adequately described attributes for physical security systems and associated components, hardware, or configurations as ITAAC for verification.

- The applicant has identified appropriate and reasonable commitments, test methods (inspection, tests, or analyses), and acceptance criteria for the U.S. EPR design certification.

- The applicant has appropriately committed in the FSAR the requirement that a COL applicant referencing the U.S. EPR design certification establishes a process that will include identification of requirements, construction verifications that review the as-built systems and conditions, and compliance determination for physical protection systems performance and acceptance that are not specifically identified as ITAAC.

- The applicant has provided adequate descriptions of elements of the test protocol for physical protection systems (i.e., objectives, prerequisites, test methods, data required, and acceptance criteria) that supports FSAR Tier 1 descriptions of ITAAC for complying with the requirements of 10 CFR 52.47(b)(1).

- The applicant has identified appropriate and reasonable descriptions of test abstracts (protocols) that establish the framework for the development of the detail test procedures for the conduct of inspections, tests, and analyses that will be performed and, if met, will demonstrate that the plant incorporated the U.S. EPR design certification and the identified security system and hardware built and will operate in accordance with the U.S. EPR.

- The applicant has provided adequate and reasonable descriptions of requirements (i.e., COL Information Items 14.2.1, 14.2.2, and 14.2.3) for a COL applicant referencing the U.S. EPR design certification to describe the management controls and processes for the organization, staffing, and procedures for the verification program that include ITAAC and acceptance tests for physical protection systems in the U.S. EPR standard design.

The staff concludes that except for the open items, the applicant has met 10 CFR Part 52, Subpart B, Section 52.47, which requires information submitted for a U.S. EPR must include performance requirements and design information sufficiently detailed to permit the preparation of acceptance and inspection requirements by the NRC, and procurement specifications and construction and installation specifications by an applicant. In addition, the applicant has met 10 CFR 52.47(b)(1) that requires a U.S. EPR application to contain the proposed inspections, tests, analyses, and acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criterion are met, a plant that incorporates the U.S. EPR is built and will operate in accordance with the U.S. EPR design certification.