CHAPTER 14 – VERIFICATION PROGRAMS

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14.0 VERIFICATION PROGRAMS

Chapter 14, "Verification Programs," of the United States Nuclear Regulatory Commission (NRC) Safety Evaluation Report (SER) for the design certification (DC) of the Mitsubishi Heavy Industries (MHI), hereinafter referred to as "the applicant," United States Pressurized-Water Reactor (US-APWR) presents the results of the review of Chapter 14 of the US-APWR Design Control Document (DCD) by the NRC staff (the staff). The information provided in Chapter 14 of the US-APWR DCD addresses major phases of the initial test program, including preoperational tests, initial fuel loading and initial criticality, low-power tests, and power ascension tests. This chapter also describes the bases, processes, and selection criteria used to develop the Tier 1 material, which are to be verified appropriately by inspection, test, analysis, and acceptance criterion/criteria (ITAAC).

14.1 Specific Information to be Included in Preliminary/Final Safety Analysis Reports

The staff review of this chapter begins with Section 14.2 since DCD Section 14.1, "Specific Information to be Included in Preliminary/Final Safety Analysis Reports," does not address any DC-relevant information.

14.2 Initial Plant Test Program - Design Certification and New License Applicants

This chapter of the SER contains detailed information to address the following 12 areas associated with the Initial Plant Test (ITP) Program, which are discussed in the sections below:

14.2.1 Summary of Test Program and Objectives
14.2.2 Organization and The staffing
14.2.3 Test Procedures
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14.2.1 Summary of Test Program and Objectives

14.2.1.1 Introduction

The ITP for the plant is applied to the nuclear portion of the facility as well as to the balance of plant. This section also describes the major phases of the ITP including the general prerequisites and specific objectives to be achieved for each phase.

Generic Editorial Comment:
This is the formal title of Section 2.14 and therefore should use use title case capitalization, .i.e., capitalize the word "programs". This comment applies to every instance of this title in the SE document.

14.2.1.2 Summary of Application

DCD Tier 1: The Tier 1 information associated with this section is f
Tier 1, Section 2.14, "Initial Test program." In this section the applic
overview of the ITP that includes: the main activities and phases of the ITP; an overview of the administrative controls used for the ITP; and basic definitions of preoperational tests, startup test and power ascension tests.

DCD Tier 2: In Tier 2, Section 14.2 of the DCD, Revision 3 the applicant provided a Tier 2 design description of its ITP for the US-APWR, which is summarized below:

> The objectives of the ITP include a demonstration that the plant construction is in compliance with the plant design; that the plant systems perform in accordance with that design; and that the initial fuel load, initial criticality, low-power testing, and power ascension testing are performed in an approved predetermined methodology.
>
> The US-APWR ITP includes preoperational and startup tests and a listing are provided in Table 14.2-1, Comprehensive Listing of Tests. Preoperational tests, which are performed after the construction and installation of plant equipment but before initial fuel loading, demonstrate the capability of the plant systems to meet relevant performance requirements. Startup tests, which begin with initial fuel loading, demonstrate the capability of the integrated plant to meet performance requirements.
>
> The ITP includes tests on systems in the nuclear portion of the plant, the balance of plant, and nonnuclear areas. US-APWR plants will conduct preoperational and startup testing in accordance with an approved manual containing ITP administrative controls. The manual describes procedures for different aspects related to organization, staffing, preparation, conduct, review, and approval of preoperational and startup tests.
>
> Major phases of the ITP (construction, preoperational, and startup phases) are discussed in terms of the activities or tests conducted and the major objectives of the tests in each phase. The construction and preliminary tests and the inspection test phase verify and document that the applicant's construction and installation of equipment in the facility are in accordance with design, and that the equipment and components are functional and ready for preoperational testing. Preoperational tests occur after the construction tests are complete and before fuel loading. Startup tests take place after completion of preoperational testing and they demonstrate adequate performance of the nuclear steam supply system and other systems at various power levels.

Inspection, Test, Analysis, and Acceptance Criteria: There are no ITAAC associated with Tier 1, Section 2.14.

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

Technical Reports (TRs):

Consistency Comment:
In all other places in this document you spell out Technical Report instead of using TR.

MHI TR MUAP-08009, "US-APWR Test Program Description"
MHI TR MUAP-07004 P (Proprietary) and MUAP-07004 NP (Non Proprietary), "Safety I&C System Description and Design Process," Revision 1, July 2007

Technical Comment:
This report is currently as Rev. 8, but at the time of DCD Rev. 3, the report was at Rev. 6. Either way, it does not seem appropriate for the Ch 14 SE to reference Rev. 1.

Topical Reports: There are no topical reports associated with this su

US-APWR Interface Issues Identified in the DCD: There are no US-APWR interface issues associated with this area of review.

Site Interface Requirements Identified in the DCD: There are no site interface requirements associated with this area of review

Editorial Comment:
Missing period at end of sentence.

Cross-cutting Requirements (Three Mile Island [TMI], Unresolved Safety Issue [USI]/Generic Safety Issue [GSI], Op Ex): TMI Action Plan Item II.D.3.

Regulatory Treatment of Non-safety Systems (RTNSS): There are no RTNSS issues for this area of review.

10 CFR 20.1406: There are no issues related to 10 CFR 20.1406 for this area of review.

14.2.1.3 Regulatory Basis

The relevant requirements of the Commission's regulations for this area of review, and the associated acceptance criteria, are given in Section 14.2, "Initial Plant Test Program - Design Certification and New License Applicants," of NUREG 0800, "Standard Review Plan for Safety Analysis Reports for Nuclear Power Plants, LWR *[light-water reactor]* Edition" (the SRP), and are summarized below.

1. 10 CFR 50.34(b)(6)(iii), which requires the applicant to provide plans for preoperational testing and initial operations.

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

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

4. Section III.A.4 of Appendix J to 10 CFR Part 50, 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), which requires that a DC application include 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 DC has been constructed and will operate in accordance with the DC, the provisions of the Atomic Energy Act, and the NRC's regulations.

6. 52.47(c)(1) of Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," of Title 10 of the *Code of Federal Regulations* (10 CFR 52.47(c)(1)), which specifies, in part, that an applicant for design certification submit the technical

information required of applicants for operating licenses that is technically relevant to the design and not safety-related.

7. 10 CFR 52.79(b) and 10 CFR 50.34(b)(6)(iii), which requires that an applicant for an operating license provide information concerning plans for preoperational testing and initial operations.

The SRP acceptance criteria for this area of review adequate to meet the above regulatory requirements are given in Section II of SRP Section 14.2 and include the following:

1. Regulatory Guide (RG) 1.68, "Initial Test Programs for Water-Cooled Nuclear Power Plants," Revision 3, issued March 2007, which describes the general scope and depth of the ITPs acceptable to the staff.
   a. As stated in RG 1.68, the objectives of an acceptable ITP are: (1) to provide additional assurance that the facility has been adequately designed, (2) to the extent practical, to validate the analytical models and verify the correctness or conservatism of assumptions used to predict plant responses to anticipated transients and postulated accidents, (3) to provide assurance that construction and installation of equipment in the facility have been accomplished in accordance with the design, (4) to familiarize the plant's operating and technical staff with the operation of the facility, and (5) to verify by trial use, to the extent practical, the adequacy of the facility's operating and emergency procedures.

   b. For each phase of the ITP, a design certification applicant should provide test abstracts that include the objectives of each test, a summary of prerequisites and test method, and specific acceptance criteria. The ITP should also address programmatic aspects, including consideration of organization and staffing; preparation, review, and technical content of test procedures; conduct of the test program; review, evaluation, and approval of test results; and use of reactor operating and testing experiences. Conformance of a proposed test program to the guidelines of RG 1.68, "Initial Test Programs for Water-Cooled Nuclear Power Plants" and the acceptance criteria outlined in the standard review plan (SRP) Section 14.2 provide reasonable assurance that it meets these objectives. ITPs that satisfy these objectives should provide the necessary assurance that the facility can be operated in accordance with its design criteria and in a manner that will not endanger the health and safety of the public.

2. Other SRP Section 14.2 acceptance criteria for the summary of test programs and objectives are as follows:
   a. The ITP should describe the objectives, including a description of the objectives for each of the major phases of the test program.
   b. The ITP should describe the criteria for selection of plant features to be tested by the applicant.
   c. Objectives and testing selection criteria should be consistent with the general guidelines and applicable regulatory positions in RG 1.68. The applicant should appropriately justify exceptions.

3. RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," issued June 2007 Section C.III.1, Chapter 14, C.I.14.2.1, "Summary of Test Program and Objectives," has similar wording for this aspect of the DCD.

14.2.1.4 Technical Evaluation

Using the guidance contained in SRP Section 14.2, the staff reviewed the ITP administrative requirements and the technical adequacy of the preoperational and startup test abstracts. The staff's review methodology consisted of (1) reviewing the test program's conformance to NRC regulatory guidance and (2) reviewing test abstracts to ensure t demonstrates the performance of the pertinent structures, syste described in the specific technical DCD section for each system. The entire portion of SRP Section 14.2, RG 1.68, and of RG 1.206, Section C.I.14, "Verification Programs" served as the main review guidance. In addition, the DCD and RG 1.68refer to other RGs for specific SSC testing that the staff used for more detailed guidance. Each of these documents is formatted somewhat differently, but the SER review is organized to agree with the DCD and RG 1.206. Within that structure, the appropriate sections address the guidance of the SRP and RG 1.68. Where the applicant did not conform to the RGs, the staff reviewed the applicant's justification for the exception to ensure that the test program scope remained sufficient.

Editorial Comment:
Missing space between "1.68" and "refer".

The staff performed the original review using Revision 0 of the DCD. Subsequently, the applicant submitted DCD Revision 1, issued August 2008; Revision 2, issued October 2009; and Revision 3, issued March 2011. The staff also reviewed all changes to Section 14.2 in Revisions 1, 2, and 3 and related relevant sections. Section 14.2.1, "Summary of Test Program and Objectives," of the US-APWR DCD, Revision 3, describes the ITP and addresses its major phases; namely, construction, preoperational, and startup tests. As part of the summary, this section lists the regulatory requirements relevant to the ITP, the objectives of the ITP, and the criteria for performing preoperational and startup tests on the various plant SSCs.

Section 2.14.1, "Design Description" of the Tier 1 DCD, Revision 3, provides a high-level overview of the ITP that gives the key points of the program. It discusses the major phases of the program, the administrative controls, and the development and use of approved test procedures, preoperational testing, and startup testing. The information is consistent with that provided in Tier 2, which the staff reviewed acceptably in this SER.

In DCD, Revision 3, Section 14.2.1, the applicant committed to the appropriate sections of the regulations. DCD, Revision 3, Section 14.2.1, also provides an acceptable set of objectives for the ITP and lists the scope of SSCs that will be tested. This scope is in accordance with RG 1.68.

This section of DCD, Revision 3, includes the two major phases of the ITP, preoperational testing and startup tests. It also discusses construction tests, but they are considered as prerequisites to the ITP rather than as part of the ITP. This section and other parts of Section 14.2 refer to various aspects of the test program that are the responsibility of the combined license (COL) applicant or licensee, while Section 14.2.13 contains the complete list.

DCD, Revision 3, Section 14.2.1.1, "Test Program for Nuclear and Balance of Plant Systems," describes the approved test manual and administrative procedures that the startup organization developed and that the ITP will use. This section summarizes them, and subsequent sections of the DCD discuss them in more detail. The applicant will test each component and system

independently and then in an integrated fashion for the entire plant. The referenced "Test Program Description Technical Report," MUAP-08009, addresses testing for safety-related systems.

DCD, Revision 3, Section 14.2.1.2.1, "Construction Tests," describes tests which verify that the applicant's construction and installation of equipment is in accordance with the design and that the SSCs are functional and ready for preoperational testing. It describes the activities included such as hydrostatic pressure tests, flushing, cleaning, wiring continuity and separation checks, initial instrument calibrations, valve functional checks, motor rotational checks, and functional tests of components. The DCD notes that either the construction organization or the startup organization will conduct the construction tests. The section also notes that each system has a construction test matrix to define what is to be tested. The test requirements are based on RG 1.68, Appendix C, "Preparation of Procedures," descriptions in final safety analysis reports (FSARs), vendor recommendations, and other NRC and industry guidance. Cleanliness control for systems and components during preoperational and startup testing is in accordance with NRC RG 1.37, "Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants," Revision 1, issued March 2007.

DCD Revision 3, Section 14.2.1.2.2, "Preoperational Tests," provides a listing of the major objectives of the preoperational test program. It also discusses various types of preoperational tests that comprise the program. Section 14.2.1.2.3, "Startup Tests," discusses the phases of the general objectives of the startup test program.

14.2.1.5 Combined Licensed Information Items

DCD Revision 3 contains no COL items relative to this DCD section. The staff's review identified no additional COL items.

14.2.1.6 Conclusions

The staff concludes that the information provided in Section 14.2.1 of the US-APWR DCD, Revision 3, adequately describes the test program and its objectives. The staff has compared the information in the application to the relevant NRC regulations, acceptance criteria defined in SRP Section 14.2, RG 1.68 and other NRC RGs and it concludes that the applicant is in compliance with the NRC regulations and adequately addresses NRC guidance with respect to initial test programs. The objectives agree with the guidance of RG 1.68 and are acceptable.

14.2.2 Organization and the staffing

14.2.2.1 Introduction

This section addresses the organization used to manage, supervise, and execute all phases of the test program.

14.2.2.2 Summary of Application

DCD Tier 1: The Tier 1 information associated with this section is found in DCD Tier 1, Section 2.14, "Initial Test program," of the DCD.

DCD Tier 2: In Tier 2, Section 14.2 of the DCD, Revision 3 the applicant provided a Tier 2 design description of its ITP for the US-APWR, which is summarized below:

DCD Revision 3 provides a general description of the organization and staffing, as well as the qualifications and training needed for the personnel conducting the ITP. It states that the COL licensee is responsible for conducting the ITP and will establish an organization to perform the functions needed for completing it. This organization will manage, supervise, execute, and document all phases of the ITP.

This DCD section provides top-level guidelines for the following aspects:

- startup organization
- organizational authorities and responsibilities
- plant operating and technical staff participation
- experience and qualification of supervisory personnel
- plant operating and technical staff training to support testing

The startup organization will be a temporary organization established by the COL licensee to perform the ITP. It draws its members from different organizations, such as the plant owner and operator, the designer and NSSS supplier, MHI; the architect-engineer, constructor; the electrical generator supplier; and others. Following completion of the ITP, the startup organization transfers all responsibility for the plant operation to the plant operating organization.

The plant operating and technical staff is expected to participate in all test program phases. DCD Revision 3 addresses the role of different plant organizations after turnover from construction, at fuel loading, and afterwards. DCD Revision 3 states that experienced and qualified supervisory personnel and other principal participants will be responsible for managing, developing, and conducting each phase of the test. In addition, a training program will be developed for the plant personnel involved in the ITP.

Inspection, Test, Analysis, and Acceptance Criteria: There are no ITAAC associated with Tier 1, Section 2.14, “Initial Test Program” identified by the applicant.

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

Combined License (COL) information or action items: (See Section 14.2.2.5 below).

Technical Reports: MHI Technical Report MUAP-08009, “US-APWR Test Program Description.”

Topical Reports: There are no topical reports associated with this subsection.

US-APWR Interface Issues Identified in the DCD: There are no US-APWR interface issues associated with this area of review.

Site Interface Requirements Identified in the DCD: There are no site interface requirements associated with this area of review.

Cross-cutting Requirements (Three Mile Island [TMI], Unresolved Safety Issue [USI]/Generic Safety Issue [GSI], Op Ex): TMI Item I.G.1, "Training During Low-Power Testing," in the Three Mile Island (TMI) Action Plan (NUREG-0660, "NRC Action Plan Developed as a Result of the TMI-2 Accident)."

Regulatory Treatment of Non-safety Systems (RTNSS): There are no RTNSS issues for this area of review.

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, Section 20.1406: There are no issues related to 10 CFR 20.1406 for this area of review.

14.2.2.3 Regulatory Basis

The relevant requirements of the Commission's regulations for this area of review, and the associated acceptance criteria, are given in SRP Section 14.2 and are summarized below. Review interfaces with other SRP sections can be found in Section 14.2 of NUREG-0800:

1. 10 CFR 52.47(c)(1), which specifies, in part, that an applicant for design certification submit the technical information required of applicants for operating licenses (see 10 CFR Part 50) that is technically relevant to the design and not site-specific.

2. 10 CFR 52.79(b) and 10 CFR 50.34(b)(6)(iii), which requires that an applicant for an operating license provide information concerning plans for preoperational testing and initial operations.

The SRP acceptance criteria for this area of review adequate to meet the above regulatory requirements are given in Section II of SRP Section 14.2 and include the following:

1. The specific acceptance criteria apply to management organizations for COL applicants are and were considered to apply at a high level for a DC applicant as well.

2. Specifically, the applicant should provide organizational descriptions for principal management positions responsible for planning, execution, and documentation of preoperational and startup testing activities.

3. RG 1.68 as it relates to initial test programs

Editorial Comment:
Missing period at end of sentence.

4. RG 1.206 as it relates to requirements for applications for combined operating licenses that require some input from the DC applicant for verification programs

14.2.2.4 Technical Evaluation

Section 2.14.1 of the Tier 1 DCD, Revision 3, provides a high-level overview of the ITP that gives the key points of the program. It discusses the major phases of the program, the administrative controls, and the development and use of approved test procedures, preoperational testing, and startup testing. The information is consistent with that provided in Tier 2, which the staff reviewed acceptably in this SER.

The staff reviewed Section 14.2.2 of the US-APWR DCD, Revision 3, for conformance to the guidance in the SRP, RG 1.206 and RG 1.68. RG 1.206, Section C.III.1, Chapter 14, C.I.14.2.2, is entitled "Organization and Staffing."

The staff's technical evaluation focused on the following aspects:

- a description of the organization that manages, supervises, or executes any phase of the test program, and the adequacy of the description in delineating the organizational authorities and responsibilities, the degree of participation of each identified organizational unit, and the role of principal participants

- the experience and qualification of supervisory personnel and other principal participants responsible for managing, developing, or conducting each test phase

- sufficient information to determine the plan for personnel participation in the ITP

DCD Revision 3, Section 14.2.2, provides an overview of the COL applicant's or licensee's responsibility for conducting the ITP and the organization that it will establish. This ITP organization manages, supervises, executes, and documents all phases of the ITP for the US-APWR. Approved administrative procedures describe the organization that addresses authorities and responsibilities and the principal participants, including each organizational unit. COL Item 14.2(2) states the following:

> *"The COL Applicant reconciles the site-specific organization, organizational titles, organizational responsibilities, and reporting relationships to be consistent with US-APWR Test Program Description Technical Report, MUAP-08009 (Reference 14.2-29) [14.2.2]."*

DCD Revision 3, Section 14.2.2.1, "Startup Organization," describes the temporary organization that will perform the ITP and determines who its members will be. At the completion of the test program, the startup organization transfers all responsibility to the normal plant operating organization. However, since the startup organization is composed of personnel from various other organizations, including the normal plant staff, the experience attained during the ITP is carried into the operational phase.

DCD Revision 3, Section 14.2.2.2, "Organizational Authorities and Responsibilities," notes that the startup organization performs all tests that occur between the completion of construction and the beginning of plant commercial operation. This includes test schedules, procedures, conduct of testing, and approval of test results. MHI, the DC applicant, is the primary designer of the US-APWR and will have a resident site manager and other personnel on site to assist the constructor, the plant operator, and the startup organization.

DCD, Revision 3, Section 14.2.2.3, "Plant Operating and Technical Staff Participation," notes that the plant operating and technical staff will participate in each major test phase as much as possible. This provides valuable personnel for the test program and allows the staff to gain useful plant experience in the process. This also addresses TMI Item I.G.1, "Training During Low-Power Testing," in the Three Mile Island (TMI) Action Plan (NUREG-0660, "NRC Action Plan Developed as a Result of the TMI-2 Accident)." After turnover from construction, the plant operating staff controls and operates SSCs. At fuel loading and afterwards, licensed operators perform all operation of equipment and systems. The plant staff calibrates or controls the instrumentation.

14.2.2.5 Combined Licensed Information Items

Table 14.2.2-1 US-APWR Combined License Information Items		
Item No.	**Description**	**Section**
14.2(2)	The COL applicant reconciles the site-specific organization, organizational titles, organizational responsibilities, and reporting relationships to be consistent with US-APWR Test Program Description Technical Report, MUAP-08009 (Reference 14.2-29) [14.2.2].	14.2.2

The staff's review identified no additional COL items for this section.

14.2.2.6 Conclusions

The staff concludes that the information provided in Section 14.2.2 of the US-APWR DCD, Revision 3, adequately describes the organization and staffing for the US-APWR ITP. The staff has compared the information within the application to the relevant NRC regulations, acceptance criteria defined in SRP Section 14.2, and other NRC RGs and concludes that the applicant is in compliance with the NRC regulations.

14.2.3 Test Procedures

14.2.3.1 Introduction

The startup manual addresses 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. Testing during all phases of the ITP uses detailed, step-by-step written procedures to control and document 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), and specify acceptance criteria by which the test is to be evaluated, and provide or specify the format for recording data or observations.

14.2.3.2 Summary of Application

DCD Tier 1: The Tier 1 information associated with this section is found in DCD Tier 1, Section 2.14, "Initial Test Program," of the DCD.

DCD Tier 2: In Tier 2, Section 14.2 of the DCD, Revision 3 the applicant provided a Tier 2 design description of its ITP for the US-APWR, which is summarized below:

DCD Revision 3 addresses different aspects related to test procedure development, review, and approval, and defines the organizations involved in developing the test procedures.

The startup organization will develop the test procedures adhering to the NRC RGs listed in Table 14.2-2. The applicant is to provide the procedures to the NRC for review at least 60 days before their use, in accordance with COL Item 14.2(12).

MHI and other major participants associated with the ITP provide plant and system information specific enough to determine test objectives, acceptable criteria applicable to the plant design, delineation of specific plant operational conditions under which tests are to be conducted, testing methodologies to be used, specific data to be collected, and acceptable data analysis techniques.

The DCD Revision 3, Section 14.2.3, addresses the following aspects relating to test procedures:

- organizational functions during development, review, and approval of test procedures
- test procedure content
- system designer participation in developing test procedures
- qualification of test procedure developers and reviewers
- test procedure format

ITAAC: There are no ITAAC associated with Tier 1, Section 2.14 identified by the applicant.

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

Technical Reports: MHI Technical Report MUAP-08009, "US-APWR Test Program Description."

Topical Reports: There are no topical reports associated with this subsection.

US-APWR Interface Issues Identified in the DCD: There are no US-APWR interface issues associated with this area of review.

Site Interface Requirements Identified in the DCD: There are no site interface requirements associated with this area of review.

Cross-cutting Requirements (Three Mile Island [TMI], Unresolved Safety Issue [USI]/Generic Safety Issue [GSI], Op Ex): There are no cross-cutting issues for this area of review.

Regulatory Treatment of Non-safety Systems (RTNSS): There are no RTNSS issues for this area of review.

10 CFR 20.1406: There are no issues related to 10 CFR 20.1406 for this area of review.

14.2.3.3 Regulatory Basis

The relevant requirements of the Commission's regulations for this area of review, and the associated acceptance criteria, are given in Section 14.2 of NUREG-0800 and are summarized below. Review interfaces with other SRP sections can be found in Section 14.2 of NUREG-0800. Acceptance criteria are based on meeting the relevant requirements of the following Commission regulations:

1. 10 CFR 52.47(c)(1), which specifies, in part, that an applicant for design certification submit the technical information required of applicants for operating licenses (see 10 CFR Part 50) that is technically relevant to the design and not site-specific.

2. 10 CFR 52.79(b) and 10 CFR 50.34(b)(6)(iii), which require that an applicant for an operating license provide information concerning plans for preoperational testing and initial operations.

Acceptance criteria adequate to meet the regulatory requirements are given in SRP Section 14.2, Subsection II, and include the following:

1. To comply with the specific acceptance criteria for test procedures, the applicant should provide general guidance for administrative controls that will be used to develop, review, and approve individual test procedures; coordinate with organizations involved in the test program; involve plant operating and technical staff; and review, evaluate, and approve test results.

5. RG 1.68 as it relates to initial test programs

6. RG 1.206 as it relates to requirements for applications for combined operating licenses that require some input from the DC applicant for verification programs

14.2.3.4 Technical Evaluation

Section 2.14.1 of the Tier 1 DCD, Revision 3, provides a high-level overview of the ITP that gives the key points of the program. It discusses the major phases of the program, the administrative controls, and the development and use of approved test procedures, preoperational testing, and startup testing. The information is consistent with that provided in Tier 2, which the staff reviewed acceptably in this SER.

The staff reviewed Section 14.2.3, "Test Procedures" of the US-APWR DCD, Revision 3, for conformance to the guidance in the SRP, RG 1.206 and RG 1.68. RG 1.206, Section C.III.1, Chapter 14, C.I.14.2.3, is entitled "Test Procedures."

The staff's technical evaluation focused on the following aspects:

- General guidance provides for administrative controls to develop, review, and approve test procedures to be developed by the COL applicant.
- Guidance ensures that plant operating and technical staff is inv reviewing, and approving test procedures.

Editorial Comment:
This word should be "all".

DCD Revision 3, Section 14.2.3, notes that the development of test procedures uses the test abstracts contained in DCD Revision 3, Section 14.2.12. This will ensure that tall SSC tests address the objectives of the ITP. Plant management has ultimate responsibility for the ITP, with MHI assistance.

MHI, the architect engineer, and other participants provide design and system information to the startup organization so that it can develop the detailed test procedures based on the test

abstracts in the DCD and related NRC RGs. The test procedures are prepared, reviewed, and approved in accordance with the startup manual and approved administrative procedures.

COL Item 14.2(7) states the following:

> *The COL applicant provides an event-based schedule, relative to fuel loading, for conducting each major phase of the test program, and a schedule for the development of plant procedures that assures required procedures are available for use during the preparation, review and performance of preoperational and startup testing. For multiunit sites, the COL applicant discusses the effects of overlapping initial test program schedules on organizations and personnel participating in each ITP. The COL applicant identifies and cross-references each test or portion of a test required to be completed prior to fuel load which satisfies ITAAC requirements. [14.2.9] [14.2.11]*

COL Item 14.2(12) states the following:

> *The COL holder makes available approved test procedures for satisfying testing requirements described in Section 14.2 to the NRC approximately 60 days prior to their intended use. [14.2.3, 14.2.11, 14.2.12.1]*

An overview of the test procedure contents, which is provided without specific details, contains safety precautions and limitations, objectives, prerequisites, initial conditions, methods to direct and control test performance (including sequencing of testing), acceptance criteria, the format for recording data or observations, and data analysis methods.

DCD Revision 3 notes that the administrative procedures define the qualifications of the test procedure developers and reviewers, along with their position titles. It notes the need for a method using system engineers to provide objectives and acceptance criteria for developing test procedures, but it does not specify the method.

DCD Revision 3, Section 14.2.3.5, states, in part, that the guidance provided in RG 1.68, Appendix C, Section 1, is the basis for the format for the test procedures, with some minor exceptions. The exceptions, as stated, are merely title changes and the addition of more information that will be useful. The guidance specifies the test procedure format for different sections, with a brief explanation of the content of each section.

MUAP-08009, Revision 1, addresses test procedures and test control in Sections 8.0, 9.0 and 10.0. Specifically, 8.1, “Preparation of Test Procedures,” 8.2, “Review and Approval of Test Procedures,” 9.3, “Procedure Control,” 9.4, “Procedure Changes,” and 10.1, “Review and Approval of Test Results Reports.”

14.2.3.5 Combined Licensed Information Items

Table 14.2.3-1
US-APWR Combined License Information Items

Item No.	Description	Section

Table 14.2.3-1
US-APWR Combined License Information Items

Item No.	Description	Section
14.2(7)	The COL applicant provides an event-based schedule, relative to fuel loading, for conducting each major phase of the test program, and a schedule for the development of plant procedures that assures required procedures are available for use during the preparation, review and performance of preoperational and startup testing. For multiunit sites, the COL applicant discusses the effects of overlapping initial test program (ITP) schedules on organizations and personnel participating in each ITP. The COL applicant identifies and cross-references each test or portion of a test required to be completed prior to fuel load which satisfies ITAAC requirements.	14.2.9 and 14.2.11
14.2(12)	The COL holder makes available approved test procedures for satisfying testing requirements described in Section 14.2 to the NRC approximately 60 days prior to their intended use.	14.2.3, 14.2.11, and 14.2.12.1

The staff's review identified no additional COL items for this section.

14.2.3.6 Conclusions

The staff concludes that the information provided in Section 14.2.3 of the US-APWR DCD, Revision 3, adequately describes the test procedures for the US-APWR. The staff has compared the information within the application to the relevant NRC regulations, acceptance criteria defined in SRP Section 14.2, and other NRC RGs and concludes that the applicant is in compliance with the NRC regulations.

14.2.4 Conduct of the Test Program

14.2.4.1 Introduction

This section describes the following: (1) the administrative controls that govern the conduct of each major phase of the test program, including those used to ensure that each major phase and individual test satisfies the necessary prerequisites, (2) the methods to be followed in initiating plant modifications or maintenance tasks necessary to conduct the test program and the methods used to ensure retesting following such modifications or maintenance, (3) the involvement of design organizations and the applicant in reviewing and approving proposed plant modifications, (4) the methods and provisions to ensure that the retesting required for modifications or maintenance remains in compliance with ITAAC commitments, and (5) the administrative controls pertaining to adherence to approved test procedures during the conduct of the test program as well as the methods for making changes to approved test procedures.

14.2.4.2 Summary of Application

DCD Tier 1: The Tier 1 information associated with this section is found in DCD Tier 1, Section 2.14, "Initial Test program," of the DCD.

DCD Tier 2: In Tier 2, Section 14.2 of the DCD, Revision 3 the applicant provided a Tier 2 design description of its ITP for the US-APWR, which is summarized below:

DCD Revision 3 defines the requirements for controlling the activities of the startup organizations. These requirements control the conduct of testing and are included in the ITP administrative procedures. The COL applicant will develop a description of the administrative controls that will govern the conduct of the test program.

DCD Revision 3 addresses the following aspects relating to conducting the test program:

- administrative controls for test prerequisites
- use of plant modifications and maintenance during testing
- post modification and post maintenance testing
- compliance with ITAAC
- test procedure compliance
- changes to approved test procedures

In addition, in response to RAIs, the applicant submitted MUAP-08009, Revision 0, dated September, 2008, and subsequently submitted Revision 1, dated October, 2009.

ITAAC: There are no ITAAC associated with Tier 1, Section 2.14 identified by the applicant.

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

COL information or action items: See Section 14.2.4.5 below

Editorial Comment:
Missing period at end of sentence.

Technical Reports: MHI Technical Report MUAP-08009, "US-APWR Test Program Description.

Editorial Comment:
Missing closing quotes on the report title.

Topical Reports: There are no topical reports associated with this subsection.

US-APWR Interface Issues Identified in the DCD: There are no US-APWR interface issues associated with this area of review.

Site Interface Requirements Identified in the DCD: There are no site interface requirements associated with this area of review.

Cross-cutting Requirements (Three Mile Island [TMI], Unresolved Safety Issue [USI]/Generic Safety Issue [GSI], Op Ex): There are no cross-cutting issues for this area of review.

Regulatory Treatment of Non-safety Systems (RTNSS): There are no RTNSS issues for this area of review.

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, Section 20.1406: There are no issues related to 10 CFR 20.1406 for this area of review.

14.2.4.3 Regulatory Basis

The relevant requirements of the Commission's regulations for this area of review, and the associated acceptance criteria, are given in SRP Section 14.2 and are summarized below. Review interfaces with other SRP sections can be found in Section 14.2 of NUREG-0800:

1. 10 CFR 52.47(a)(i), which specifies, in part, that an applicant for design certification submit the technical information required of applicants for operating licenses (see 10 CFR Part 50) that is technically relevant to the design and not site-specific; and

2. 10 CFR 52.79(b) and 10 CFR 50.34(b)(6)(iii), which require that an applicant for an operating license provide information concerning plans for preoperational testing and initial operations

The SRP acceptance criteria for this area of review adequate to meet the above regulatory requirements are given in Section II of SRP Section 14.2 and include the following:

1. To comply with the specific acceptance criteria for conducting the ITP, the applicant should provide general guidance to control ITP activities, including administrative controls that will be used to develop, review, and approve individual test procedures, coordination with organizations involved in the test program, participation of plant operating and technical staff, and review, evaluation, and approval of test results

Editorial Comment:
Missing period at end of sentence.

2. RG 1.68 as it relates to initial test programs

3. RG 1.206 as it relates to requirements for applications for combined operating licenses that require some input from the DC applicant for verification programs

14.2.4.4 Technical Evaluation

Section 2.14.1 of the Tier 1 DCD, Revision 3, provides a high-level overview of the ITP that gives the key points of the program. It discusses the major phases of the program, the administrative controls, and the development and use of approved test procedures, preoperational testing, and startup testing. The information is consistent with that provided in Tier 2, which the staff reviewed acceptably in this SER.

The staff reviewed Section 14.2.4 of the US-APWR DCD, Revision 3, and MUAP-08009 for conformance to the guidance in the SRP, RG 1.206 and RG 1.68. RG 1.206, Section C.III.1, Chapter 14, C.I.14.2.4, is entitled “Conduct of Test Program.”

The staff’s review of this section addressed the following aspects:

- general guidance that describes the administrative controls governing the conduct of each major phase of the test program;
- general guidance for methods to follow in performing plant modifications and maintenance for conducting tests;

- general guidance for adhering to test procedures and methods for effecting changes to test procedures; and
- general guidance for conducting post modification and post maintenance testing

DCD Revision 3, Section 14.2.4, and related sections summarize the types of administrative procedures that the startup organization will deve will address such things as format and content of test procedures, issuance of initial test procedure and revisions, compliance with test procedures, use of test prerequisites, temporary system modifications needed for testing, changes to approved test procedures, the process to review test results, maintenance needed during the ITP, a description of the ITP phases and requirements for making the transition between phases, methods to track the as-tested system status, permanent modifications needed to address test discrepancies, methods to track system modifications for systems already tested, and methods to track retest requirements caused by system modifications. This gives an outline of a program that will provide adequate controls for the ITP of the US-APWR.

Editorial Comment:
Missing period at end of sentence.

The ITP administrative controls will ensure adherence to the program and procedures. If a test procedure cannot be followed as written, change controls are in place to revise the procedures. DCD Revision 3 states, in part, that methods exist to control post modification (either permanent or temporary) and post maintenance testing and to define the involvement of design organizations in the design and approval of plant modifications. Controls are defined in the administrative procedures to ensure that the as-tested status of components is known and that modifications are tracked, including retest requirements. Administrative controls are also defined to assure that retesting required for modifications and maintenance remains in compliance with ITAAC requirements.

Additionally, the staff asked the applicant to prepare a startup administrative manual that would address the test pr in more detail than the DCD provides. In response, the applicant subm

Editorial Comment:
The October 2009 version is Rev. 1.

MUAP-08009, issued October, 2009, provides the following abstract of the document's contents:

> *This Technical Report supplements the "US-APWR Design Control Document," Chapter 14, Section 14.2 with a description of the administrative control program used to develop and administer the initial test program.*
>
> *This document describes the organizational structure of the test organization and organizational interfaces, test review groups, organizational responsibilities for testing, transfer of jurisdictional controls from construction to operations, the use of test specifications, development, review, approval, and closure of test procedures, and controls related to performance of testing, test results reports, and certification of test personnel.*

The table of contents documents the following program elements:

- purpose
- scope
- organization and responsibilities

- testing
- jurisdictional controls
- work controls
- test specifications
- test procedures
- conduct of testing
- test results
- certification and qualification of test personnel
- references

Section 2.0, "Scope," of the MHI documents the following:

This Technical Report describes the organizational structure of the test organization and organizational interfaces with the plant operating organization, construction organization, engineering organizations, and v from construction, installation (component-level) tes d acceptance testing, and startup testing.

Generic Comment:
These brackets denote text to be replaced by the COL applicant, not proprietary content.

This Technical Report provides a description of the processes and controls employed for development of ITP test specifications and test procedures, test procedure performance, test results report development, test results acceptance, and test closeout. A description of the [Joint Test Group (JTG)] and [Test Review Group (TRG)] charters and membership is included.

Section 4.4, "Test Administrative Manual," of the MHI document notes the following:

The test administrative manual consists of administrative procedures that implement the requirements specified in Section 14.2 of the DCD and this Technical Report. The test administrative manual includes procedures for the following:

- *Test program administration (provides a description of the test organization, roles, and responsibilities of its members, applicability of the test program and interfacing organizations and responsibilities)*
- *[Joint Test Group] and [Test Review Group] review committees (charter, membership, and responsibilities)*
- *Construction turnover process*
- *System Release for Operation process*
- *Preparation, review and approval of construction installation test procedures*
- *Preparation, review, and approval of preoperational, acceptance and startup test procedures*
- *Conduct of testing, including test log entries, pre-test briefings, test change requests, test deficiency reports, and retests*

- *Test closure process, including test data packages, test results reports, test open items, and records preparation*
- *Control of post-modification and post-maintenance testing*
- *Test engineer and supervisor certification and qualification*

The applicant confirmed that the reference COL (RCOL) applicant will prepare the test administrative manual referenced in Section 4.4 of MUAP-08009. COL Item 14.2(2) specifies the following:

"*The COL Applicant reconciles the site-specific organization, organizational titles, organizational responsibilities, and reporting relationships to be consistent with US-APWR Test Program Description Technical Report, MUAP-08009 (Reference 14.2-29) [14.2.2].*"

14.2.4.5 Combined Licensed Information Items

Table 14.2.4-1
US-APWR Combined License Information Items

Item No.	Description	Section
14.2(2)	The COL applicant reconciles the site-specific organization, organizational titles, organizational responsibilities, and reporting relationships to be consistent with US-APWR Test Program Description Technical Report, MUAP-08009 (Reference 14.2-29) [14.2.2].	14.2.2

The staff's review identified no additional COL items for this section.

14.2.4.6 Conclusions

The staff concludes that the information provided in Section 14.2.4 of the US-APWR DCD, Revision 3, adequately describes the conduct of the US-APWR test program. The staff has compared the information within the application to the relevant NRC regulations, acceptance criteria defined in SRP Section 14.2, and other NRC RGs and concludes that the applicant is in compliance with the NRC regulations. The applicant has provided sufficient information to satisfy, at a programmatic level, Criterion XI, "Test Control," of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50, "Domestic Licensing of Production and utilization Facilities." The NRC will make a detailed verification of these requirements, as part of the preoperational phase inspection program, after the COL holder writes the full test manual and test procedures.

14.2.5 Review, Evaluation, and Approval of Test Results

14.2.5.1 Introduction

The section in DCD Revision 3 on the review of test results describes the specific controls to be established for the review, evaluation, and approval of test results for each major phase of the program by the appropriate personnel 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. This section also discusses plans for (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.

14.2.5.2 Summary of Application

DCD Tier 1: The Tier 1 information associated with this section is found in DCD Tier 1, Section 2.14, "Initial Test program," of the DCD.

DCD Tier 2: In Tier 2, Section 14.2 of the DCD, Revision 3 the applicant provided a Tier 2 design description of its ITP for the US-APWR, which is summarized below:

DCD Revision 3 discusses the specific controls for the review, evaluation, and approval of test results of the program by appropriate personnel or organizations. The COL applicant will develop a description of the specific controls including the methods and schedules for approval of the test data for each major phase. DCD Revision 3 discusses the administrative controls for the following aspects:

- review, evaluation, and approval of test results for each major test phase
- review, evaluation, and approval of test results at each power test plateau
- notification when acceptance criteria are not met
- resolution of failed acceptance criteria
- test data approval

Inspection, Test, Analysis, and Acceptance Criteria: There are no ITAAC associated with Tier 1, Section 2.14 identified by the applicant.

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

COL information or action items: See Section 14.2.5.5 below

Editorial Comment:
Missing period at end of sentence.

Technical Reports: MHI Technical Report MUAP-08009, "US-APWR Test Program Description."

Topical Reports: There are no topical reports associated with this subsection.

US-APWR Interface Issues Identified in the DCD: There are no US-APWR interface issues associated with this area of review.

Site Interface Requirements Identified in the DCD: There are no site interface requirements associated with this area of review.

Cross-cutting Requirements (Three Mile Island [TMI], Unresolved Safety Issue [USI]/Generic Safety Issue [GSI], Op Ex): There are no cross-cutting issues for this area of review.

Regulatory Treatment of Non-safety Systems (RTNSS): There are no RTNSS issues for this area of review.

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, Section 20.1406: There are no issues related to 10 CFR 20.1406 for this area of review.

14.2.5.3 Regulatory Basis

The relevant requirements of the Commission's regulations for this area of review, and the associated acceptance criteria, are given in SRP Section 14.2 and are summarized below. Review interfaces with other SRP sections can be found in Section 14.2 of NUREG-0800:

1. 10 CFR 52.47(c)(1), which specifies, in part, that an applicant for design certification submit the technical information required of applicants for operating licenses (see 10 CFR Part 50) that is technically relevant to the design and not site-specific

2. 10 CFR 52.79(b) and 10 CFR 50.34(b)(6)(iii), which require that an applicant for an operating license provide information concerning plans for preoperational testing and initial operations.

The SRP acceptance criteria for this area of review adequate to meet the above regulatory requirements are given in Section II of SRP Section 14.2 and include the following:

1. To comply with the specific acceptance criteria for review, evaluation, and approval of test results, the applicant should provide general guidance to control ITP activities, including administrative controls to develop, review, and approve individual test procedures; coordinate with organizations involved in the test program; include plant operating and technical staff, and review, evaluate, and approve test results.

2. RG 1.68 as it relates to initial test programs

Editorial Comment:
Missing period at end of sentence.

3. RG 1.206 as it relates to requirements for applications for combined operating licenses that require some input from the DC applicant for verification programs

14.2.5.4 Technical Evaluation

Section 2.14.1 of the Tier 1 DCD, Revision 3, provides a high-level overview of the ITP that gives the key points of the program. It discusses the major phases of the program, the administrative controls, and the development and use of approved test procedures, preoperational testing, and startup testing. The information is consistent with that provided in Tier 2, which the staff reviewed acceptably in this SER.

The staff reviewed Section 14.2.5 of the US-APWR DCD, Revision 3, for conformance to the guidance in the SRP, RG 1.206 and RG 1.68. RG 1.206, Section C.III.1, Chapter 14, C.I.14.2.5, is entitled “Review, Evaluation, and Approval of Test Results.”

The staff’s review of this application addressed the following aspects:

- control for the review, evaluation, and approval of test results for each major phase of the program by appropriate personnel or organizations;

- collection of test data for each major test phase before proceeding to the next phase and approval of test data at each test plateau (during the power ascension phase) before increasing the power level; and

- controls to ensure notification of appropriate personnel and organizations when test acceptance criteria are not met and controls to resolve such matters

DCD Revision 3, Section 14.2.5, specifies that the ITP administrative controls define the review, evaluation, and approval process. The startup organization has the initial approval authority for the overall test results, for results from each of the major phases, and for the transition to the next power test plateau.

Following review of the test results, the startup organization will communicate test exceptions and the failure to meet the acceptance criteria to the responsible organizations, such as the applicant, to properly resolve any issues. The evaluation of test results may result in accepting the system as tested or may require modification or maintenance and retest to verify that the steps taken to correct the deficiency are adequate. Individual test data may require an engineering review or analysis before the approval of test results. A designated level of plant management provides the final review and approval.

The US-APWR safety analysis accounts for measurement errors and uncertainty in the determination of set points as described in Chapter 7, Section 7.2.3.2 for the “Reactor Trip System,” and Section 7.3.3.2 for “Engineered Safety Features,” using the methods described in Sections 7.2.2.7 and 7.3.2.7. Preoperational test 14.2.12.1.18, “Reactor Trip System and ESF System Logic Preoperational Test,” includes demonstration that the reactor trip (RT) and engineered safety feature (ESF) system functions occur at design set points. Design set points include the allowances for measurement uncertainties developed in Chapter 7. Acceptance criteria demonstrated using portable equipment is conservatively set to account for instrument uncertainty.

Technical Report MUAP-08009 provides added detail on how the COL applicants’ test organization will control the review and approval of test results. Section 10 of this document describes the method used to review the results to ensure that required systems are operating properly and that testing can proceed to the subsequent phases. It also describes how deficiencies are reviewed, evaluated, retested if necessary, and tracked to closure.

14.2.5.5 Combined Licensed Information Items

DCD Revision 3 contains no COL items relative to this DCD section. The staff’s review identified no additional COL items.

14.2.5.6 Conclusions

The staff concludes that the information provided in Section 14.2.5 of the US-APWR DCD, Revision 3, and the referenced Technical Report MUAP-08009 adequately describe the review, evaluation, and approval of test results for the US-APWR. The staff has compared the information within the application to the relevant NRC regulations, acceptance criteria defined in SRP Section 14.2, and other NRC RGs and concludes that the applicant is in compliance with the NRC regulations.

14.2.6 Test Records

14.2.6.1 Introduction

This section discussing maintenance of test records describes the protocols pertaining to the disposition of test procedures and data following completion of the test program. The startup manual, plant administrative procedures, and applicable regulatory requirements determine how to compile and maintain ITP results. The applicant retails test records that demonstrate the adequacy of safety-related SSCs for the life of the plant. Retention periods for other test records are based on their usefulness in documenting initial plant performance characteristics.

14.2.6.2 Summary of Application

DCD Tier 1: The Tier 1 information associated with this section is found in DCD Tier 1, Section 2.14, "Initial Test program," of the DCD.

DCD Tier 2: In Tier 2, Section 14.2 of the DCD, Revision 3 the applicant provided a Tier 2 design description of its ITP for the US-APWR, which is summarized below:

This section of DCD Revision 3 describes the test records from the results of the ITP and how they will be maintained. DCD Revision 3 also references to provide added detail.

Technical Comment:
This sentence does not make sense as written. DCD Rev. 3 references what?

Inspection, Test, Analysis, and Acceptance Criteria: There ar
Tier 1, Section 2.14 identified by the applicant.

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

COL information or action items: See Section 14.2.6.5 below

Editorial Comment:
Missing period at end of sentence.

Technical Reports: MHI Technical Report MUAP-08009, "US-APWR Test Program Description."

Topical Reports: There are no topical reports associated with this subsection.

US-APWR Interface Issues Identified in the DCD: There are no US-APWR interface issues
ea of review.

Editorial Comment:
Missing a blank line here.

Site Interface Requirements Identified in the DCD: There are no site interface requirements associated with this area of review.

Cross-cutting Requirements (Three Mile Island [TMI], Unresolved Safety Issue [USI]/Generic Safety Issue [GSI], Op Ex): There are no cross-cutting issues for this area of review.

Regulatory Treatment of Non-safety Systems (RTNSS): There are no RTNSS issues for this area of review.

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, Section 20.1406: There are no issues related to 10 CFR 20.1406 for this area of review.

14.2.6.3 Regulatory Basis

The relevant requirements of the Commission's regulations for this area of review, and the associated acceptance criteria, are given in SRP Section 14.2 and are summarized below. Review interfaces with other SRP sections can be found in Section 14.2 of NUREG-0800:

1. 10 CFR 52.47(c)(1), which specifies, in part, that an applicant for design certification submit the technical information required of applicants for operating licenses (see 10 CFR Part 50) that is technically relevant to the design and not site-specific; and

2. 10 CFR 52.79(b) and 10 CFR 50.34(b)(6)(iii), which require that an applicant for an operating license provide information concerning plans for preoperational testing and initial operations.

The SRP acceptance criteria for this area of review adequate to meet the above regulatory requirements are given in Section II of SRP Section 14.2 and include the following:

1. RG 1.16, “Reporting of Operating Information – Appendix A, “Technical Specifications,” which contains guidance for preparing startup test reports;

2. RG 1.28, “Quality Assurance Program Criteria (Design and Construction),” provides guidance for maintaining test records;

3. RG 1.68 as it relates to initial test programs; and

Editorial Comment:
Missing period at end of sentence.

4. RG 1.206 as it relates to requirements for applications for combined operating licenses that require some input from the DC applicant for verification programs

14.2.6.4 Technical Evaluation

Section 2.14.1 of the Tier 1 DCD, Revision 3, provides a high-level overview of the ITP that gives the key points of the program. It discusses the major phases of the program, the administrative controls, and the development and use of approved test procedures, preoperational testing, and startup testing. The information is consistent with that provided in Tier 2, which the staff reviewed acceptably in this SER.

The staff reviewed Section 14.2.6 of the US-APWR DCD, Revision 3, for conformance to the guidance in the SRP, RG 1.206 and RG 1.68. RG 1.206, Section C.III.1, Chapter 14, C.I.14.2.6, is entitled, "Test Records."

The staff's review of this application addressed the following:

- protocols pertaining to disposition or retention of test procedures and data following completion of the test program
- retention of test records as part of the plant's historical records

DCD, Revision 3, Section 14.2.6 the applicant specified that licensees will retain for the life of the plant test records for the US-APWR plants, including the test procedures and results that demonstrate the adequacy of the safety-related SSCs. The retention period for other test records follow the guidance in RG 1.28. It will be based on the usefulness in documenting the initial plant performance characteristics. The COL applicant will follow the controls in Technical Report MUAP-08009, Section 10.3 for the control of test records. This section specifies that completed test packages are kept for the life of the plant and include the completed test procedure with all attachments, data sheets, logs, deficiency reports, and test change requests. The COL applicant's test administrative manual developed in accordance with DCD Section 14.2.1.1, Test Program for Nuclear and Balance of Plant Systems and Section 4.4 of Technical Report MUAP-08009 will include more detailed controls.

A startup test report prepared in accordance with RG 1.16 will summarize the startup testing and associated results and findings. DCD Revision 3 specifies many aspects of the test program this report will document.

14.2.6.5 Combined License Information Items

DCD Revision 3 lists no COL items related to this DCD section. The staff's review identified no additional COL items.

14.2.6.6 Conclusions

The staff concludes that the information provided in Section 14.2.6 of the US-APWR DCD, Revision 3, adequately describes the test records for the US-APWR. The staff has compared the information within the application to the relevant NRC regulations, acceptance criteria defined in SRP Section 14.2, and other NRC RGs and concludes that the applicant is in compliance with the NRC regulations.

14.2.7 Conformance of Test Program to Regulatory Guides

14.2.7.1 Introduction

The ITP for a plant is conducted in conformance to the regulatory positions in RG 1.68. To demonstrate the ITP conformance to RG 1.68, this section refers to US-APWR DCD Section

1.9.1 and Table 1.9.1-1, "US-APWR Conformance with Division 1 RGs," which lists all pertinent RGs and describes how the US-APWR conforms to each of them.

14.2.7.2 Summary of Application

DCD Tier 1: The Tier 1 information associated with this section is found in DCD Tier 1, Section 2.14, "Initial Test program," of the DCD.

DCD Tier 2: In Tier 2, Section 14.2 of the DCD, Revision 3 the applicant provided a Tier 2 design description of its ITP for the US-APWR, which is summarized below:

Table 1.9.1-1 defines the conformance to the guidance of the full list of Division I RGs. Table 14.2-2, "Regulatory Guides Associated with the ITP," lists the RGs used in developing the preoperational and startup test program. In addition DCD Revision 3, Appendix 14A, "Comparison of RG 1.68, Appendix A, Versus US-APWR Test Abstracts," provides a matrix that relates the various requirements of Appendix A of RG 1.68 to the actual ITP abstracts in DCD Section 14.2.12.

Inspection, Test, Analysis, and Acceptance Criteria: There are no ITAAC associated with Tier 1, Section 2.14 identified by the applicant.

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

Technical Reports: MHI Technical Report MUAP-08009, "US-APWR Test Program Description"

Topical Reports: There are no topical reports associated with this subsection.

US-APWR Interface Issues Identified in the DCD e issues associated with this area of review

Editorial Comment:
Missing period at end of sentence.

Site Interface Requirements Identified in the DCD: There are no site interface requirements associated with this area of review

Cross-cutting Requirements (Three Mile Island [TMI], Unresolved Safety Issue [USI]/Generic Safety Issue [GSI], Op Ex): There are no cross-cutting issues for this area of review.

Regulatory Treatment of Non-safety Systems (RTNSS): There are no RTNSS issues for this area of review.

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, Section 20.1406: There are no issues related to 10 CFR 20.1406 for this area of review.

14.2.7.3 Regulatory Basis

The relevant requirements of the Commission's regulations for this area of review, and the associated acceptance criteria, are given in SRP Section 14.2 and are summarized below. Review interfaces with other SRP sections can be found in Section 14.2 of NUREG-0800:

1. 10 CFR 52.47(c)(1), which specifies, in part, that an applicant for design certification submit the technical information required of applicants for operating licenses (see 10 CFR Part 50) that is technically relevant to the design and not site-specific.

2. 10 CFR 52.79(b) and 10 CFR 50.34(b)(6)(iii), which require that an applicant for an operating license provide information concerning plans for preoperational testing and initial operations.

The SRP acceptance criteria for this area of review adequate to meet the above regulatory requirements are given in Section II of SRP Section 14.2 and include the following:

1. To comply with the specific acceptance criteria for review, evaluation, and approval of test results, the applicant should provide general guidance to control ITP activities, including administrative controls to develop, review, and approve individual test procedures; coordinate with organizations involved in the test program; include plant operating and technical staff, and review, evaluate, and approve test results. .

2. RG 1.68 as it relates to initial test programs to comply with the specific acceptance criteria for the test program's conformance to RGs:

   a. The applicant should commit to the revision of RG 1.68 and the RGs listed in RG 1.68 that are referenced in the SRP and are in effect 6 months before submittal.

   b. The applicant may propose exceptions or alternatives to the specific criteria in any of these RGs, and the staff may find them acceptable if the applicant provides adequate justification

3. RG 1.206 as it relates to requirements for applications for combined operating licenses that require some input from the DC applicant for verification programs

14.2.7.4 Technical Evaluation

Section 2.14.1 of the Tier 1 DCD, Revision 3, provides a high-level overview of the ITP that gives the key points of the program. It discusses the major phases of the program, the administrative controls, and the development and use of approved test procedures, preoperational testing, and startup testing. The information is consistent with that provided in Tier 2, which the staff reviewed acceptably in this SER.

The staff reviewed Section 14.2.7 of the US-APWR DCD, Revision 3, for conformance to the guidance in the SRP, RG 1.206 and RG 1.68. RG 1.206, Section C.III.1, Chapter 14, C.I.14.2.7, is entitled "Conformance of Test Programs with Regulatory Guides." The staff also reviewed Table 1.9.1-1 and Table 14.2-2.

The staff review addressed the following aspects:

- list of all RGs to which the development of the ITP adhered; and

- identification of exceptions, if any and justification of the alternative methods used

The applicant originally committed to using in its ITP the 18 RGs listed in DCD Table 14.2-2, Revision 0. This was expanded to 23 RGs during the staff's review process as documented in Revisions 2 and 3. DCD Revision 3, Table 1.9.1-1, addresses the actual conformance to these RGs and any exceptions.

Of the 23 RGs listed in Table 14.2-2, the applicant committed to full conformance with no exceptions for 15 of them. The NRC recently withdrew two RGs, RG 1.16 and RG 1.116, "Quality Assurance Requirements for Installation, Inspection, and Testing of Mechanical Equipment and Systems." Their withdrawal does not affect the review of this chapter.

Table 1.9.1-1 notes some exceptions for the others six RGs, which are discussed below.

With regard to RG 1.20, "Comprehensive Vibration Assessment Program for Reactor Internals During Preoperational and Initial Startup Testing," the DCD takes one exception, namely: "The measurement at startup test for steam generator (SG) internals is not planned." This is acceptable. See Section 14.2.8.4 below for an evaluation of the vibration assessment program.

With regard to RG 1.30, "Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electric Equipment," the DCD takes one exception, namely: "Installation is not included in Design Certification phase." This is acceptable since construction and installation are not part of the DCD-addressed preoperational and startup test programs. Also, DCD Section 17.5 includes COL Item 17.5(1) that assigns responsibility to the COL applicant for the construction (i.e., installation) and operational quality assurance program. This is acceptable.

With regard to RG 1.37, the applicant stated, "Programmatic/operational aspect is not applicable to US-APWR design certification." This is acceptable in that DCD Section 14.2.1.2.1 makes it clear that RG 1.37 will be used for all of the preoperational and startup testing phases of the plant.

With regard to RG 1.68, the applicant stated, "Programmatic/operational aspect is not applicable to US-APWR design certification." This is acceptable in that DCD Section 14.2 makes it clear that all other aspects of RG 1.68 will be used for all of the preoperational and startup testing phases of the plant. RG 1.68 was the principal regulatory guidance document the staff used to review DCD Chapter 14.2.

With regard to RG 1.68.3, "Preoperational Testing of Instrument and Control Air Systems," issued April 1982, the applicant initially took exception to a number of sections of this RG. Currently DCD Revision 3 takes one exception, namely RG Item C.7. The applicant stated, "This criterion applies to instrument and control air system important (to) safety. USAPWR instrument and control air system is not important to safety." The staff noted that Item C.7 states, in part, "When redundant components and air supplies are provided to meet the single-failure criterion for a given safety function, it should be verified that this criterion is met." The US-APWR air systems are not designed to the s and Section 9.3.1 of the DCD state that the three air syst e air-operated valves fail safe on a loss of instrument a C.7 is not applicable.

Technical Comment:
This is a historical statement that was true for DCD Rev. 0 through Rev.2. But it is written here in present tense suggesting it is currently a true statement. Suggest wording like "the DCD originally took one exception:"

With regard to RG 1.128, "Installation Design and Installation of Vented Lead-Acid Storage Batteries for Nuclear Power Plants," the DCD takes one exception: "The hydrogen

concentration limit required in RG 1.189 is appropriate for the fire protection scenario, over the RG 1.128." During the evaluation of the design of the battery systems in Chapter 8, the staff noted that this exception should be deleted. The applicant has updated Chapter 8 and Table 1.9.1-1 appropriately. The applicant now takes no exceptions to RG 1.128.

With regard to RG 1.206, the RG is very broad, and the only exceptions taken do not pertain to the test program.

In summary, the staff found that the exceptions taken to these six RGs are acceptable. The NRC also reviewed the RGs and other documents referenced in RG 1.68 to see if DCD Table 14.2-2 included them all. It found only three additional documents: RG 1.10, "Mechanical (Cadweld) Splices in Reinforcing Bars of Category I Concrete Structures"; NUREG-0554, "Single-Failure-Proof Cranes for Nuclear Power Plants," issued May 1979; and NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants: Resolution of Generic Technical Activity A-36," issued July 1980. The NRC withdrew RG 1.10. The DCD acceptably addressed NUREG-0612 in Test Abstract 14.2.12.1.86, "Fuel Handling System." In **RAI 33-651, Question 14.02-76**, the staff requested that the applicant revise DCD Subsection 14.2.12.1.86 to incorporate a reference to NUREG-0554 and to address the RG 1.68 guidance that full operational testing be conducted at 100 percent of rated load. In a September 4, 2008, response to **RAI 33-651, Question 14.02-76**, the applicant proposed a revision to DCD Subsection 14.2.12.1.86 to include reference to NUREG-0554, to NUREG-0612 for the spent fuel cask handling crane, and to clarify that full operational testing can be conducted at 100 percent of rated load. The staff finds the proposed DCD revisions are consistent with the guidance in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-76**, **resolved and closed**.

14.2.7.5 Combined Licensed Information Items

DCD Revision 3 did not identify any COL items relating to the conformance of the test program to RGs. The staff review identified no additional COL items.

14.2.7.6 Conclusions

The staff concludes that the information provided in Section 14.2.7 of the US-APWR DCD, Revision 3, adequately describes the conformance of the US-APWR test programs to RGs. The staff has compared the information within the application to the relevant NRC regulations, acceptance criteria defined in SRP Section 14.2, and other NRC RGs and concludes that the applicant is in compliance with the NRC regulations.

14.2.8 Use of Reactor Operating and Testing Experience in Test Program Development

14.2.8.1 Introduction

The US-APWR plant used the design, testing, startup, and operating experience from previous nuclear power plants to develop the initial preoperational and startup test program.

14.2.8.2 Summary of Application

DCD Tier 1: The Tier 1 information associated with this section is found in DCD Tier 1, Section 2.14, "Initial Test program," of the DCD.

DCD Tier 2: In Tier 2, Section 14.2 of the DCD, Revision 3 the applicant provided a Tier 2 design description of its ITP for the US-APWR, which is summarized below:

The US-APWR DCD, Revision 3, states, in part, that the operating experience and knowledge gained in the successful startup of pressurized water reactors (PWRs) in Japan are both factored into the US-APWR ITP, as well as applicable US experience. DCD Revision 3, states, in part, that the applicant used these insights in developing and carrying out the IT, however, it provided no details.

The DCD identified three first-plant-only tests: Reactor Internal Vibration Test, Natural Circulation Test, and Rod Cluster Control Assembly (RCCA) Misalignment Measurement and Radial Power Distribution Oscillation Test. The US-APWR DCD, Revision 3, provides justifications for these first-plant-only-tests but does not specify any first-three-plant tests.

Inspection, Test, Analysis, and Acceptance Criteria: There are no ITAAC associated with Tier 1, Section 2.14 identified by the applicant.

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

COL information or action items: See Section 14.2.8.5 below

Editorial Comment:
Missing period at end of sentence.

Technical Reports: MHI Technical Report MUAP-07027, "Comprehensive Vibration Assessment Program for US-APWR Reactor Internals," Revision 0.

Technical Comment:
This report is current at Rev. 2 dated August 2009; however, at the time of DCD Rev. 3 is was at Rev. 1 dated May 2009.

Topical Reports: There are no topical reports associated with this subsecti

US-APWR Interface Issues Identified in the DCD: There are no US-APWR
associated with this area of review.

Site Interface Requirements Identified in the DCD: There are no site interface requirements associated with this area of review.

Cross-cutting Requirements (Three Mile Island [TMI], Unresolved Safety Issue [USI]/Generic Safety Issue [GSI], Op Ex): There are no cross-cutting issues for this area of review.

Regulatory Treatment of Non-safety Systems (RTNSS): There are no RTNSS issues for this area of review.

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, Section 20.1406: There are no issues related to 10 CFR 20.1406 for this area of review.

14.2.8.3 Regulatory Basis

The relevant requirements of the Commission's regulations for this area of review, and the associated acceptance criteria, are given in SRP Section 14.2 and are summarized below. Review interfaces with other SRP sections can be found in Section 14.2 of NUREG-0800:

1. 10 CFR 52.47(c)(1), which specifies, in part, that an applicant for design certification submit the technical information required of applicants for operating licenses (see 10 CFR Part 50) that is technically relevant to the design and not site-specific; and

2. 10 CFR 52.79(b) and 10 CFR 50.34(b)(6)(iii), which require that an applicant for an operating license provide information concerning plans for preoperational testing and initial operations.

The SRP acceptance criteria for this area of review adequate to meet the above regulatory requirements are given in Section II of SRP Section 14.2 and include the following:

1. To comply with the specific acceptance criteria for the test program, the applicant should include general guidance for the review of operating and testing experience at other facilities. This guidance should recognize reportable occurrences of repeatedly experienced safety concerns and other operating experience that could potentially affect the performance of the test program. Additionally, the applicant will submit, for review and approval, the functional testing requirements and acceptance criteria necessary to verify the performance of new, unique, or first-of-a-kind (FOAK) design features used in the facility.

2. RG 1.68 as it relates to initial test programs To comply with the specific acceptance criteria for the test program's conformance to RGs

   a. The applicant should commit to the revision of RG 1.68 and the RGs listed in RG 1.68 that are referenced in the SRP and are in effect 6 months before submittal.

   b. The applicant may propose exceptions or alternatives to the specific criteria in any of these RGs, and the staff may find them acceptable if the applicant provides adequate justification

3. RG 1.206 as it relates to requirements for applications for combined operating licenses that require some input from the DC applicant for verification programs

14.2.8.4 Technical Evaluation

Section 2.14.1 of the Tier 1 DCD, Revision 3, provides a high-level overview of the ITP that gives the key points of the program. It discusses the major phases of the program, the administrative controls, and the development and use of approved test procedures, preoperational testing, and startup testing. The information is consistent with that provided in Tier 2, which the staff reviewed acceptably in this SER.

The staff reviewed Section 14.2.8 of the US-APWR DCD, Revision 3, for conformance to the guidance in the SRP, RG 1.206 and RG 1.68. RG 1.206, Section C.III.1, Chapter 14, C.I.14.2.8, is entitled: "Utilization of Reactor Operating and Testing Experiences in Test Program Development."

The staff review of this application addressed the following aspects:

- analyses of operating and testing experiences at other similar reactor facilities and their use in developing the test program; and

- identification of unique design features that will require FOAK testing

DCD Revision 3, Section 14.2.8 notes that the applicant based the US-APWR design on previous PWR plants and factored the operating experience and knowledge gained in the successful startup of many PWR plants in Japan into both the design and the ITP. Further, the applicant uses NRC licensee event reports, Institute of Nuclear Power Operations' correspondence, significant operating event reports, and other industry sources to obtain experience from similar nuclear power plants. The applicant places emphasis on repeat occurrences of safety significance.

Technical Comment: Why is 14.2.12.1.119 for the HFT performance test not included here? The reactor internals vibration and RCCA misalignment tests are first-plant only. The other two items are first-plant with the option for subsequent plants to not repeat the test. Thus MHI does not understand why teh HFT performance test and the natural circulation test are treated differently in terms of being included in this paragraph.

evision 3, Section 14.2.8.1, "Preoperational and/or Startup Testing for Unique or a-Kind Principal Design Features," provides information on FOAK tests for new design s. Applicants for previous design certification did not perform these tests. Also, because tandardization of the US-APWR design, the parameters will not change from plant to d thus the tests only need be performed on the first plant containing the unique design. evision 3 identifies and discusses the following four FOAK tests:

reactor internals vibration test
pressurizer surge line HFT performance test
natural circulation test
RCCA misalignment measurement and radial power distribution oscillation test

The staff noted that Section 14.2.8.1, "Preoperational and/or Startup Testing for Unique or First-of-a-Kind Principal Design Features" of the US-APWR DCD designates certain tests as FOAK, first-plant-only tests. Sections 14.2.12.1.7, "Reactor Internals Vibration Test," 14.2.12.2.3.9, "Natural Circulation Test" and 14.2.12.2.4.5, "RCCA Misalignment Measurement and Radial Power Distribution Oscillation Test" in DCD Revision 3 document these FOAK tests.

In **RAI 31-658, Question 14.02-23**, the staff requested that the applicant revise DCD Section 14.2.13 to add a COL information item requiring each COL holder to perform the tests documented in Section 14.2.8.1 of the DCD or provide justification that the results of the first-plant-only tests are applicable to subsequent plants. In an August 29, 2008 response to **RAI 31-658, Question 14.02-23**, the applicant proposed a revision to the DCD to add COL item 14.2(11) that requires each COL holder to perform the tests documented in Section 14.2.8.1 of the DCD or provide justification that the results of the first-plant-only tests are applicable to subsequent plants. The text of COL Item 14.2(11) is as follows:

> *The COL holder for the first plant is to perform the first plant only tests and prototype test. For subsequent plants, either these tests are performed, or the COL applicant provides a justification that the results of the first-plant only tests are applicable to the subsequent plant and are not required to be repeated. [14.2.8]*

The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68 and 1.206, and are therefore acceptable. The staff confirmed that the DCD 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 31-658, Question 14.02-23**, **resolved and closed**.

DCD Sections 3.9.2.3 and 3.9.2.4 originally provided justification for performing the reactor internals vibration test on the first plant. DCD Section 3.9.2.4, "Preoperational Flow-Induced Vibration Testing of Reactor Internals" stated that the first operational US-APWR reactor internals are classified as a prototype. Upon qualification of the first US-APWR as a valid prototype (using the RG 1.20 test program), subsequent plants will be classified as Non-Prototype Category I. These designations are in accordance with RG 1.20, "Comprehensive Vibration Assessment Program for Reactor Internals During Preoperational and Initial Startup Testing," and are acceptable. Denoting the first-plant-only test of the reactor internals vibration as a prototype is acceptable. Additionally, Section 3.9 of this SER documents the staff's review of MHI Technical Report MUAP-07027, "Comprehensive Vibration Assessment Program for US-APWR Reactor Internals," Revision 0. ~~The nat~~ ng SGs is performed in the startup test phase of the first US-APWR as a pr

Technical Comment: This report is current at Rev. 2 dated August 2009; however, at the time of DCD Rev. 3 is was at Rev. 1 dated May 2009.

In **RAI 27-550, Question 14.02-09**, and **RAI 70-11**, the staff requested that the applicant justify the assertion in US-APWR DCD Section 14.2.8.1.2 that: "The natural circulation test using SGs is performed in the startup test phase of the first US-APWR as a prototype test. It is unnecessary for following plants to compare flow and temperature data (without reactor coolant pumps (RCPs)) to that of this plant because no design differences exist that would significantly affect natural circulation capabilities." In a July 31, 2008, response to **RAI 27-550, Question 14.02-09**, and September 25, 2008, response to **RAI 70-1152, Question 14.02-87**, the applicant proposed a revision to the DCD to note that the natural circulation test will be conducted at every plant. Also, the applicant has included an option for omitting the test for subsequent plants based on verification that flow and temperature data are comparable to prototype designs for which equivalent tests have been successfully completed. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 27-550, Question 14.02-09**, and **RAI 70-1152, Question 14.02-87**, **resolved and closed**.

The Pressurizer Surge Line HFT Performance Test is described in DCD Section 3.12.5.10, "Thermal Stratification." It is performed during heat up and cool down of the reactor coolant system (RCS) as well as during RCP starts and stops to verify that the pressurizer surge line operating characteristics are within allowable values and there is no excessive thermal stratification in the surge line that could result in undue stresses and fatigue to the surge line. The DCD, Section 14.2.8.2.2, "Pressurizer Surge Line HFT Performance Test" notes that the COL holder for the first plant is to perform the first plant only tests and prototype test. In accordance with COL Item 14.2(11), subsequent plants either perform these tests or the COL applicant provides a justification that the results of the first-plant only tests are applicable to the subsequent plant and are not required to be repeated.

In **RAI 742-5703, Question 03.12-25**, the staff asked the applicant how it will ensure that all US-APWR plants will use the same heat up and cooldown procedures. In a July 6, 2012 response to **RAI 742-5703, Revision 3, Question 03.12-25**, the applicant proposed addition of a FOAK pressurizer surge line preoperational test. The applicant will add a pressurizer surge line hot functional test abstract in DCD Section 14.2.12.1.119. The preoperational test, with continued surge line monitoring during the first year of operation, confirms adequate design

margins for the surge line. Discussion applicable to subsequent plants will be added to the DCD as Subsection 14.2.8.2. The proposed revisions are consistent with the guidance contained in RG 1.68 and are therefore acceptable. Resolution of the Chapter 14 aspects of **RAI 742-5703, Question 03.12-25** is **Confirmatory Item 14.02-1** pending verification of DCD Revision 4.

The RCCA misalignment measurement and radial power distribution oscillation tests are performed during the power-ascension phase. The DCD notes that this test is required only for the first plant, because the stability of the radial power distribution is dependent upon the core diameter only. This test validates the calculation tools and instrument responses. A separate axial flux distribution oscillation test, 14.2.12.2.4.3, will address potential oscillations, and cores are typically very stable in the radial direction. The startup test program will confirm this.

14.2.8.5 Combined License Information Items

Table 14.2.8-1
US-APWR Combined License Information Items

Item No.	Description	Section
14.2(11)	The COL holder for the first plant is to perform the first plant only tests and prototype test. For subsequent plants, either these tests are performed, or the COL applicant provides a justification that the results of the first-plant only tests are applicable to the subsequent plant and are not required to be repeated.	14.2.8

The staff's review identified no additional COL items for this section.

14.2.8.6 Conclusions

The staff concludes that the information provided in Section 14.2.8 of the US-APWR DCD, Revision 3, adequately describes the use of reactor operating and testing experience in the development of the test program for the US-APWR. The staff has compared the information within the application to the relevant NRC regulations, acceptance criteria defined in SRP Section 14.2, and other NRC RGs and concludes that except for the confirmatory item discussed above, the applicant is in compliance with the NRC regulations.

14.2.9 Trial Testing of Plant Operating And Emergency Procedures

14.2.9.1 Introduction

To the extent practicable throughout the preoperational and initial startup test program, test procedures should use operating, emergency, and abnormal procedures where applicable. The use of these procedures is intended to do the following:

a. Prove the specific procedure or identify changes that may be required

b. Provide training of plant personnel in the use of these procedures

c. Increase the level of knowledge of plant personnel on the systems being tested

A test procedure may use an operating, emergency, or abnormal procedure by referencing the procedure directly or by extracting a series of steps from the procedure (or both), in a way that accomplishes the above goals while efficiently performing the specified testing.

14.2.9.2 Summary of Application

DCD Tier 1: The Tier 1 information associated with this section is found in DCD Tier 1, Section 2.14, "Initial Test program," of the DCD.

DCD Tier 2: In Tier 2, Section 14.2 of the DCD, Revision 3 the applicant provided a Tier 2 design description of its ITP for the US-APWR, which is summarized below:

Preoperational and startup tests in US-APWR DCD Revision 3, use plant operation, surveillance, emergency, and abnormal procedures either by reference or verbatim incorporation. This help to verify the plant procedures through actual use.

Editorial Comment:
This word should be "helps".

Inspection, Test, Analysis, and Acceptance Criteria: There are no ITAAC associated with Tier 1, Section 2.14 ide t.

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

COL information or action items: See Section 14.2.9.5 below

Editorial Comment:
Missing period at end of sentence.

Technical Reports: There are no Technical Reports associated with this area of review.

Topical Reports: There are no topical reports associated with this subsection.

US-APWR Interface Issues Identified in the DCD: There are no US-APWR interface issues associated with this area of review.

Site Interface Requirements Identified in the DCD: There are no site interface requirements associated with this area of review.

Cross-cutting Requirements (Three Mile Island [TMI], Unresolved Safety Issue [USI]/Generic Safety Issue [GSI], Op Ex): There are no cross-cutting issues for this area of review.

Regulatory Treatment of Non-safety Systems (RTNSS): There are no RTNSS issues for this area of review.

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, Section 20.1406: There are no issues related to 10 CFR 20.1406 for this area of review.

14.2.9.3 Regulatory Basis

The relevant requirements of the Commission's regulations for this area of review, and the associated acceptance criteria, are given in SRP Section 14.2 and are summarized below. Review interfaces with other SRP sections can be found in Section 14.2 of NUREG-0800:

1. 10 CFR 52.47(c)(1), which specifies, in part, that an applicant for design certification submit the technical information required of applicants for operating licenses (see 10 CFR Part 50) that is technically relevant to the design and not site-specific

2. 10 CFR 52.79(b) and 10 CFR 50.34(b)(6)(iii), which require that an applicant for an operating license provide information concerning plans for preoperational testing and initial operations.

The SRP acceptance criteria for this area of review adequate to meet the above regulatory requirements are given in Section II of SRP Section 14.2 and include the following:

1. To comply with the specific acceptance criteria for the trial use of plant operating and emergency procedures, the applicant should include general guidance about how, and to what extent, the test program will use and test plant operating, emergency, and surveillance procedures.

2. RG 1.68 as it relates to initial test programs To comply with the specific acceptance criteria for the test program's conformance to RGs
   a. The applicant should commit to the revision of RG 1.68 and the RGs listed in RG 1.68 that are referenced in the SRP and are in effect 6 months before submittal.
   b. The applicant may propose exceptions or alternatives to the specific criteria in any of these RGs, and the staff may find them acceptable if the applicant provides adequate justification

3. RG 1.206 as it relates to requirements for applications for combined operating licenses that require some input from the DC applicant for verification programs

14.2.9.4 Technical Evaluation

Section 2.14.1 of the Tier 1 DCD, Revision 3, provides a high-level overview of the ITP that gives the key points of the program. It discusses the major phases of the program, the administrative controls, and the development and use of approved test procedures, preoperational testing, and startup testing. The information is consistent with that provided in Tier 2, which the staff reviewed acceptably in this SER.

The staff reviewed Section 14.2.9 of the US-APWR DCD, Revision 3, for conformance to the guidance in the SRP, RG 1.206 and RG 1.68. RG 1.206, Section C.III.1, Chapter 14, C.I.14.2.9, is entitled, "Trial Use of Plant Operating and Emergency Procedures."

The staff review of this application addressed the following aspects:

- general guidance on the test program's use of plant operating, emergency, and surveillance procedures

- specific training to be conducted, as part of use-testing, during the special low-power testing program, related to the resolution of TMI Action Plan Item I.G.1

SRP Section 14.2 and RG 1.68 specify that plants should develop operating and emergency procedures, hire necessary staff, and establish training schedules. Regulatory Position C.7 of RG 1.68 further states that "plant operating and emergency procedures should, to the extent practical, be developed, trial-tested, and corrected during the ITP prior to fuel loading to establish their adequacy." DCD Revision 3, Section 14.2.9, "Trial Testing of Plant Operating and Emergency Procedures," states that the COL applicant is responsible for providing a schedule for the development of plant procedures that ensures that required procedures are available for use during preoperational and startup testing. The applicant effectively addressed this in COL Item 14.2(7) in DCD Revision 3, Section 14.2(13):

> *The COL applicant provides an event-based schedule, relative to fuel loading, for conducting each major phase of the test program, and a schedule for the development of plant procedures that assures required procedures are available for use during the preparation, review and performance of preoperational and startup testing. For multiunit sites, the COL applicant discusses the effects of overlapping initial test program schedules on organizations and personnel participating in each ITP. The COL applicant identifies and cross-references each test or portion of a test required to be completed prior to fuel load which satisfies ITAAC requirements. [14.2.9] [14.2.11]*

DCD, Revision 3, Section 14.2.9 further states the following:

> "Plant operating and emergency procedures are, to the extent practical, developed, trial-tested, and corrected during the ITP prior to fuel loading to establish their adequacy. Preoperational and startup test procedures utilize plant operating, surveillance, emergency, and abnormal procedures either by reference or verbatim incorporation in the performance of tests. This verifies the plant procedures by actual use and provides experience to the plant personnel."

This provides the desired use of procedures per RG 1.68.

In DCD Revision 3, Section 14.2.9.1, "Operator Training during Special Low-Power Testing," the applicant acknowledged the requirement to identify the specific operator training to be conducted as a part of use-testing during low-power testing according to TMI Action Plan Item I.G.1. At approval to load fuel, the plant operating organization assumes legal responsibility for the plant and conducts further training for licensed operators and operator trainees.

14.2.9.5 Combined License Information Items

Section 14.2 refers to various aspects of the test program that are the responsibility of the COL applicant or licensee, and DCD Revision 3, Section 14.2.13, contains the complete list. DCD Revision 3 identified the COL Item 14.2(7) relating to trial testing of plant operating and emergency procedures, as noted below. The staff's review identified no additional COL items for this section.

Table 14.2.9-1 US-APWR Combined License Information Items		
Item No.	**Description**	**Section**
14.2(7)	The COL Applicant provides an event-based schedule, relative to fuel loading, for conducting each major phase of the test program, and a schedule for the development of plant procedures that assures required procedures are available for use during the preparation, review and performance of preoperational and startup testing. For multiunit sites, the COL Applicant discusses the effects of overlapping ITP schedules on organizations and personnel participating in each ITP. The COL Applicant identifies and cross-references each test or portion of a test required to be completed prior to fuel load which satisfies ITAAC requirements.	14.2.9 and 14.2.11

14.2.9.6 Conclusions

The staff concludes that the information provided in Section 14.2.9 of the US-APWR DCD, Revision 3, adequately describes the trial testing of plant operating and emergency procedures for the US-APWR. The staff has compared the information within the application to the relevant NRC regulations, acceptance criteria defined in SRP Section 14.2, and other NRC RGs and concludes that the applicant is in compliance with the NRC regulations.

14.2.10 Initial Fuel Loading and Initial Criticality

14.2.10.1 Introduction

As part of the startup test phase, the COL applicant will conduct initial fuel loading and initial criticality in a very controlled manner, in accordance with specific written procedures. The NRC approves fuel loading after it has verified that the COL applicant has satisfactorily completed prerequisite testing or has provided appropriate justification to proceed with fuel loading and complete the preoperational testing after fuel loading.

This section addresses the completion of preoperational testing, including the review and approval of test results required before fuel loading. If portions of any preoperational tests are to be conducted, or their results approved, after fuel loading, the applicant will (1) list each test, (2) state which portions of each test it will delay until after fuel loading, (3) provide technical justification for delaying these portions, and (4) state when it will complete each test and approve the results.

14.2.10.2 Summary of Application

DCD Tier 1: The Tier 1 information associated with this section is found in DCD Tier 1, Section 2.14, "Initial Test program," of the DCD.

DCD Tier 2: In Tier 2, Section 14.2 of the DCD, Revision 3 the applicant provided a Tier 2 design description of its ITP for the US-APWR, which is summarized below:

DCD Revision 3 defines the predetermined set of checks to be conducted before initial fuel loading and the requirements for initial fuel loading. The completion of the ITAAC is to be verified before fuel loading. A licensed SRO with no concurrent duties will supervise fuel loading. The fuel loading process, which is summarized, includes procedures specifying predetermined checks of shutdown margin and subcriticality and a complete check of the fully loaded reactor core. Procedures are also to be prepared in advance to respond to unexpected reactivity changes.

The process of approaching and achieving initial criticality, which is summarized, includes the tests that are to be completed in preparation for criticality and the conditions that are to exist before initial criticality.

Low-power and power-ascension tests are to be conducted in a controlled manner. These tests are summarized, including some details of the test, the test purpose, and data collected as part of the tests.

Inspection, Test, Analysis, and Acceptance Criteria: There are no ITAAC associated with Tier 1, Section 2.14 identified by the applicant.

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

COL information or action items: See Section 14.2.10.5 below

Editorial Comment:
Missing period at end of sentence.

Technical Reports: There are no Technical Reports associated with this area of review.

Topical Reports: There are no topical reports associated with this subsection.

US-APWR Interface Issues Identified in the DCD: There are no US-APWR interface issues associated with this area of review.

Site Interface Requirements Identified in the DCD: There are no site interface requirements associated with this area of review.

Cross-cutting Requirements (Three Mile Island [TMI], Unresolved Safety Issue [USI]/Generic Safety Issue [GSI], Op Ex): There are no cross-cutting issues for this area of review.

Regulatory Treatment of Non-safety Systems (RTNSS): There are no RTNSS issues for this area of review.

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, Section 20.1406: There are no issues related to 10 CFR 20.1406 for this area of review.

14.2.10.3 Regulatory Basis

The relevant requirements of the Commission's regulations for this area of review, and the associated acceptance criteria, are given in SRP Section 14.2 and are summarized below. Review interfaces with other SRP sections can be found in Section 14.2 of NUREG-0800:

1. 10 CFR 52.47(c)(1), which specifies, in part, that an applicant for design certification submit the technical information required of applicants for operating licenses (see 10 CFR Part 50) that is technically relevant to the design and not site-specific

2. 10 CFR 52.79(b) and 10 CFR 50.34(b)(6)(iii), which require that an applicant for an operating license provide information concerning plans for preoperational testing and initial operations.

The SRP acceptance criteria for this area of review adequate to meet the above regulatory requirements are given in Section II of SRP Section 14.2 and include the following:

1. To comply with the specific acceptance criteria for initial fuel loading, initial criticality, low-power, and power ascension testing, the applicant should include in the ITP a description of the general provisions and precautions for fuel loading, initial criticality, low-power testing, and power ascension phases.

2. RG 1.68 as it relates to general provisions, precautions and measures for fuel loading, initial criticality, low-power testing, and power ascension phases, including guidance for
   a. The completion of all ITAAC associated with preoperational tests before fuel load;
   b. Measures to review and evaluate the results of the completed preoperational test;
   c. Appropriate remedial actions to take if acceptance criteria are not satisfied;
   d. Applicable technical specification (TS) requirements; and
   e. Actions to take if unanticipated errors or malfunctions occur.

3. RG 1.206 as it relates to requirements for applications for combined operating licenses that require some input from the DC applicant for fuel loading and initial criticality

14.2.10.4 Technical Evaluation

Section 2.14.1 of the Tier 1 DCD, Revision 3, provides a high-level overview of the ITP that gives the key points of the program. It discusses the major phases of the program, the administrative controls, and the development and use of approved test procedures, preoperational testing, and startup testing. The information is consistent with that provided in Tier 2, which the staff reviewed acceptably in this SER.

The staff reviewed conformance of Section 14.2.10 of the US-APWR DCD, Revision 3, to the guidance in RG 1.206, Chapter 14, C.I.14.2.10, "Initial Fuel Loading and Initial Criticality."

The staff's review of this application addressed the following aspects:

- general provisions and precautions for initial fuel loading, initial criticality, low-power testing, and power ascension phases;
- identification of remedial actions if acceptance criteria are not met; and
- actions to take if unanticipated errors or malfunctions occur

RG 1.68 and SRP Section 14.2 provide general guidance on the conduct of the initial fuel load and initial criticality following the completion of preoperational testing. After verification of SSC functional capability during preoperational testing, including the successful completion of ITAAC, the ITP continues with initial fuel loading, pre-critical testing, initial criticality, low-power testing, and power ascension testing. DCD Revision 3, Section 14.2.11, notes the following:

> "The ITP schedule assures that the test requirements are met for those plant SSCs credited to prevent, limit, or mitigate the consequences of postulated accidents prior to the beginning of the initial fuel load."

14.2.10.4.1 Initial Fuel Load

Initial fuel loading and pre-critical tests ensure safe initial core loading and maintain sufficient shutdown margin. In DCD, Revision 3, Section 14.2.10.1, "Initial Fuel Loading," the applicant provided the prerequisites and precautions for conducting the initial fuel load. RG 1.68, Appendix A, states that "licensees should cautiously conduct initial fuel loading to preclude inadvertent criticality." RG 1.68, Appendix A, further states that before loading fuel: "licensees should establish and follow specific safety measures, such as (a) ensuring that all applicable technical specification requirements and other prerequisites have been satisfied, (b) establishing requirements for continuous monitoring of the neutron flux throughout core loading so that all changes in the multiplication factor are observed, (c) establishing requirements for periodic data-taking, and [during the fuel load evolution] (d) independently verifying that the fuel and control components have been properly installed." In addition, RG 1.68, Appendix A specifies that: "predictions of core reactivity should be prepared in advance to aid in evaluating the measured responses to specified loading increments," and that: "the initial core loading should be directly supervised by a senior licensed operator." DCD, Revision 3, Section 14.2.10.1 states that TS surveillances are implemented to ensure the operability of systems required for fuel loading. The applicant also noted in Section 14.2.10 that it includes each of the prerequisites outlined in RG 1.68, Appendix C, Section 2.a.

RG 1.68, Appendix C provides 15 specific prerequisites for the initial fuel load:

1. Specify the composition, duties, and emergency procedure responsibilities of the fuel handling crew.

2. Test the radiation monitors, nuclear instrumentation, manual initiation, and other devices, and verify that they are operable to actuate the building evacuation alarm and ventilation control.

3. Specify the status of all systems required for fuel loading.

4. Conduct inspections of fuel, control rods, and poison curtains.

5. Ensure that nuclear instruments have been calibrated, and are operable and properly located (source-fuel-detector geometry). One operating channel should have audible indication or annunciation in the control room.

6. Require a response check of nuclear instruments to a neutron source within N hours prior to loading (or resumption of loading, if delayed for N hours or more), where N is consistent with the Technical Specification surveillance frequency for source range nuclear instruments in the refueling mode (typically 8 or 12 hours).

7. Specify and establish the status of containment.

8. Specify the status of the reactor vessel. Components should be either in place or out of the vessel, as specified, to make it ready to receive fuel.

9. Establish the vessel water level, and prescribe the minimum level for fuel loading and unloading.

10. Specify and establish coolant circulation for borated reactors, and take precautions (such as valve and pump lockouts) to prevent deboration.

11. Ensure that the emergency boron addition system (or other negative reactivity insertion system) is operable.

12. Check the fuel handling equipment, and perform dry runs.

13. Prescribe and verify the status of protection systems, interlocks, mode switch, alarms, and radiation protection equipment. For reactors that have operable control rods during fuel loading, the high-flux trip points should be set for a relatively low-power level (normally not greater than 1 percent of full power).

14. Establish water quality and identify limits.

Generic Comment:
This is a historical statement that is written as present tense - the DCD originally listed only 5 and did not address the remaining 10 items. The change described below was made in DCD Rev. 1 in 2008; it was not a recent DCD update. Another solution might be to change the confirmation sentence to say DCD Rev. 1 contains the changes committed to in the RAI response.

fuel loading boron concentration.

-10, the staff requested that the applicant expand DCD Section requisites for fuel loading described in RG 1.68, App. C.2.a, " but not included in DCD Section 14.2.10.1. RG 1.68, App. C.2.a includes 15 specific items. DCD Section 14.2.10.1 lists 5 of these fuel loading prerequisites but does not address the remaining 10 items. In a July 31, 2008, response to **RAI 28-478, Question 14.02-10** the applicant proposed replacing a limited reproduction of the prerequisites listed in RG 1.68, Appendix C with a direct reference and commitment to them. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 28-478, Question 14.02-10**, **resolved and closed**.

14.2.10.4.2 Initial Criticality

After the initial core is loaded, sufficient tests and checks should be performed to ensure that the facility is in a final state of readiness to achieve criticality and perform low-power testing. RG 1.68, Appendix A, listed verifications that should be conducted during or following initial fuel loading, as described below:

- testing of the control rod withdrawal and insert speeds and sequencers, control rod position indication, protective interlocks, control functions, alarms, and scram timing of control rods after the core is fully loaded;

- final functional testing of the reactor protection system to demonstrate proper trip points, logic, and operability of scram breakers and valves, as well as demonstration of the operability of manual scram functions;

- final test of the RCS to verify that system leak rates are within specified limits;

- measurements of the water quality and boron concentration of the RCS;

- final calibration of source-range neutron flux measuring instrumentation, including verification of proper operation of associated alarms and protective functions of source- and intermediate-range monitors;

- mechanical and electrical tests of in-core monitors;

- scram time tests - to the extent practical, testing to demonstrate control rod scram times at both hot zero power and cold temperature conditions, with flow and no-flow conditions in the RCS as required, to bound conditions under which scram might be required; and

- verification that all systems required for startup or protection of the plant, including the reactor protection system and emergency shutdown system, are operable and in a state of readiness and that TS requirements are met

DCD Revision 3, Section 14.2.12.2.1.5, “Precritical Test Sequence,” states, as a prerequisite, that SSCs required by TS to support a specified operational mode shall be operational before the initiation of precritical testing. Also, DCD Revision 3, Section 14.2.12.2.2.2, “Initial Criticality,” states, in Prerequisite B.1, that “Plant system conditions are established as required in the plant Technical Specifications.” After the applicant addressed the RAIs, the staff found the procedure abstracts in the DCD acceptable.

Likewise, the prerequisites for the initial criticality test described in DCD Revision 3, Test Abstract 14.2.12.2.2.2, “Initial Criticality,” include the requirement that “plant system conditions are established as required in the plant Technical Specifications.” The DCD applicant added a statement in DCD Revision 3, Section 14.2.10.2, that “all systems required for startup or protection of the plant should be operable and in a state of readiness.”

Additionally, in RG 1.68, Appendices A and C provides a number of precautions for initial criticality:

- The initial approach should be conducted in a deliberate and orderly manner consistent with methods that will be used for subsequent startups.

- The reactivity addition sequence should be prescribed, and the procedure should require a cautious approach in achieving criticality to prevent passing through criticality in a period shorter than approximately 30 seconds (less than 1 decade per minute).

- A critical rod position (boron concentration) should be predicted so that any anomalies may be noted and evaluated.

- A neutron count rate (of at least ½ counts per second) should register on startup channels before the startup begins, and the signal-to-noise ratio should be known to be greater than 2.

- High-flux scram trips should be set at their lowest value (approximately 5 – 20 percent).

In DCD, Section 14.2.10.2, the applicant did not initially address all of the precautions found in RG 1.68. In **RAI 28-478, Question 14.02-12**, the staff requested that the applicant revise DCD Section 14.2.10.2 to describe the initial approach to criticality in a deliberate and orderly manner using the same rod withdrawal sequences and patterns that will be used during subsequent startups, as described in RG 1.68, App. A.3. In a July 31, 2008, response to **RAI 28-478, Question 14.02-12** the applicant proposed a revision to add the rod withdrawal sequence precaution to DCD Section 14.2.12.2.2.2, "Initial Criticality." The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 28-478, Question 14.02-12**, **resolved and closed**.

In **RAI 33-651, Question 14.02-25**, the staff requested that the applicant revise DCD Section 14.2.10.2 to incorporate the statement, "a critical rod position (boron concentration) should be predicted so that any anomalies may be noted and evaluated," prior to initial criticality. RG 1.68, App. C.3, includes this reactivity control precaution, but DCD Section 14.2.10.2 does not include it in the list of conditions that need to exist prior to initial criticality. In a September 4, 2008, response to **RAI 33-651, Question 14.02-25**, the applicant proposed a revision to DCD Section 14.2.10.2 to include prediction of core conditions including rod position and boron concentration at criticality. The staff finds the proposed revisions are consistent with RG 1.68, Appendix C, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-25**, **resolved and closed**.

In **RAI 33-651, Question 14.02-26**, the staff requested that the applicant revise DCD Section 14.2.10.2 to caution that "high-flux scram trips should be set at their lowest value (approximately 5 percent - 20 percent)" prior to initial criticality. RG 1.68, App. C.3, cautions that "high-flux scram trips should be set at their lowest value (approximately 5 percent - 20 percent)" prior to initial criticality. In a September 4, 2008, response to **RAI 33-651, Question 14.02-26** the applicant proposed a revision to add the high-flux scram trip adjustment to the lowest value to DCD Section 14.2.12.2.2.2. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, Appendix C, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-26**, **resolved and closed**.

14.2.10.4.3 Low Power and Power Ascension

As described in RG 1.68, after the initial reactor startup, low-power testing is conducted to (1) confirm the design, (2) validate analytical models and verify correctness or conservatism of assumptions used in the safety analysis to the extent practical, and (3) confirm the operability of plant systems and design features that could not be completely tested during the preoperational test phase because of the lack of an adequate heat source for the RCS and the main steam system. Finally, power ascension testing is conducted to demonstrate that the facility can be operated in accordance with its design during normal steady-state conditions, and, to the extent practical, during and following anticipated transients.

In DCD Section 14.2.10.3.1, "Low Power Testing," the applicant discussed confirming the design and validating analytical models and the veracity of any assumptions. It did not initially discuss confirming plant systems and design features with respect to the test philosophy and sequencing. In **RAI 28-478, Question 14.02-13**, the staff requested that the applicant revise DCD Section 14.2.10.3.1 to augment the discussion to confirm the operability of plant systems and design features that could not be completely tested during the preoperational test phase because of the lack of an adequate heat source for the reactor coolant and main steam systems. In a July 31, 2008, response to **RAI 28-478, Question 14.02-13** the applicant proposed to add a discussion of the operability of plant systems and design features that could not be completely tested during the preoperational test phase because of the lack of an adequate heat source. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 28-478, Question 14.02-13**, **resolved and closed**.

RG 1.68, Regulatory Position C.4, states that: "as a minimum, applicants should establish hold points at approximately 25 percent, 50 percent, and 75 percent power level test conditions for pressurized-water reactors." RG 1.68, Appendix C further states that "individual test procedures should include instructions and precautions for establishing special conditions necessary for conducting tests." In DCD, Revision 3, Section 14.2.10.3.2, "Power Ascension Testing," the applicant stated that "the requirements for each stage of the power ascension are prescribed in the startup test procedures." The staff finds the applicant's approach acceptable for power-ascension test hold points.

The COL applicant is expected to provide its plans for startup testing procedures, including the prerequisites and precautionary measures to be established to ensure safe operation, consistent with the guidelines and regulatory positions contained in RG 1.68. Prerequisites should include successful completion of all ITAAC associated with preoperational tests before fuel load, adherence to TS requirements, and identification of actions to be taken in the event of unanticipated errors or malfunctions. COL Information Item 14.2(7), detailed in DCD Revision 3, Section 14.2.13, discusses the successful completion of ITAAC:

> *The COL applicant provides an event-based schedule, relative to fuel loading, for conducting each major phase of the test program, and a schedule for the development of plant procedures that assures required procedures are available for use during the*

preparation, review and performance of preoperational and startup testing. For multiunit sites, the COL applicant discusses the effects of overlapping initial test program schedules on organizations and personnel participating in each ITP. The COL applicant identifies and cross-references each test or portion of a test required to be completed prior to fuel load which satisfies ITAAC requirements. [14.2.9] [14.2.11]

Because development of ITP test procedures will require detailed plant-specific design information and review and approval by the COL applicant, the staff concurs that it is acceptable to defer responsibility for developing remedial actions if acceptance criteria are not met and for identifying actions to take if unanticipated errors or malfunctions occur.

14.2.10.5 Combined License Information Items

Section 14.2 refers to various aspects of the test program that are the responsibility of the COL applicant or licensee, and DCD Revision 3, Section 14.2.13, contains the complete list. DCD Revision 3 identified the COL Item 14.2(7) relating to addressing ITAAC in the ITP, as noted below. The staff's review identified no additional COL items for this section.

Table 14.2.10-1
US APWR Combined License Information Items

Item No.	Description	Section
14.2(7)	The COL Applicant provides an event-based schedule, relative to fuel loading, for conducting each major phase of the test program, and a schedule for the development of plant procedures that assures required procedures are available for use during the preparation, review and performance of preoperational and startup testing. For multiunit sites, the COL Applicant discusses the effects of overlapping ITP schedules on organizations and personnel participating in each ITP. The COL Applicant identifies and cross-references each test or portion of a test required to be completed prior to fuel load which satisfies ITAAC requirements.	14.2.9 and 14.2.11

14.2.10.6 Conclusions

The staff concludes that the information provided in Section 14.2.10 of the US-APWR DCD, Revision 3, adequately describes the prerequisites and precautions for initial fuel loading and initial criticality of the US-APWR. The staff has compared the information within the application to the relevant NRC regulations, acceptance criteria defined in SRP Section 14.2, and other NRC RGs and concludes that the applicant is in compliance with the NRC regulations.

14.2.11 Test Program Schedule

14.2.11.1 Introduction

The COL applicant pursuant to COL Item 14.2(7) as described in Section 14.2.10.5, is required to develop a schedule, relative to the fuel loading date, for conducting each major phase of the test program. The applicant also provides an overview of the ITP and identifies each test required to be completed before initial fuel loading.

In addition, the applicant identifies and cross-references each test (or portion thereof) required to be completed before initial fuel loading, designed to satisfy the requirements for completing ITAAC, in accordance with 10 CFR 52.99(a).

14.2.11.2 Summary of Application

DCD Tier 1: The Tier 1 information associated with this section is found in DCD Tier 1, Section 2.14, "Initial Test program," of the DCD.

DCD Tier 2: In Tier 2, Section 14.2 of the DCD, Revision 3 the applicant provided a Tier 2 design description of its ITP for the US-APWR, which is summarized below:

The major phases of the test program include preoperational testing, initial fuel loading, initial criticality, low-power testing, and power-ascension testing. ITP administrative procedures include further details relating to progression from one phase to the next, requirements for moving beyond the selected hold points or milestones within a given phase, and different test plateaus.

The applicant will use an event-based schedule to conduct the ITP. DCD Revision 3 presents the guidelines for setting up the schedule. The guidelines provide times for the completion of preoperational, startup, and power-ascension testing and include specific requirements in scheduling testing. For example, a system required to support another system is tested before it is needed to ensure that plant safety does not depend on untested systems; common support systems are tested before the process systems they support, as much as possible; before exceeding 25 percent power, the test requirements are met for those plant SSCs that are relied on to prevent, limit, or mitigate the consequences of postulated accidents.

The applicant will seek NRC approval if a test is delayed and not completed before fuel loading.

Inspection, Test, Analysis, and Acceptance Criteria: There are no ITAAC associated with Tier 1, Section 2.14 identified by the applicant.

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

COL information or action items: See Section 14.2.11.5 below

Editorial Comment:
Missing period at end of sentence.

Technical Reports: There are no Technical Reports associated with this area of review.

Topical Reports: There are no topical reports associated with this subsection.

US-APWR Interface Issues Identified in the DCD: There are no US-APWR interface issues associated with this area of review.

Site Interface Requirements Identified in the DCD: There are no site interface requirements associated with this area of review.

Cross-cutting Requirements (Three Mile Island [TMI], Unresolved Safety Issue [USI]/Generic Safety Issue [GSI], Op Ex): There are no cross-cutting issues for this area of review.

Regulatory Treatment of Non-safety Systems (RTNSS): There are no RTNSS issues for this area of review.

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, Section 20.1406: There are no issues related to 10 CFR 20.1406 for this area of review.

14.2.11.3 Regulatory Basis

The relevant requirements of the Commission's regulations for this area of review, and the associated acceptance criteria, are given in SRP Section 14.2 and are summarized below. Review interfaces with other SRP sections can be found in Section 14.2 of NUREG 0800:

1. 10 CFR 52.47(c)(1), which specifies, in part, that an applicant for design certification submit the technical information required of applicants for operating licenses (see 10 CFR Part 50) that is technically relevant to the design and not site-specific

2. 10 CFR 52.79(b) and 10 CFR 50.34(b)(6)(iii), which require that an applicant for an operating license provide information concerning plans for preoperational testing and initial operations.

Section II in SRP Section 14.2 presents the acceptance criteria for the ITP schedule, but the applicable criteria are for COL applicants rather than DC applicants. They include the following:

1. RG 1.68 as it relates to ITP schedules
   a. Section C.5 states, “Sufficient time should be scheduled to perform orderly and comprehensive testing.” Previous applicants’ schedules for conducting the preoperational and initial startup phases have typically allowed a minimum time of approximately 9 months and 3 months, respectively. The applicant should justify significantly shorter time periods.
   b. Section C.8 states, “Applicants should establish appropriate hold points at selected milestones throughout the power-ascension test phase to ensure that relevant test results are evaluated and approved by the designated personnel or groups before proceeding with the power-ascension test phase. As a minimum, applicants should establish hold points at approximately 25 percent, 50 percent, and 75 percent power level test conditions for pressurized-water reactors (PWRs).”

2. RG 1.206 as it relates to requirements for applications for combined operating licenses that require some input from the DC applicant for verification programs

Editorial Comment:
Missing period at end of sentence.

14.2.11.4 Technical Evaluation

Section 2.14.1 of the Tier 1 DCD, Revision 3, provides a high-level overview of the ITP that gives the key points of the program. It discusses the major phases of the program, the administrative controls, and the development and use of approved test procedures, preoperational testing, and startup testing. The information is consistent with that provided in Tier 2, which the staff reviewed acceptably in this SER.

The staff reviewed Section 14.2.11 of the US-APWR DCD, Revision 3, for conformance to the guidance in the SRP, RG 1.206 and RG 1.68. RG 1.206, Section C.III.1, Chapter 14, C.I.14.2.11, is entitled, "Test Program Schedule."

The staff review of this application addressed the following aspects:

- presentation of the test program schedule in the DCD
- identification of COL information items relating to test program schedules

DCD Revision 3, Section 14.2.11, provides an event-based schedule for testing and states that it includes at least 9 months for preoperational testing and at least 3 months for startup and power-ascension testing. The major phases of the ITP are the preoperational testing, initial fuel loading, initial criticality, low-power testing, and power-ascension testing. The power-ascension testing plateaus consist of low-power testing at less than 5-percent power, 30-percent power, 50-percent power, 75-percent power, and 100-percent power. The schedule is designed to ensure that the test requirements are met for those plant SSCs credited to prevent, limit, or mitigate the consequences of postulated accidents before the beginning of the initial fuel load. A key factor in the schedule is to prevent plant safety from relying on untested systems, components, or features.

DCD Revision 3 identified the following two COL Items 14.2(7) and 14.2(12).

COL Item 14.2(7) states the following:

> *The COL applicant provides an event-based schedule, relative to fuel loading, for conducting each major phase of the test program, and a schedule for the development of plant procedures that assures required procedures are available for use during the preparation, review and performance of preoperational and startup testing. For multiunit sites, the COL applicant discusses the effects of overlapping initial test program schedules on organizations and personnel participating in each ITP. The COL applicant identifies and cross-references each test or portion of a test required to be completed prior to fuel load which satisfies ITAAC requirements. [14.2.9] 14.2.11]*

This COL item will ensure the deferral of these aspects to the COL applicant, which is appropriate.

COL Item 14.2(12) states the following:

The COL holder makes available approved test procedures for satisfying testing requirements described in Section 14.2 to the NRC approximately 60 days prior to their intended use. [14.2.3, 14.2.11, 14.2.12.1]

14.2.11.5 Combined License Information Items

Table 14.2.11-1
US APWR Combined License Information Items

Item No.	Description	Section
14.2(7)	The COL Applicant provides an event-based schedule, relative to fuel loading, for conducting each major phase of the test program, and a schedule for the development of plant procedures that assures required procedures are available for use during the preparation, review and performance of preoperational and startup testing. For multiunit sites, the COL Applicant discusses the effects of overlapping ITP schedules on organizations and personnel participating in each ITP. The COL Applicant identifies and cross-references each test or portion of a test required to be completed prior to fuel load which satisfies ITAAC requirements.	14.2.9 and 14.2.11
14.2(12)	The COL holder makes available approved test procedures for satisfying testing requirements described in Section 14.2 to the NRC approximately 60 days prior to their intended use.	14.2.3, 14.2.11, and 14.2.12.1

14.2.11.6 Conclusions

The staff concludes that the information provided in Section 14.2.11 of the US-APWR DCD, Revision 3, adequately describes the test program schedules for the US-APWR. The staff has compared the information within the application to the relevant NRC regulations, acceptance criteria defined in SRP Section 14.2, and other NRC RGs and concludes that the applicant is in compliance with the NRC regulations.

14.2.12 Individual Test Descriptions

14.2.12.1 Introduction

This section provides abstracts for each individual test conducted during the ITP. The tests emphasize the SSCs and design features satisfying the following criteria:

1. used for safe shutdown and cool down of the reactor under normal plant conditions and for maintaining the reactor in a safe condition during an extended shutdown period

2. used for safe shutdown and cool down of the reactor under transient conditions (infrequent or moderately frequent event) and postulated accident conditions and for

maintaining condition during an extended shutdown period following such conditions

Editorial Comment: Missing blank line.

3. establishes conformance to safety limits or limiting conditions for operation (LCOs) included in the facility's TS
4. classified as ESF used to support or ensure the operation of ESFs within design limits
5. assumed to function or for which credit is taken in the facility's accident analysis, as described in the DCD and FSAR
6. used to process, store, control, measure, or limit the release of radioactive materials
7. used in the special low-power testing program to be conducted at power levels no greater than 5 percent to provide meaningful technical information beyond that obtained in the normal startup test program as required for resolution of TMI Action Plan Item I.G.1
8. identified as risk-significant in the facility-specific probabilistic risk assessment

14.2.12.2 Summary of Application

DCD Tier 1: The Tier 1 information associated with this section is found in DCD Tier 1, Section 2.14, "Initial Test program," of the DCD.

This section of the DCD provides a total of 164 test abstracts for the preoperational and startup phases of the ITP.

Inspection, Test, Analysis, and Acceptance Criteria: There are no ITAAC associated with Tier 1, Section 2.14 identified by the applicant.

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

COL information or action items: See Section 14.2.12.5 below

Editorial Comment: Missing period at end of sentence.

Technical Reports: There are no Technical Reports associated with this area of review.

Topical Reports: There are no topical reports associated with this subsection.

US-APWR Interface Issues Identified in the DCD: There are no US-APWR interface issues associated with this area of review

Site Interface Requirements Identified in the DCD: Table 1.8-1 of the DCD identifies the Circulating Water System (CWS) and Steam Generator Blowdown System (SGBS) as having significant interfaces between the US-APWR standard plant design and the conceptual design information (CDI) for the SSCs outside the scope of the certified design. The system design of the CWS is CDI. A typical "reference plant" physical layout, configuration and the associated design basis information for the CWS are presented in the DCD. The final system configuration for the CWS is site-specific. In addition, the portions of the SGBDS that are downstream of the processing equipment for SG blowdown are CDI; including the flow path to the waste water system that is outside of the US-APWR standard plant design.

Cross-cutting Requirements (Three Mile Island [TMI], Unresolved Safety Issue [USI]/Generic Safety Issue [GSI], Op Ex): There are no cross-cutting issues for this area of review.

Regulatory Treatment of Non-safety Systems (RTNSS): There are no RTNSS issues for this area of review.

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, Section 20.1406: There are no issues related to 10 CFR 20.1406 for this area of review.

14.2.12.3 Regulatory Basis

The relevant requirements of the Commission's regulations for this area of review, and the associated acceptance criteria, are given in SRP Section 14.2 and are summarized below. Review interfaces with other SRP sections can be found in Section 14.2 of NUREG 0800:

1. 10 CFR 52.47(c)(1), which specifies, in part, that an applicant for design certification submit the technical information required of applicants for operating licenses (see 10 CFR Part 50) that is technically relevant to the design and not site-specific

2. 10 CFR 52.79(b) and 10 CFR 50.34(b)(6)(iii), which require that an applicant for an operating license provide information concerning plans for preoperational testing and initial operations.

The SRP acceptance criteria for this area of review adequate to meet the above regulatory requirements are given in Section II of SRP Section 14.2 and include the following:

1. To comply with the specific criteria for individual test descriptions, the applicant should provide test abstracts for SSCs and unique design features that will be tested to verify that system and component performance is in accordance with the design. These test abstracts should include the objective[illegible]at will be included in the test procedures.

   Editorial Comment:
   Missing period at end of sentence.

2. RG 1.206 as it relates to requirements for applications for combined operating licenses that require some input from the DC applicant for individual test descriptions

14.2.12.4 Technical Evaluation

Section 2.14.1 of the Tier 1 DCD, Revision 3, provides a high-level overview of the ITP that gives the key points of the program. It discusses the major phases of the program, the administrative controls, and the development and use of approved test procedures, preoperational testing, and startup testing. The information is consistent with that provided in Tier 2, which the staff reviewed acceptably in this SER.

The staff reviewed each of the test abstracts of Section 14.2.12 of the US-APWR DCD, Revision 3, for conformance to the guidance in the SRP, RG 1.206 and RG 1.68. RG 1.206, Section C.III.1, Chapter 14, C.I.14.2.12, is entitled, "Individual Test Descriptions."

The staff's review of this application addressed the following aspects:

- SSCs selected for demonstration and verification of performance capabilities are based on the functions defined in RG 1.206, Chapter 14, C.I.14.2.12.
- The abstracts included test objectives, prerequisites, test methods, significant parameters and plant performance characteristics to be monitored, and acceptance criteria in sufficient detail to establish the functional adequacy of the SSCs and the design features tested.
- If the testing method will not subject the SSC to representative design operating conditions, the test abstract should contain sufficient information to justify the proposed test method.

In addition, the NRC expects the COL applicant to describe the site-specific tests it will conduct at the plant. Section 14.2.12 notes one area where the COL applicant is responsible for testing; namely, personnel radiation monitors and radiation survey instruments. In **RAI 93-1592, Question 14.02-90**, the staff requested that the applicant revise DCD Tier 2, Section 14.2 to provide sufficient information in regards to tests of radiation detection and monitoring instruments associated with the ITP as part of the initial plant startup for compliance with 10 CFR 30.53(c) and 10 CFR 52.79(a)(28). In a December 5, 2008, response to **RAI 93-1592, Question 14.02-90**, the applicant stated that initial testing of personnel monitors and radiation survey instruments, and laboratory equipment used to analyze or measure radiation levels and radioactivity concentrations, will be conducted in accordance with the COL licensee's operational radiation protection program. Development of this program is the responsibility of the COL applicant as identified in Sections 12.1.3, 12.5, and COL Information Item COL 12.1(5). As stated in Section 12.1.3, the radiation protection program is to be developed, implemented and maintained as described in the Nuclear Energy Institute Technical Report, NEI 07-03A, Revision 0, "Generic FSAR Template Guidance for Radiation Protection Program Description." The specific CFR criteria referenced in NEI 07-03A shall be met and strictly adhered to. All recommendations and guidance referenced in NEI 07-03A are to be addressed and implemented as applicable to the US-APWR and the plant site.

Revision 7 of NEI 07-03, currently under NRC review and not yet approved, includes the commitment that the radiation protection program will ensure compliance with the provisions of 10 CFR Parts 19, 20, 50, and 71 and be consistent with the guidance in RGs 8.4, "Personnel Monitoring Device – Direct-Reading Pocket Dosimeters," 8.6, "Standard Test Procedure for Geiger-Muller Counters" and 8.28, "Audible-Alarm Dosimeters" and the consolidated guidance in NUREG-1736, "Consolidated Guidance: 10 CFR Part 20—Standards for Protection Against Radiation," issued October 2001 (which includes 3.20.1501(b), "Instrument Calibration"). The applicant also revised Table 14A-1, Item 1.k(2), to indicate that the COL licensee will develop the program for testing personnel monitors and radiation survey instruments under the operational radiation protection program. The applicant revised Table 14A-1, Item 1.k(3), to indicate that the COL licensee will develop the program for testing laboratory equipment used to analyze or measure radiation levels and radioactivity concentrations under the operational radiation protection program. Finally, the applicant revised the beginning portion of Section 14.2.12 to clarify that the operational radiation protection program includes this testing, as described in DCD Section 12.5. The staff finds the proposed DCD revisions are consistent with the guidance in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addresses this issue and, therefore, considers **RAI 93-1592, Question 14.02-90**, **resolved and closed**.

DCD Table 14.2-1, "Comprehensive Listing of Tests," lists all tests planned for all phases of the ITP in the order of the phases. The remainder of DCD Section 14.2.12 discusses each phase and provides abstracts of each test listed in the table.

The abstracts (1) identify each test by title, (2) specify the prerequisites and major plant operating conditions necessary for each test (such as power level and mode of operation of major control systems), (3) provide a summary description of the test objectives and test method, significant parameters, and plant performance characteristics to be monitored, and (4) summarize the acceptance criteria established for each test to ensure that the test verifies the functional adequacy of the SSCs involved in the test. DCD Revision 3, Section 14, Appendix 14A, provides a table or matrix of applicable guidance in RG 1.68, Appendix A, versus typical test abstracts. This correlates the specific guidance in the RG to the test abstracts to ensure that all are addressed. Where the applicant took exceptions to the RG, it provided justification.

The applicant will prepare actual test procedures based on the test abstracts. Test procedures document specific testing performed and the applicable acceptance criteria for each preoperational test. Preoperational tests are prepared in accordance with the system and associated component specifications for the equipment in those systems provided by the applicant and other major participants associated with the ITP. The tests will demonstrate that the installed equipment and systems perform within the limits of the system and component specifications.

For each test abstract, the staff reviewed the test description, purpose, prerequisites, general test acceptance criteria, and test methods, using the guidance described in SRP Section 14.2, RG 1.68, and other pertinent RGs. The staff also reviewed the pertinent technical sections of the DCD to understand the system being tested and to ensure that the test addressed the appropriate design features described in the DCD. The following sections describe the staff's review of the initial fuel loading tests, initial criticality tests, low-power testing, and power-ascension testing.

14.2.12.4.1 Preoperational Tests

DCD Revision 3, Table 14.2-1, "Comprehensive Listing of Tests," contains 117 tests in the preoperational phase. The staff reviewed all the abstracts and identified the main issues, which are summarized here. These were addressed in revisions to DCD and described herein. Some other test abstracts had minor issues that were also corrected in revisions to the DCD. The staff found that all preoperational test abstracts now meet the guidance in SRP Section 14.2 and RG 1.68 and are, therefore, acceptable. For those tests where the NRC identified issues and addressed RAIs to the applicant for resolution, this SER provides a short summary of the issues and resolutions.

In **RAI 33-651, Question 14.02-29**, the staff requested that the applicant revise the Chemical Volume Control Systems (CVCS) Preoperational Tests described in DCD Sections 14.2.12.1.12 to 14.2.12.1.14 to include any tests relating to the verification of alarms in the system. Appendix A to RG 1.68 includes verification of operation of the alarms for many systems. In the DCD, verification of the operation of alarms in different systems is not consistently addressed. In some system preoperational tests, verification of alarms and functional indications is included. However, such verification is not included in other test abstracts of the DCD. For example,

Generic Comment:
This is a historical statement that is written as present tense - the DCD originally did not include these tests, but they have been included since DCD Rev. 1. Simply changing the "do" to "did" would be an acceptable resolution.

CVCS Preoperational Tests described in Sections 14.2.12.1.12 to 14.2.12.1.14 do not include any tests relating to the verification of alarms in the system. Water levels in the Volume Control Tank (VCT), Boric Acid Tank (BAT) and the Holdup Tank have associated alarms. In a September 4, 2008, response to **RAI 33-651, Question 14.02-29**, the applicant described review of the preoperational test abstracts to ensure that testing of alarms is adequately addressed. As a result of this review, more than 25 preoperational test abstracts were revised. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-29**, **resolved and closed**.

In **RAI 33-651, Question 14.02-31**, and **RAI 102-1391, Question 14.02-93**, the staff requested that the applicant revise DCD Section 14.2.12.1.1 to address items a through d described below:

a. Prerequisites: Add that all systems to be operated have completed cold functional testing. Add specifications for RCS and secondary water quality.

b. Specify the actual temperatures at which the test will be performed. Specify the expected and maximum heat up and cool down rates.

c. Also, Objective A.2 and Acceptance Criterion D.2 relate that this test is used to coordinate preoperational tests of other systems that require hot temperatures. Since this procedure is the coordinating mechanism, these other tests should be listed here.

d. Add the following to the Test Method Section:
   - Perform inspections for leakage.
   - Demonstrate the capability to control the RCS under solid conditions (no pressurizer bubble) both cold and hot.
   - Include temperature and pressure plateaus to be used.
   - Include provisions to perform trial applications of plant operating procedures and to keep track of recommended changes.
   - Provide for the hot ECCS testing of RG 1.79: C.1.a.(2) – SI Hot Flow test; C.1.c.(3) – Accumulator Hot Flow Test; C.2.b.(3), Valve operability at maximum expected temperatures.

In a September 4, 2008, response to **RAI 33-651, Question 14.02-31**, and a December 18, 2008, response to **RAI 102-1391, Question 14.02-93** the applicant addressed all of the above comments with appropriate proposed revisions to the DCD. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-31**, and **RAI 102-1391, Question 14.02-93**, **resolved and closed**.

In **RAI 33-651, Question 14.02-32**, the staff requested that the applicant revise DCD Section 14.2.12.1.3 to address RCP test requirements. DCD Section 14.2.12.1.3, "RCP Initial Operation Preoperational Test," refers to DCD Section 5.4.1 for RCP design specifications. The RCP is a complex pump with many subsystems that should be tested, and that are not listed in the test abstract. Examples from Section 5.4.1 include:

- RCPs provide design flow rate to the reactor vessel (5.4.1.2)
- RCPs provide adequate flow rate during coast down on a LOOP and there is adequate natural circulation to cool the core (5.4.1.2)
- Design seal injection rates are obtained (5.4.1.3.2)
- Thermal barrier heat exchanger (HX) provides adequate cooling on loss of seal injection (5.4.1.3.2)
- Component cooling water (CCW) cooling to bearings is adequate (5.4.1.3.2)
- Oil spillage protection system functions as designed (5.4.1.3.2)
- All instrumentation functions (e. g., resistance temperature detector, seal injection flow, CCW flow) (5.4.1.3.2)
- Anti-rotation device is functional (5.4.1.3.2)
- Motor air cooling and CCW are functional (5.4.1.3.2)
- RCP frame vibration is acceptable (5.4.1.3.2)
- CCW cooling is adequate on a loss of seal injection (5.4.1.3.3)
- Seal injection provides adequate cooling on loss of CCW (5.4.1.3.4)
- Seal leak-off values are acceptable (5.4.1.4.1 and 5.4.1.4.9)

In a September 4, 2008, response to **RAI 33-651, Question 14.02-32**, the applicant provided information that most of these items are tested in a variety of other locations and times, including factory testing, construction completion component testing, system preoperational testing (e. g., CCW System), and startup testing of the RCP. The applicant proposed revision to the test abstract to reference some of this other testing. The staff transmitted follow-up **RAI 102-1391, Question 14.02-94** to request further information related to the answers to **RAI 33-651, Question 14.02-32**, and will therefore evaluate follow-up **RAI 102-1391, Question 14.02-94**, separately. The staff finds the remaining proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-32**, **resolved and closed**.

Editorial Comment: Suggested change makes the cross-reference consistent with the rest of the paragraph when you either use DCD Section X, or test X or test abstract X.

In **RAI 102-1391, Question 14.02-94**, the staff requested that the applicant revise information o DCD Section 14.2.12.2.4.12 to provide more information to explain how the actual RCS flow is determined. The staff also requested that the applicant revise information o DCD Section ~~test~~ 14.2.12.1.87, to add a step to the RCP test to verify temperatures quate cooling to the thermal barrier HX and the motor air coolers or explain where that d. In a December 18, 2008, response to **RAI 102-1391, Question 14.02-94** the applicant proposed a revision to DCD Section 14.2.10.2. The applicant provided substantial added information that acceptably explained the methodology for RCS flow determination. The applicant also proposed adding a statement to the RCP test abstract 14.2.12.3 to verify all necessary temperatures. The staff finds the additional information and proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 102-1391, Question 14.02-94**, **resolved and closed**.

In **RAI 337-2398, Question 14.02-115**, the staff requested that the applicant revise DCD Section 14.2.12.1.87, "Component Cooling Water System Preoperational Test" to adequately document testing of the components listed below:

- Testing of radiation alarms and active functions to close the surge tank valve need to be specifically defined in the preoperational test.
- Testing of coolant flow to the thermal barrier via cross-tie needs to be specifically defined in the preoperational test.
- Flow verification backup water sources including from safety-related sources need to be specifically defined.
- Testing of the thermal barrier high flow logic and isolation valves closure needs to be specifically defined.

Editorial Comment:
Unsure of the meaning of the word "remaining" in this sentence.

18, 2009, response to **RAI 337-2398, Question 14.02-115**, the applicant proposed revision to DCD Section 14.2.12.1.87 to incorporate the specific test attributes identified. The staff finds the remaining proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 337-2398, Question 14.02-115**, **resolved and closed**.

Generic Comment:
See prior comments about historical statements that are written in present tense.

3-651, Question 14.02-33, the staff requested that the applicant revise DCD Section 1.5 to provide information on testing for proper Pressurizer Relief Tank (PRT) operation on a steam discharge from the steam dump valves (SDVs). DCD Section 14.2.12.1.5 describes the PRT test. DCD Sections 14.2.12.1.4 and 14.2.12.1.6 test the SDVs and relief valves (RVs). The PRT test does not verify proper PRT operation upon relief valve or SDV operation, which is its main function. In a September 4, 2008, response to **RAI 33-651, Question 14.02-33** the applicant proposed a revision to DCD Section 14.2.12.1.5 to provide information on testing for proper PRT operation on a steam discharge from the SDVs. The proposed changes are consistent with RG 1.68 and are therefore acceptable. Review of the DCD confirms that the committed changes have been incorporated. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, considers **RAI 33-651, Question 14.02-33 resolved and closed**.

In **RAI 33-651, Question 14.02-34**, and **RAI 102-1391, Question 14.02-95**, the staff requested that the applicant revise DCD Sections 14.2.12.1.4 and 14.2.12.1.6 to clearly describe testing the SDVs and RVs respectively. Neither test abstract mentions clearly that both SDVs and all 4 RVs will be tested. The staff also requested that the applicant revise the DCD to describe the check of the supports and restraints for pressure relief valves discharge piping after the valves have actuated. RG 1.68, App. A, Item 1.a(2)(d) calls for a check of the: "pressure relief valves … supports and restraints for discharge piping." In a September 4, 2008, response to **RAI 33-651, Question 14.02-34**, and response dated December 18, 2008, to **RAI 102-1391, Question 14.02-95**, the applicant proposed a revision to preoperational test abstracts 14.2.12.1.4 and 14.2.12.1.6 to indicate that both pressurizer safety depressurization valves (SDVs) and all 4

pressurizer safety valves are to be tested. The applicant is also coordinating various tests in the DCD 14.2.12.1.1, "RCS Hot Functional Test," including the vibration/displacement monitoring. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-34**, and **RAI 102-1391, Question 14.02-95**, **resolved and closed**.

In **RAI 33-651, Question 14.02-35**, the staff requested that the applicant revise DCD Section 14.2.12.1.7, "Reactor Internals Vibration Test," to specifically reference and incorporate RG 1.20 for test methodology and acceptance criteria as appropriate. The DCD Section refers to RG 1.20 in a footnote. DCD Table 1.9.1-1 commits to RG 1.20 with no exceptions. The staff requested that the applicant DCD also note that the RCOL will be designated and tested as a prototype per RG 1.20. Further, upon successful qualification of the RCOL as a valid prototype, the SCOL plants will be designated and tested as Non-Prototype Category I, per RG 1.20. Also, the staff requested that the applicant needs to identify any COL Information Item(s) as part of its response to this request for additional information. In a September 4, 2008, response to **RAI 33-651, Question 14.02-35** the applicant provided additional information to DCD Section 3.9.2.4. The reactor internal vibration test is described in DCD Section 3.9.2.4 as the part of the comprehensive vibration assessment program based on RG 1.20. In DCD Section 3.9.2.4.1, the relations between the plant classifications and required vibration assessments are based on RG 1.20. The methods, including measurement locations and the acceptance criteria, are described in DCD Sections 3.9.2.4.2, "Measurement Program" and 3.9.2.4.3, "Inspection Program." DCD Section 14.2.12.1.7, "Reactor Internals Vibration Test" is the test abstract. Also, the applicant proposed revision to Reactor Internals Vibration Test to add reference to Section 3.9.2.4 for details and to clarify the relationship with RG 1.20 for the base requirements. The staff finds the additional information provided and the proposed DCD revisions are consistent with the guidance contained in RG 1.20, and are therefore acceptable. The staff's review of MHI Technical Report MUAP-07027, performed separately, is documented in Section 3.9 of this SER. The staff confirmed that the DCD 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 33-651, Question 14.02-35**, **resolved and closed**.

In **RAI 33-651, Question 14.02-40** and **RAI 102-1391, Question 14.02-96**, the staff requested that the applicant revise DCD Section 14.2.12.1.12, "Chemical and Volume Control System (CVCS) Preoperational Test – Boric Acid Blending," to discuss the testing for the heaters and heat tracing and include in the DCD, as appropriate. RG 1.68 1.b. (2), "Chemical Control System Tests," includes verification of operation of heaters and heat tracing. As stated in Section 9.3.4.3 of the DCD, the CVCS is designed to ensure that the boric acid solution remains soluble. Heat tracing or a heated area with temperature alarms is provided for portions of the system which normally contain 4 percent wt. of boric acid solution, to assure that boric acid solution temperature does not go below 65 °F. In a September 4, 2008, response to **RAI 33-651, Question 14.02-40**, and a December 18, 2008, response to **RAI 102-1391, Question 14.02-96**, the applicant proposed revision to preoperational test abstract 14.2.1.2.1.12 to include testing of the heaters and heat tracing within the CVCS preoperational test. A separate item was added under: "Objectives, Test Method, and Acceptance Criteria" sections, for testing of heaters and heat tracing. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-40**, and **RAI 102-1391, Question 14.02-96**, **resolved and closed**.

In **RAI 33-651, Question 14.02-42**, the staff requested that the applicant revise DCD Section 14.2.12.1.15, to add a criterion for proper operation of the Lithium Addition component. The staff also requested that the applicant clarify test method step C.3. In a Septembe 2008, response to **RAI 33-651, Question 14.02-42**, the applicant proposed a revision Section 14.2.12.1.15 to clarify Items B.5, A.1 and C.3, add C.4, and revise Section D, "Acceptance Criterion."

Technical Comment: There is no statement regarding the status of this question (which is Resolved-Closed in eRAI) in the SE.

In **RAI 33-651, Question 14.02-43**, the staff requested that the applicant revise DCD Section 14.2.12.1.16, "PMWS Preoperational Test," to discuss and address the availability of DWST and demineralized water transfer pumps for the prerequisites for PMWS preoperational tests. Item B, Prerequisites, does not include the availability of Demineralized Water Storage Tank (DWST) and Demineralized Water Transfer Pumps. DWST and the transfer pumps supply demineralized water to the Primary Makeup Water Tanks. In a September 4, 2008, response to **RAI 33-651, Question 14.02-43** the applicant proposed a revision to DCD Section 14.2.12.1.16 to clarify the prerequisites for the test and specifically noted the availability of Demineralized Water Storage Tank (DWST) and Demineralized Water Transfer Pumps as prerequisites. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-43**, **resolved and closed**.

In **RAI 33-651, Question 14.02-44**, the staff requested that the applicant revise DCD Section 14.2.12.1.17, "Reactor Trip System and ESF System Response Time Test," to discuss and modify the DCD to address, as appropriate, the testing of the response time of each of the protection channels including sensors in the Reactor Trip and ESF systems. RG 1.68 1.c guidance is to verify (by testing) the response time of each of the protection channels, including sensors. In a September 4, 2008, response to **RAI 33-651, Question 14.02-44**, the applicant proposed modification to the test method, by adding a new Item C.1, to include information regarding the response time testing of primary sensors. The new step C.1 refers to appropriate sections in Chapter 16 for detailed supporting information. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-44**, **resolved and closed**.

In **RAI 33-651, Question 14.02-45**, the staff requested that the applicant revise DCD Section 14.2.12.1.18 "Reactor Trip System and ESF System Logic Preoperational Test," to include additional information for determining the adequacy of the test results. In a September 4, 2008, response to **RAI 33-651, Question 14.02-45** the applicant included additional details in DCD Section 14.2.12.1.18 for determining the adequacy of the test results. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-45**, **resolved and closed**.

In **RAI 33-651, Question 14.02-46**, the staff requested that the applicant revise DCD Section 7.7.1.1 to provide information regarding acceptability of the RTDs. DCD Section 14.2.12.1.19 refers to DCD Section 7.7.1.1 and BTP-HICB-13 for Acceptance Criterion D.1.; Section 7.7.1.1 does not provide any information regarding acceptability of the RTDs. The referenced Branch Technical Position (HICB-13) does not give specific tolerances as inferred by this Acceptance Criterion. The staff also requested that the applicant revise DCD Section 14.2.12.1.19 to be more specific regarding the acceptable tolerance. In a September 4, 2008, response to **RAI 33-651, Question 14.02-46**, the applicant proposed revision to DCD Section 14.2.12.1.19 to address "Branch Technical Position 7-13." Changes were made to both the "Test Method," (Section C) and the "Acceptance Criteria," (Section D). The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68 and BTP 7-13, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-46**, **resolved and closed**.

In **RAI 33-651, Question 14.02-47** the staff requested that the applicant revise DCD Section 14.2.12.1.21, "Main Steam Supply System Preoperational Testing," to include the testing for the main steam relief valve block valve. DCD Section 14.2.12.1.21 discusses the testing for relief valves, turbine bypass valves, and main steam safety valve, but the DCD does not discuss the testing for the main steam relief valve block valve. In a September 4, 2008, response to **RAI 33-651, Question 14.02-47**, the applicant proposed a revision to DCD Section 14.2.12.1.21 to include testing for the main steam relief valve block valve. Objectives and Test Method included in DCD Section 14. 2.12.1.21 was both revised to include the main steam relief block valve. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-47**, **resolved and closed**.

In **RAI 33-651, Question 14.02-51**, the staff requested that the applicant revise DCD Section 14.2.12.1.41 to include TS SR 3.8.8.1 as part of the acceptance criteria in DCD Section 14.2.12.1.41. DCD Section 14.2.12.1.41 includes a reference to Technical Specification (TS) SR 3.8.9.1. TS SR 3.8.8.1 (inverter voltage, frequency, and alignment) is also relevant to this test. In a September 4, 2008, response to **RAI 33-651, Question 14.02-51** the applicant proposed to add the reference to SR 3.8.8.1 to the test acceptance criterion. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-51**, **resolved and closed**.

In **RAI 33-651, Question 14.02-53**, the staff requested that the applicant revise DCD Section 14.2.12.1.44 to document the acceptance criterion that validates the safety functions for the FOS as described in DCD Section 9.5.4.1. DCD Section 14.2.12.1.44 describes the preoperational test for the Gas Turbine Generator, including objectives associated with the electrical, mechanical, and logic subsystems. Objective A.2 is related, in part, to verifying the proper operation of the fuel oil storage and transfer system (FOS). Test methods C.1 and C.6 discuss this attribute, but there is no acceptance criterion, that validates the safety functions for the FOS, that is described in DCD Section 9.5.4.1. In a September 4, 2008, response to **RAI 33-651, Question 14.02-53** the applicant proposed detailed revisions to the test abstracts for tests 44 and 53. The applicant has committed to RG 1.9 with two exceptions that are not

applicable for a gas turbine. The major rewrite of the gas turbine sections addressed the specific tests recommended in Table 1 of RG 1.9. By doing so, the applicant addressed all of the items identified in **RAI 33-651, Question 14.02-53**. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68 and RG 1.9, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-53**, **resolved and closed**.

In **RAI 33-651, Question 14.02-56**, **RAI 33-651, Question 14.02-57**, and **RAI 102-1391, Question 14.02-97**, the staff requested that the applicant revise DCD Section 14.2.12.1.50, to include the list of specific transients that will be tested and to specify how the transients will be initiated. The staff also requested that the applicant revise DCD Sections 14.2.12.1.50 and 14.2.12.1.51 to reflect expected test method similarities between the two sections or justify the difference in test methods. In a September 4, 2008, response to **RAI 33-651, Question 14.02-56** and **RAI 33-651, Question 14.02-57**, and December 18, 2008, response to **RAI 102-1391, Question 14.02-97**, the applicant suggested several changes to DCD Section 14.2.12.1.50 and DCD Section 14.2.12.1.51:

- In Section A. "Objective," it suggested to delete "specified" from the phrases "specified transients." If the intention of this section is to instrument and monitor the piping during plant transients experienced during preoperational testing (and listed in the proposed changes to the: "RCS preoperational Hot Functional Test" abstract – 14.2.12.1.1) then the word "specified" should be replaced with "preoperational test transients." Revise DCD Section 14.2.12.1.50 with "preoperational test transients" replacing "specified."

- In Section C., "Test Method," the applicant suggested replacing the deflection measurement to be recorded during various plant transients with three (3) specific action items. These specific items are acceptable. However, the dynamic response in their new item (1) and perceptible vibration by visual inspection in item (2) should be clearly defined. Deflection measurements may be considered as one of the vibration responses. However, the "Acceptance Criteria" should state clearly the response level at which the RVI components perform their intended functions. The current DCD Section 14.2.12.1.50 refers to DCD Section 3.9.2, which does *not* provide any such acceptance criteria for RVI components. Revise DCD Section 14.2.12.1.50 and 51 to give or reference specific acceptance criteria.

Additionally, the applicant noted that the intention of DCD Section 14.2.12.1.50 is to instrument and monitor safety-related and high energy piping during plant transients experienced during preoperational testing and in particular, hot functional testing. This test abstract is not intended to direct the performance of particular plant operations in order to collect data; all plant evolutions are directed by other preoperational tests. The applicant proposed revision to DCD Section 14.2.12.1.50 to specify the testing evolutions during which monitoring is to be performed, in order to assure that data is collected and evaluated for all pertinent preoperational test transients. The applicant further revised tests 50 and 51 to address the specific staff concerns noted above. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-56**, **RAI 33-651, Question 14.02-57**, and **RAI 102-1391, Question 14.02-97**, **resolved and closed**.

In **RAI 58-872, Question 14.02-86**, and **RAI 102-1391, Question 14.02-98**, the staff requested that the applicant revise DCD Section 14.2.12.1.52, to verify that actual piping thermal growth rates do not exceed snubber lock-up velocities. The staff also noted that DCD Section 3.9.3.4.2.7 commits to initial in-situ dynamic lock-up testing and thermal motion testing of snubbers. In a September 18, 2008 response to **RAI 58-872, Question 14.02-86**, and a December 18, 2008 response to **RAI 102-1391, Question 14.02-98**, the applicant proposed revision to DCD Section 14.2.12.1.52 to include methods and acceptance criteria to verify that actual piping thermal growth rates do not exceed snubber lock-up velocities in systems or components that experience high thermal growth rates. In addition, the applicant proposed revision to DCD Section 3.9.3.4.2.7 to delete the testing program of in-situ snubber dynamic lock-up testing. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68 and SRP 3.9.3, and are therefore acceptable. The staff confirmed that the DCD 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 58-872, Question 14.02-86**, and **RAI 102-1391, Question 14.02-98**, **resolved and closed**.

In **RAI 33-651, Question 14.02-58**, the staff requested that the applicant revise DCD Section 14.2.12.1.53 to verify that all components operate properly under both maximum and minimum design voltages. DCD Section 14.2.12.1.53 has as an objective to demonstrate proper alignment and operation of ESF and other safety components with gas turbine maximum and minimum design voltages. In a September 4, 2008 response to **RAI 33-651, Question 14.02-58**, the applicant has committed to RG 1.9 with two exceptions that are not applicable for a gas turbine. The applicant also made detailed changes to test abstracts 44 and 53. The major rewrite by the applicant of the gas turbine sections was proposed to address the specific tests recommended in Table 1 of RG 1.9. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68 and RG 1.9, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-58**, **resolved and closed**.

In **RAI 33-651, Question 14.02-59**, the staff requested that the applicant revise DCD Section 14.2.12.1.56, “Safety Injection Check Valve Preoperational Test,” to add information related to safety injection testing as follows:

Part A: Test Method C.2 in DCD Section 14.2.12.1.56, “Safety Injection Check Valve Preoperational Test,” presents the method for operability of accumulator discharge check valves. However, the test abstract does not specify testing of each of the 4 accumulator injection trains in accordance with RG 1.79, “Preoperational Testing of Emergency Core Cooling Systems for Pressurized Water Reactors.” RG 1.79 states that: “Each accumulator injection train should be tested individually or simultaneously by opening the isolation valve and then slowly…” Provide additional information in DCD Section 14.2.12.1.56 to document that each injection train will be tested in accordance with the guidance in RG 1.79 and that the operability of the check valves will be demonstrated.

Part B: Test Methods C.1 and C.2 in DCD Section 14.2.12.1.56 discuss the operation of the accumulator discharge check valves and injection line check valves. It is not clear how the test methods described verify the operation of the accumulator discharge check valves. Revise DCD Section 14.2.12.1.56 to include a test method that verifies the operation of the accumulator discharge check valves.

In a September 4, 2008, response to **RAI 33-651, Question 14.02-59**, the applicant proposed a revision to DCD Section 14.2.12.1.56 to document that each injection train will be tested in accordance with RG 1.79. The applicant also proposed revision to DCD Section 14.2.12.1.56, to describe operability verification of accumulator discharge check valves. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.79, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-59**, **resolved and closed**.

In **RAI 33-651, Question 14.02-60**, the staff requested that the applicant revise Test Method C.3 in DCD Section 14.2.1.57, "Safety Injection Accumulator Test," to provide additional information to indicate how accumulator discharge valve operation is demonstrated for both normal and emergency power conditions. RG 1.79, "Preoperational Testing of ECCS for PWRs," Section C.1.c (2), states that this capability should be demonstrated for both normal and emergency power conditions. Neither the test method nor the acceptance criteria discuss the operability demonstration for both the normal and emergency power conditions. In a September 4, 2008, response to **RAI 33-651, Question 14.02-60**, the applicant proposed a revision to DCD Section 14.2.12.1.57 to address that the operation of the accumulator discharge isolation valve operation is demonstrated for both normal and emergency power conditions. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.79, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-60**, **resolved and closed**.

In **RAI 33-651, Question 14.02-61**, the staff requested that the applicant revise DCD Section 14.2.12.1.58 to document the pump and system characteristics being tested and the associated design limits that should be met. Acceptance Criterion D.2 for the containment spray system (CSS) preoperational test in DCD Section 14.2.12.1.58 states that CS/RHRS pumps and CS system performance are within design limits without a discussion or reference to the specific design limits. In a September 4, 2008, response to **RAI 33-651, Question 14.02-61**, the applicant proposed revision to DCD Section 14.2.12.1.58 to add references to clarify pump and system characteristics. The acceptance criteria now reference the characteristics defined in DCD Section 6.2.2.2. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-61**, **resolved and closed**.

In **RAI 33-651, Question 14.02-62**, the staff requested that the applicant provide additional information in DCD Section 14.2.12.1.58 to identify the preoperational tests that record performance data and verify the interlocks for the CS and RHR systems. DCD Section 14.2.12.1.58 does not specifically discuss testing of the proper operation of CS/RHR system interlocks. RG 1.79 C.2.d(2) states that performance data should be recorded and the proper operation of interlocks and equipment protective devices in pump and valve controls are verified. The CSS containment isolation valves are interlocked and are allowed to open only if two in-series RHR hot leg suction isolation valves are closed. In a September 4, 2008, response to **RAI 33-651, Question 14.02-62**, the applicant proposed revision to DCD Section 14.2.12.1.58 to specifically address testing of the CS/RHR pump hot leg isolation valve open

permissive interlocks as described in DCD Section 7.6.1.1 and the CS/RHR valve open block interlocks as described in DCD Section 7.6.1.2. Specific items to be added in the Section were defined. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.79, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-62**, **resolved and closed**.

In **RAI 33-651, Question 14.02-51**, **RAI 33-651, Question 14.02-64**, and **RAI 102-1391, Question 14.02-99**, the staff requested that the applicant revise DCD Section 14.2.12.1.59, "Refueling Water Storage System Preoperational Test" to include demonstration of proper operation of systems and equipment within the scope of this test abstract, and verify the accuracy of the acceptance criteria. RG 1.68, Appendix A, 1.h.(8), states that testing should include demonstration of proper operation of associated alarms, indicators, controls, heating and chilling systems, and valves. DCD Section 14.2.12.1.59 only addresses verification of control circuits and alarms. Further, the acceptance criterion in DCD Section 14.2.12.1.59 references DCD Section 6.3.2.2.4 for the refueling water storage pit (RWSP) system components controls. However, the RWSP system is also discussed in DCD Sections 6.2.2.2.3 and 6.2.2.2.5, and the RWSP system instrumentation is briefly discussed in DCD Section 6.3.5.4. Finally, DCD Sections 6.3.2.2.3, 6.2.2.2.5 and 6.3.5.4 and Table 6.3-5 provide RWSP system specifications but do not provide any discussion of the alarms and their verifications. In a September 4, 2008, response to **RAI 33-651, Question 14.02-51**, and **RAI 33-651, Question 14.02-64**, and December 18, 2008, response to **RAI 102-1391, Question 14.02-99**, the applicant proposed revision to DCD Section 14.2.12.1.59, to clarify the intent of the testing. The changes in acceptance criteria in DCD Section 14.2.12.1.59 clarify the wording. Criterion D.1 now references DCD Section 6.3.5.4 which briefly discusses the alarms. The applicant also revised DCD Section 14.2.12.1.59 to address the alarm levels and to reference the correct DCD section. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.2-51**, **RAI 33-651, Question 14.02-64**, and **RAI 102-1391, Question 14.02-99**, **resolved and closed**.

In **RAI 33-651, Question 14.02-65**, the staff requested that the applicant revise DCD Section 14.2.12.1.60 and DCD Section 9.2.7 to describe the acceptance criteria for the ECCS system in terms of the system function during normal conditions, and following receipt of an ECCS actuation signal, and to specify the system and pump performance characteristics. In a September 4, 2008, response to **RAI 33-651, Question 14.02-65**, the applicant proposed revision to DCD Section 14.2.12.1.60 and to DCD Section 9.2.7.2.1, to include testing of system flows, pump and chiller performance, and verification of system response on receipt of an ECCS actuation signal. Specifically, test method acceptance criteria were modified to include testing of system and pump characteristics and for verification of system response on receipt of an ECCS actuation signal. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-65**, **resolved and closed**.

In **RAI 678-5241, Question 14.02-123**, the staff requested that the applicant revise the SIS and Safety Injection Accumulator Test to include a test abstract for the Emergency Letdown System

(ELS). In a March 1, 2011, response to **RAI 678-5241**, **Question 14.02-123** the applicant proposed to revise DCD Section 14.2.12.1.54, to include testing of the emergency letdown line. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. **RAI 678-5241**, **Question 14.02-123** was not included in Revision 3 to the DCD and is **Confirmatory Item 14.02-2** pending verification of DCD Revision 4.

In **RAI 33-651**, **Question 14.02-66** and **RAI 102-1391**, **Question 14.02-100**, the staff requested that the applicant:

- Revise DCD Section 14.2.12.1.61 to include the performance of the pre-stressed concrete containment vessel SIT in accordance with RGs and ASME code requirements as documented in DCD Section 3.8.1.7.
- Add RGs 1.35 and 1.35.1 to Table 14.2-2 of the DCD.
- Verify that the SIT meets the applicable guidance in RG 1.68, Appendix A, Item 1.i.

In a September 4, 2008 response to **RAI 33-651, Question 14.02-66**, and December 18, 2008, response to **RAI 102-1391, Question 14.02-100**, the applicant proposed revision to the DCD Section 14.2.12.1.61 test abstract to reference DCD Section 3.8.1.7, which contains commitments to all the required reference documents. The applicant also added RGs 1.35 and 1.35.1 to Table 14.2-2 and clarified that the SIT meets the RG 1.68 stipulation with the commitments noted in DCD Section 3.8.1.7. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.35 and RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-66** and **RAI 102-1391, Question 14.02-100**, **resolved and closed**.

In **RAI 33-651, Question 14.02-67**, the staff requested that the applicant revise DCD Section 14.2.12.1.66 to document the verification of the temperature limits in DCD Section 9.4.6.1.2.3 during hot functional testing. Acceptance Criterion D.1 of DCD Section 14.2.12.1.66, references DCD Section 9.4.6. DCD Section 9.4.6.1.2.3 documents two temperature limits that serve as a design basis for the system. In a September 4, 2008, response to **RAI 33-651, Question 14.02-67**, the applicant proposed revision to the test abstract to include the temperature limits. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-67**, **resolved and closed**.

In **RAI 33-651, Question 14.02-68**, the staff requested that the applicant revise DCD Section 14.2.12.1.69 to document the verification of the temperature limits in DCD Section 9.4.6.1.2.1 during hot functional testing. Acceptance Criterion D.1 of DCD Section 14.2.12.1.69 references DCD Section 9.4.6. DCD Section 9.4.6.1.2.1 documents two temperature limits that serve as a design basis for the system. In a September 4, 2008, response to **RAI 33-651, Question 14.02-68** the applicant proposed revision to the test method and acceptance criteria of preoperational test abstract 14.2.12.1.69 to include verification that temperature limits, specified in DCD Section 9.4.6.1.2.1, are specifically addressed during hot functional testing. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and

are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-68**, **resolved and closed**.

In **RAI 33-651, Question 14.02-69**, the staff requested that the applicant revise DCD Section 14.2.12.1.71 and DCD Table 14.2-2, as described in Part A through Part D listed below.

Part A: DCD Section 5.2.5.1 notes, in part, that the RCPB leakage detection system is designed in accordance with RG 1.45, "Reactor Coolant Pressure Boundary Leakage Detection Systems." RG 1.45 is listed in DCD Table 1.9.1-1, but is not listed in DCD Table 14.2-2. Revise DCD Section 14.2.12.1.71 to reference RG 1.45, and add RG 1.45 to DCD Table 14.2-2.

Part B: DCD Section 14.2.12.1.71 only addresses 2 of the 4 RCS leakages in LCO 3.4.13 (items b and c). Revise DCD Section 14.2.12.1.71 to add Items a and d (no pressure boundary leakage and primary-to-secondary leakage less than 150 gpd) to the objectives, test method, and acceptance criteria sections of the test abstract.

Part C: The test method section of DCD Section 14.2.12.1.71 does not address all of the leakage detection methods in DCD sections 5.2.5.3 and 5.2.5.4. Revise DCD Section 14.2.12.1.71 to add these additional leakage detection methods to the test abstract.

Part D: Neither DCD Section 5.2.5 or DCD Section 14.2.12.1.71 identifies quantitative methods for determining RCPB leakage rates for each of the several detection methods. The majority of these methods are qualitative. Identify which leakage detection rates will be quantitative and which will be qualitative, and provide test step(s) in DCD Section 14.2.12.1.71 that will determine and correlate, as appropriate, the leakage results of the various methods.

In follow-up **RAI 102-1391, Question 14.02-101**, the staff requested that the applicant revise the test procedure to provide for conversion of the various leak detection sub-system measures to RCS leakage rate and comparisons between the leak rates determined by the various sub-systems to ensure consistency within system capability and sensitivity. In **RAI 243-2044, Question 14.02-112**, **RAI 371-2617, Question 14.02-117** and **RAI 455-3648, Question 14.02-119**, the staff requested that the applicant address additional follow-up questions.

In a September 4, 2008, response to **RAI 33-651, Question 14.02-69**, the applicant responded to Part A through Part D above. In a December 18, 2008 response to **RAI 102-1391, Question 14.02-101**, a May 18, 2009 response to **RAI 243-2044, Question 14.02-112**, a June 17, 2009 response to **RAI 371-2617, Question 14.02-117** and an October 1, 2009 response to **RAI 455-3648, Question 14.02-119**, the applicant responded to follow-up questions. The applicant proposed revision to DCD Tables 14.2-2 and 1.9.1-1 to add a commitment to RG 1.45, Revision 1. The applicant added a test for the RCPB leak detection systems as a new preoperational test in DCD Section 14.2.12.115 and addressed all of the leakage detection methods in DCD Sections 5.2.5.3 and 5.2.5.4. The applicant noted preoperational test abstract 14.2.12.1.115 explicitly identifies and verifies the calibration and testing of all RCPB leakage detection subsystems. The applicant noted that they do not intend to address only items b and c of LCO 3.4.13 in DCD Section 14.2.12.1.71. The applicant revised the description in DCD Section 14.2.12.1.71, “Objective,” and “Test Method,” deleting the terms “identified and unidentified,” to avoid confusion. The applicant noted the unidentified leakage detection methods described in DCD Sections 5.2.5.4.1.1, “Containment Sump Level and Flow Monitoring System” 5.2.5.4.1.2, Containment Airborne Particulate Radioactivity Monitor and 5.2.5.4.1.4, Containment Air Cooler

Condensate Flow Rate Monitoring System" are quantitative. In addition, changes in the reactor coolant inventory described in DCD Section 5.2.5.4.2 Item C also provide quantitative information of unidentified leakage. The applicant also revised DCD Section 14.2.12.1.71 item C, "Test Method," to add the description of additional detection methods that will be used to determine leakage results. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.45, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-69**, **RAI 102-1391, Question 14.02-101**, **RAI 243-2044, Question 14.02-112**, **RAI 371-2617, Question 14.02-117** and **RAI 455-3648, Question 14.02-119**, **resolved and closed**.

In **RAI 521-4248, Question 14.02-120**, the staff requested that the applicant revise the DCD as follow-up to the applicant responses to **RAI 371-2617, Question 14.02-117**, and **RAI 455-3648, Question 14.02-119**. The staff requested that the applicant address RG 1.45, Rev. 1, regulatory positions C.2.1 and C.2.5 in the DCD, and revise the multiple references to RG 1.45, Rev. 0 in Section 5.2.5 of DCD. In a February 5, 2010, response to RAI 521 Question 14.02-120, the applicant proposed including RG 1.45, Revision 1, Regulatory Positions C.2.1 and C.2.5 in the DCD. The applicant also proposed correction of multiple references to RG 1.45, Revision 0, by revision to the DCD and the Technical Specification Bases Sections 3.4.13 and 3.4.15. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.45, and are therefore acceptable. The staff confirmed that the DCD 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 521-4248, Question 14.02-120**, **resolved and closed**.

In **RAI 33-651, Question 14.02-70**, the staff requested that the applicant revise DCD Section 14.2.12.1.75 to add acceptance criteria that verify any nuclear instrumentation system output functions such as alarm, trip, or indication signals. The objective of DCD Section 14.2.12.1.75 includes the demonstration of the nuclear instrumentation system to supply signals for operating the appropriate alarm and trip signals and indicating reactor power levels. The acceptance criteria for this test do not verify any nuclear instrumentation system output functions such as alarm, trip, or indication signals. In a September 4, 2008, response to **RAI 33-651, Question 14.02-70** the applicant proposed to include acceptance criteria for nuclear instrumentation system output functions. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-70**, **resolved and closed**.

In **RAI 33-651, Question 14.02-71**, the staff requested that the applicant revise DCD Section 14.2.12.1.79 to incorporate the test requirements of RG 1.52 and RG 1.140. DCD Section 14.2.12.1.79 addresses the "HEPA Filter and Charcoal Absorber Preoperational Test" for four in-plant heating, ventilation, and air conditioning (HVAC) systems and refers to DCD Section 9.4. DCD Section 14.2.12.1.79 and Tables 1.9.1-1 and 14.2-2 commit to RG 1.52, which specifies, in part, initial test requirements for the HVAC systems. One of the four HVAC systems is the technical support center (TSC) HVAC, and DCD Section 9.4.3.4.4 commits to RG 1.140 rather than RG 1.52 for the TSC. Section C.6 of each RG has guidance for testing, including "Initial in-place testing." In a September 4, 2008, response to **RAI 33-651, Question 14.02-71**, the applicant proposed revision to DCD Section 14.2.12.1.79 to refer to RG 1.52, RG 1.140, ASME N510 (Reference 9.4.8-8) and ASME AG-1 -1997 for test methods and

acceptance criteria. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.52 and RG 1.140, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-71**, **resolved and closed**.

In **RAI 33-651, Question 14.02-72**, the staff requested that the applicant revise DCD Section 14.2.12.1.80, to address liquid waste management system (LWMS) storage, sampling and analysis, treatment, recycle back to plant use, and release in the test abstract, or explain how these design objectives are being addressed by the test abstract. DCD Section 11.2.1.1 documents the design objectives of the LWMS. However, DCD Section 14.2.12.1.80 does not address the storage, sampling and analysis, treatment, recycle back to plant use, and release design objectives of the LWMS documented in DCD Section 11.2.1.1. In a September 4, 2008, response to **RAI 33-651, Question 14.02-72**, the applicant proposed a revision to DCD Section 14.2.12.1.80 to address the system operating performance, consistent with the design objectives of the LWMS documented in DCD Section 11.2.1. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-72**, **resolved and closed**.

In **RAI 243-2044, Question 14.02-109**, the staff requested that the applicant revise DCD Section 14.2.12.1.80 to address testing of equipment and floor drainage systems in accordance with RG 1.68, Appendix A, Item 1.n.(9), or identify where testing of these systems is being addressed in DCD Section 14.2. RG 1.68, Appendix A, Item 1.n.(9) identifies drain systems as one of the plant features that require initial testing. However, US-APWR DCD Section 14.2 does not identify any test requirements for the equipment and floor drainage system (EFDS) discussed in DCD Section 9.3.3. In a March 27, 2009 response to **RAI 243-2044, Question 14.02-109**, the applicant proposed revision to the DCD and added a new preoperational test, “Equipment and Drainage System Preoperational Test,” in DCD Section 14.2.12.1, and also revised Table 14A-1 to indicate conformance with RG 1.68, Appendix A, Item 1.n.(9), by this test. The new preoperational test was also added to Table 14.2-1. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, Appendix A, and are therefore acceptable. The staff confirmed that the DCD 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 243-2044, Question 14.02-109**, **resolved and closed**.

In **RAI 243-2044, Question 14.02-110**, the staff requested that the applicant identify the test abstract(s) in DCD Section 14.2 that address pre-operational testing for the check valves and manual valves used to prevent cross-divisional flooding via R/B floor drain and sump systems, consistent with RG 1.68, Appendix A, Section 1, Section h, or provide a justification for their omission. RG 1.68, Appendix A, Section 1, Section h, states the following: "Appropriate tests should also be conducted to verify the functioning of protective devices provided to protect engineered safety features from flooding..." DCD Section 3.4.1.5.2.1 notes that floor drains in the east and west areas of the RCA portion of the R/B are isolated by means of a normally closed valve or check valve in individual drainage pathways prior to connecting into a common sump tank system. This design is used to prevent flood waters from the east (or west) from passing into the west (or east) side of the building via the floor drain system. DCD Section 3.4.1.5.2.2 notes that a similar arrangement is used within the NRCA portion of the R/B to preclude cross-flow of floor drain water. DCD Section 9.3.3.1.1 notes that normally closed

manual isolation valves installed in individual drainage pathways of ESF equipment rooms preclude backflow of water into these rooms via the sump system. However, DCD Section 14.2 does not seem to address the functionality of check valves and manual valves used to prevent cross-divisional flooding via floor drain and sump systems. In a March 27, 2009, response to **RAI 243-2044, Question 14.02-110**, the applicant proposed to revise the DCD and add a new preoperational test, "Equipment and Drainage System Preoperational Test," in DCD Section 14.2.12.1, and revised DCD Table 14A-1 to indicate conformance with RG 1.68, Appendix A, Item 1.n.(9), by this test. The new preoperational test was also added to DCD Table 14.2-1. The new test includes testing of reactor building floor drains and sump systems by water addition or pressurized air (where appropriate) sufficient to show the functionality of drain piping and valves that prevent cross-divisional flooding. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, Appendix A, and are therefore acceptable. The staff confirmed that the DCD 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 243-2044, Question 14.02-110**, **resolved and closed**.

In **RAI 33-651, Question 14.02-74**, the staff requested that the applicant revise DCD Section 14.2.12.1.82 to address SWMS processing, de-watering, solidification, storage, sampling and analysis, and packaging in the test abstract, or explain how these design objectives are being addressed by the test abstract. DCD Section 14.2.12.1.82 tests the capability of the SWMS as described in DCD Section 11.4. DCD Section 11.4.1.1 documents the design objectives of the SWMS. DCD Section 14.2.12.1.82 does not seem to address the following design objectives of the SWMS documented in DCD Section 11.4.1.1: processing, de-watering, solidification, storage, sampling and analysis, and packaging. In a September 4, 2008, response to **RAI 33-651, Question 14.02-74**, the applicant proposed revision to the test methods described in DCD Section 14.2.12.1.82 to include demonstration of the operation of all subsystems included in the SWMS. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-74**, **resolved and closed**.

In **RAI 33-651, Question 14.02-75**, the staff requested that the applicant revise DCD Sections 14.2.12.1.83 and/or 14.2.12.1.84, accordingly, to clarify where and how these sampling systems are being tested. DCD Section 14.2.12.1.84, “Sampling System Pre-op Test,” tests the capability of the sampling system, and refers to DCD Section 9.3.2. However, it is not fully clear which sampling systems are within the scope of the test. DCD Section 9.3.2 is entitled: “Process and Post-Accident Sampling Systems,” and includes 6 sampling sub-systems, one of which is the SG Blowdown Sampling System, that has a separate test in DCD Section 14.2.12.1.83. In a September 4, 2008, response to **RAI 33-651, Question 14.02-75**, the applicant proposed to clarify where and how the SG Blowdown sampling system is being tested in DCD Section 14.2.12.1.83. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-75**, **resolved and closed**.

In **RAI 33-651, Question 14.02-76**, the staff requested that the applicant revise DCD Section 14.2.12.1.86 to incorporate a reference to NUREG-0554, to address the RG 1.68 guidance that full operational testing be conducted at 100 percent of rated load, and to address the fuel

handling tools discussed in DCD Section 9.1.4.2.1. DCD Section 14.2.12.1.86 addresses the tests referred to in RG 1.68, Appendix A, Section 1.m (4) and (5). RG 1.68, Appendix A, Section 1.m (4), references NUREG-0554 and NUREG-0612 for these tests. DCD Section 14.2.12.1.86 references NUREG-0612 but does not reference NUREG-0554. RG 1.68, Appendix A, Section 1.m also notes that: "full operational testing should be at 100 percent of rated load." RG 1.68, Appendix A, Section 1.m (2), calls for tests of refueling equipment, including hand tools and grapples. DCD Section 9.1.4.2.1 discusses fuel handling tools, such as a new and a spent fuel assembly handling tool and a rod control cluster (RCC) handling tool. In a September 4, 2008, response to **RAI 33-651, Question 14.02-76**, the applicant proposed revision to DCD Section 14.2.12.1.86 to include reference to NUREG-0554 and NUREG-0612 for the spent fuel cask handling crane and proposed revision to DCD Section 14.2.12.1.86 to clarify that full operational testing be conducted at 100 percent of rated load. The applicant also proposed revision to DCD Section 14.2.12.1.86 to address the fuel handling tools discussed in DCD Section 9.1.4.2.1. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, NUREG-0554, and NUREG-0612, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-76**, **resolved and closed**.

In **RAI 33-651, Question 14.02-77**, the staff requested that the applicant revise DCD Section 14.2.12.1.87 to provide CCW testing information for verification of the cooling capability of the heat exchangers, prevention of leakage of radioactive fluids into or out of the CCW system, and detection of leakage of radioactive material into the CCW system of the CCW. In a September 4, 2008, response to **RAI 33-651, Question 14.02-77**, the applicant proposed revision to DCD Section 14.2.12.1.87 to provide information on the abstract for testing the CCWS cooling capability. The hydrostatic pressure test of individual components or subsystems is performed as the construction test to verify their pressure boundary integrity. This is noted in DCD Section 14.2.1.2.1. Testing of the radiation monitors for CCW leak detection (radiation monitors RMS-RE-56A and RMS-RE-56B) and associated interlock closure of the CCW surge tank vent valve is provided in DCD Section 14.2.12.1.78, the preoperational test of process radiological monitoring. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-77**, **resolved and closed**.

In **RAI 33-651, Question 14.02-78**, the staff requested that the applicant revise DCD Sections 14.2.12.1.91, "Instrument Air System Preoperational Test" and 14.2.12.1.92, "Station Service Air System Preoperational Test" to include a reference to RG 1.68.3 and any relevant test prerequisites, objectives, and/or acceptance criteria. RG 1.68.3 provides guidance for preoperational testing of Instrument and Control Air Systems. DCD Sections 14.2.12.1.91 and 14.2.12.1.92 provide the test abstracts for testing of the Instrument Air System and the Station Service Air System. However, neither DCD Section references RG 1.68.3 for the testing. In a September 4, 2008, response to **RAI 33-651, Question 14.02-78**, the applicant proposed incorporation of the RG 1.68.3 recommendations into preoperational test abstracts 14.2.12.1.91 and 14.2.12.1.92 and 14.2.12.1.62, "Containment Local Leak Rate Preoperational Test" with exceptions noted for Items C.7, C.8.b and C.11. The staff transmitted follow-up request **RAI 102-1391, Question 14.02-102** to request further information related to the proposed response to **RAI 33-651, Question 14.02-78**. Accordingly, the staff will evaluate follow-up **RAI 102-1391, Question 14.02-102**, separately. The staff finds the remaining proposed DCD revisions are

consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-78**, **resolved and closed**.

In **RAI 33-651, Question 14.02-79**, the staff requested that the applicant add RG 1.68.3, Item C.8.b test condition to DCD Sections 14.2.12.1.91 and 14.2.12.1.92, or provide a clear justification for not performing the gradual loss of pressure test. RG 1.68.3 provides guidance for preoperational testing of Instrument and Control Air Systems. Table 1.9.1-1 notes conformance to this RG with some exceptions. One exception is to Item C.8.b of RG 1.68.3, which specifies a gradual loss of pressure test. The table does not provide a clear justification for this exception. In a September 4, 2008, response to **RAI 33-651, Question 14.02-79** the applicant proposed that in the case of both gradual loss of pressure and sudden air pressure shutoff, the resulting response of components are the same. Therefore, the applicant considers that it is not necessary to perform the gradual loss of pressure test. The staff transmitted follow-up request **RAI 102-1391, Question 14.02-102** to request further information related to the proposed response to **RAI 33-651, Question 14.02-79**. Accordingly, the staff will evaluate follow-up **RAI 102-1391, Question 14.02-102**, separately. The staff finds the remaining proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-79**, **resolved and closed**.

In **RAI 102-1391, Question 14.02-102**, follow-up to **RAI 33-651, Questions 14.02-78** and **14.02-79**, the staff requested that the applicant address each of the following nine comments.

1. Provide a commitment to test the IA, SA, and compressed gas systems to RG 1.68.3, including all sections of the RG except for C.7.

2. Revise DCD Sections 14.2.12.1.91 and 14.2.12.1.92 to address all necessary aspects of RG 1.68.3.

3. Provide a new preoperational test to test the compressed gas system, including the nitrogen, hydrogen, and oxygen sub-systems. DCD Section 9.3.1.2.1.1 states that: “Provisions are made to cross-connect the IAS and SSAS at the distribution header upstream of the dryers. In event that the instrument air compressors cannot meet the demand for instrument air, the station service air compressors will provide a backup supply of air.” The SA System, therefore, falls within the scope of RG 1.68.3 and should be tested to this RG just as the IA System is tested. Further, this statement in the DCD seems to conflict with Acceptance Criterion D.5 of DCD Section 14.2.12.1.91 (refer to Section C.9 of RG 1.68.3).

4. Reconcile the excerpt from DCD Section 9.3.1.2.1.1 with Acceptance Criterion D.5 of DCD Section 14.2.12.1.91. Section C.8.a of RG 1.68.3 calls for a sudden loss of air pressure test and Section C.8.b calls for a gradual loss of air pressure test to verify that important to safety air-operated loads respond in accordance with their design on a loss of air pressure. The RAI response states that the: “US-APWR does not perform the gradual reduction pressure test because the sudden air pressure shutoff test verifies that the affected components respond properly.” The purpose of RG 1.68.3 Section C.8.b is to verify that the components do in fact operate as designed on a gradual loss of

pressure. Just stating that they do operate that way by design does not meet the intent of the RG to verify that by testing.

5. Revise DCD Section 14.2.12.1.91 to incorporate the gradual loss of air pressure test recommended in Section C.8.b of RG 1.68.3. Section C.11 RG 1.68.3 Section calls for functional testing of air systems important to safety to ensure that credible failures resulting in an increase in the supply system pressure will not cause loss of operability. The applicant's response to **RAI 33-651, Question 14.02-78** states that C.11 does not apply because the US-APWR does not have an important-to-safety instrument and control air system. The staff does not agree with this interpretation. First, the set of safety-related components and systems is a subset of the larger set of important-to-safety systems and components. Second, Section A of footnote 1 of RG 1.68.3 describes that the RG applies to compressed air and other compressed gas systems that supply loads that could affect the overall safety and performance of the plant. This certainly applies to the US-APWR Instrument Air, which has safety-related loads listed in Table 9.3.1-1. The Service Air System can also supply these loads. And the Compressed Gas System supplies nitrogen and hydrogen to the safety injection accumulators, the pressurizer relief tank, the radwaste tanks, waste gas analyzer, and the volume control tank (VCT) for injection into the RCS. The staff does note that some testing at overpressure appears to be conducted in DCD Section 14.2.12.1.91, step C.5, despite the exception to Section C.11 of RG 1.68.3.

6. Revise DCD Sections 14.2.12.1.91 and 14.2.12.1.92 as required to document conformance to the guidance of Section C.11 of RG 1.68.3. Further, the applicant's response to **RAI 33-651, Question 14.02-78** states that it is not necessary to reference RG 1.68.3 within the test abstracts because the recommendations of the RG are incorporated into the test abstracts. However, that is not completely the case. For example, most of the sections of the RG are addressed in Test 91 but most are not addressed in Test 92. Also, Items C.8a and C.8b are not addressed in the test method section of Test 91. The staff notes that there is a statement in Test 91: "Verification of safety-related containment isolation valve position on loss of pressure is described in Section 14.2.12.1.62." However, Test 62 does not perform this test, rather lists it as a prerequisite. Also, the containment isolation valves are only a subset of all the safety-related air-operated valves of Table 9.3.1-1. There may be additional important-to-safety air-operated valves that need testing that are not listed in this Table.

7. Reference RG 1.68.3 in DCD Sections 14.2.12.1.91 and 14.2.12.1.92.

8. Revise the reference to DCD Section 14.2.12.1.62 in DCD Section 14.2.12.1.91 to reconcile the statement that "Verification of safety-related containment isolation valve position on loss of pressure is described in Section 14.2.12.1.62."

9. Revise Tests 91 and 92 to include testing of RG 1.68.3 Items C.8a and C.8b for all valves and other components within the scope of the RG; or reference where they are tested.

In a December 18, 2008 response to **RAI 102-1391, Question 14.02-102**, the applicant proposed changes addressing the nine comments described in RAI 102, Question 14.02-102. The applicant response to the nine comments was substantially acceptable, but a few areas required further follow-up. In **RAI 337-2398, Question 14.02-116**, and **RAI 409-3092,**

Question 14.02-118, the staff transmitted follow-up requests related to the applicant's proposed response to **RAI 102-1391, Question 14.02-102**. In a May 18, 2009 response to **RAI 337-2398, Question 14.02-116**, and a July 10, 2009, response to RAI 409, Question 14.02-118 the applicant agreed with the staff's position regarding testing of SSA and CG in accordance with RG 1.68.3. The applicant proposed to add a new preoperational Test #117 that will test the CG System to RG 1.68.3. Further, the applicant proposed to revise Test # 91 for Instrument Air and Test #92 for the SSA System to comply with the RG, except for Section C.7. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68.3, and are therefore acceptable. The staff confirmed that the DCD contains the changes committed to in the RAI responses. **RAI 33-651, Question 14.02-78** and **RAI 33-651, Question 14.02-79** were each addressed in the paragraphs above and have been resolved separately. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, considers **RAI 102-1391, Question 14.02-102**, **RAI 337-2398, Question 14.02-116**, and **RAI 409-3092, Question 14.02-118**, **resolved and closed**.

In **RAI 33-651, Question 14.02-82**, the staff requested that the applicant revise DCD Section 14.2.12.1.101, "Main Control Room (MCR) HVAC System Preoperational Test (including MCR Habitability)" to address proper automatic switching to the emergency pressurization mode and to the emergency isolation mode; require that the system design as specified in DCD Section 9.4.1, "Main Control Room Heating, Ventilation and Air Conditioning System" will be verified, and include relevant RG 1.196, "Control Room Habitability at Light-Water Nuclear Power Reactors" test guidance. DCD Section 14.2.12.1.101 tests the MCR HVAC System and MCR habitability. This system is described in DCD Section 9.4.1. Two important DCD Section 9.4.1 system functions, proper automatic switching to the emergency pressurization mode and to the emergency isolation mode, do not appear in the test abstract: These two functions should be added to the test abstract. The test abstract should also include a requirement to verify the system design per DCD Section 9.4.1. Additionally, DCD Section 9.4.1 and Tables 1.9.1-1 and 14.2-2 commit to RG 1.196, which specifies, among other items, testing guidance for the MCR envelope integrity. In a September 4, 2008, response to **RAI 33-651, Question 14.02-82**, the applicant proposed revision to the DCD Section 14.2.12.1.101 to include automatic switching to the emergency pressurization mode and to the emergency isolation mode; verification of design per DCD 9.4.1; and reference to RG 1.196. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.196, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-82**, **resolved and closed**.

In **RAI 33-651, Question 14.02-83**, the staff requested that the applicant revise DCD Section 14.2.12.1.103, "Technical Support Center HVAC System Preoperational Test" to include the relevant provisions of RG 1.140, Section C.6. DCD Section 14.2.12.1.103 tests the test shipping cask (TSC) HVAC System and refers to DCD Section 9.4.3. DCD Section 9.4.3.4.4 and Tables 1.9.1-1 and 14.2-2 include a commitment to conduct testing of the TSC HVAC System in accordance with RG 1.140. RG 1.140, Section C.6, includes guidance for testing, including "Initial In-Place Testing." In a September 4, 2008, response to **RAI 33-651, Question 14.02-83**, the applicant proposed revision to DCD Section 14.2.12.1.103 to refer to DCD Section 14.2.12.1.79 in order to ensure coordination of testing and refer to RG 1.140 for additional testing requirements for fans and fan motors, heaters, dampers, and ductwork. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.140, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-83**, **resolved and closed**.

In **RAI 102-1391, Question 14.02-103**, the staff requested that the applicant commit to full testing per RG 1.140 or explain the reason for areas not met or where alternative standards are used. While DCD Table 1.1.1-1 commits to RG 1.140 with no exceptions, Test 14.2.12.1.103 for the TSC HVAC System does not commit to full testing per RG 1.140. There appear to be some areas where the ITP does not implement RG 1.140. In a December 18, 2008, response to **RAI 102-1391, Question 14.02-103**, the applicant proposed committing to RG 1.140 for the TSC HVAC System and proposed revision to the DCD as committed. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.140, and are therefore acceptable. The staff confirmed that the DCD 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 102-1391, Question 14.02-103**, **resolved and closed**.

In **RAI 33-651, Question 14.02-84**, the staff requested that the applicant revise DCD Section 14.2.12.1.105, "Vessel Servicing Preoperational Test" to incorporate dynamic and static load testing of the lifting equipment identified in DCD Section 9.1.5, "Overhead Heavy Load Handling System" and require a demonstration of the operability of the safety devices identified in DCD Section 9.1.5.5. DCD Section 14.2.12.1.105 addresses the heavy lifting equipment described in DCD Section 9.1.5. RG 1.68, Appendix A, Section 1.o (1), calls for tests of the associated refueling lifting equipment (e.g., slings). DCD Section 9.1.5 mentions slings, hooks, etc. These should be added to Test abstract 14.2.12.1.105. RG 1.68 section 1.o (3) calls for a demonstration of the operability of safety devices. DCD Section 9.1.5.5 describes safety devices in addition to the interlocks. These safety devices need to be included in the test abstract. In a September 4, 2008, response to **RAI 33-651, Question 14.02-84**, the applicant proposed revision to DCD Section 14.2.12.1.105 to incorporate dynamic and static load testing of the lifting equipment identified in DCD Section 9.1.5, and require a demonstration of the operability of the safety devices identified in DCD Section 9.1.5.5. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 33-651, Question 14.02-84**, **resolved and closed**.

14.2.12.4.2 Initial Fuel Loading Tests

The staff reviewed the following US-APWR initial fuel loading test abstracts in the DCD, Revision 3, Section 14.2.12:

14.2.12.2.1.1 RCS Sampling for Fuel Loading

14.2.12.2.1.2 Fuel Loading Instrumentation and Neutron Source Requirements Test

14.2.12.2.1.3 Initial Fuel Loading

14.2.12.2.1.4 Inverse Count Rate Ratio Monitoring for Fuel Loading

14.2.12.2.1.5 Precritical Test Sequence

14.2.12.2.1.6 Rod Drop Time Measurement Test

14.2.12.2.1.7 CRDM Operational Test

14.2.12.2.1.8 Rod Position Indication Test

14.2.12.2.1.9 Rod Control System Test

14.2.12.2.1.10 Reactor Protection System Test

14.2.12.2.1.11 RCS Final Leak Test

14.2.12.2.1.12 Incore Detector Test

14.2.12.2.1.13 RCS Flow Coastdown Test

14.2.12.2.1.14 Operational Alignment of Process Temperature Instrumentation Test

For initial fuel loading, RG 1.68, Appendix A, Section 2, "Initial Fuel Loading and Precritical Tests," specifies safety measures to preclude inadvertent reactor criticality during initial fuel loading. These measures include control and monitoring of fuel loading activities, measurement and prediction of core physics parameters, and operability of reactivity control systems. These measures are addressed by the applicant in DCD, Revision 3, Section 14.2.10, "Initial Fuel Loading and Initial Criticality." Initial fuel loading testing, described in DCD, Revision 3, Section 14.2.12.2.1, "Initial Fuel Loading and Pre-critical Tests," is performed after completion of preoperational testing, but prior to initial criticality. These tests include those performed prior to the core load to verify the readiness of the plant for core loading, and the loading of the core. These tests verify that the systems necessary to monitor the fuel loading process are operational and that the core loading is conducted properly. Following core load, tests are performed at hot conditions to bring the plant to a final state of readiness prior to initial criticality.

RG 1.68, Appendix C provides fifteen specific prerequisites for the initial fuel load. RG 1.68, Appendix C, also prescribes limitations and actions associated with the initial fuel load.

In **RAI 28-478, Question 14.02-14**, the staff requested that the applicant revise the prerequisites identified in DCD, Section 14.2.12.2.1 for the initial fuel loading to address all of the prerequisites from RG 1.68, Appendix A. In a July 31, 2008, response to **RAI 28-478, Question 14.02-14** the applicant proposed to include all the prerequisites listed in RG 1.68, Appendix A, in the DCD. In addition, the applicant proposed to add a prerequisite regarding the preparation of a prediction for core reactivity. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 28-478, Question 14.02-14**, **resolved and closed**.

In **RAI 28-478, Question 14.02-15**, the staff requested that the applicant include criteria for safe fuel loading that require loading operations to stop immediately in DCD Section 14.2.12.2.1.1. RG 1.68, App. C.2.c.(1), "Limitations and Actions," provides considerations for circumstances that would require fuel loading to be stopped. In a July 31, 2008 response to **RAI 28-478, Question 14.02-15**, the applicant proposed to include circumstances that would require fuel loading to be stopped as recommended in RG 1.68, Appendix C as part of Revision 1 to the DCD. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 28-478, Question 14.02-15**, **resolved and closed**.

In **RAI 28-478, Question 14.02-17**, the staff requested that the applicant revise DCD Section 14.2.12.2.1.2 to add the prerequisite that SSCs required by Technical Specifications to support a specified operational mode be operational prior to the initiation of precritical testing. RG 1.68, Appendix C.3, "Initial Criticality Procedures," notes in part that "Technical Specification Requirements must be met." In a July 31, 2008, response to **RAI 28-478, Question 14.02-17** the applicant proposed to add an additional prerequisite that SSCs required by Technical Specifications to support a specified operational mode be operational prior to the initiation of pre-critical testing. The staff finds the proposed DCD revision to be consistent with the guidance contained in RG 1.68, and is therefore acceptable. The staff confirmed that the DCD 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 28-478, Question 14.02-17**, **resolved and closed**.

RG 1.68, Appendix A states that: "to the extent practical, [precritical] testing should demonstrate control rod scram times at both hot zero power and cold temperature conditions, with flow and no-flow conditions in the reactor coolant system as required to bound conditions under which scram might be required." This objective was initially proposed by the applicant in DCD test abstract 14.2.12.2.1.5, "Rod Drop Time Measurement Test," "to determine the rod drop time of each RCCA under full-flow conditions and no flow conditions, with the reactor at normal operating temperature and pressure." This implied that the hot testing will be completed, but did not address the cold testing.

In **RAI 28-478, Question 14.02-18** the staff requested that the applicant revise DCD Section 14.2.12.2.1.5, "Precritical Test Sequence" to document hot and cold flow conditions in Item A "Objective." Item A, "Objective," of DCD Section 14.2.12.2.1.5, "Rod Drop Time Measurement Test," addresses full-flow and no-flow conditions, but does not mention hot or cold flow conditions. Hot and cold flow conditions are mentioned in Item C, "Test Method," in DCD Section 14.2.12.2.1.5.C.3, but should also be documented in Item A "Objective." In a July 31, 2008, response to **RAI 28-478, Question 14.02-18** the applicant proposed to revise the objective language to include testing at hot and cold temperature conditions. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 28-478, Question 14.02-18**, **resolved and closed**.

RG 1.68, Appendix A recommends that prior to initial criticality, "reactor coolant system flow tests [be performed] to establish that (i) vibration levels are acceptable, (ii) differential pressures across the fully loaded core and major components in the reactor coolant system are in accordance with design values, and (iii) piping reactions to transient conditions (e.g., pump starting and stopping) and flows are as predicted for all allowable combinations of pump operation." DCD Section 14.2.12.2.1 did not contain a test abstract regarding reactor coolant system flow tests. The applicant lists an exception as follows to this test in DCD Table 14A-1, Revision 3, Item 2.f: vibration testing is not performed with fuel loaded. The applicant justifies the exception based on Topical Report MUAP-07027-P, Revision 0, "Comprehensive V Assessment Program for US-APWR Reactor Internals," and RG 1.20, "Comprehensive Vibration Assessment Program for Reactor Internals During Preoperational and Initial S Testing." This is acceptable.

Technical Comment:
The current version of this report is Rev. 2, but at the time of DCD Rev. 3 the current version was Rev. 1.

The staff finds that the initial fuel load and precritical test abstracts meet the guidance in SRP Section 14.2 and RG 1.68 and are, therefore, acceptable.

Thus, the staff concludes that initial fuel load and precritical testing prerequisites, precautions, general test methods, and performance and acceptance criteria are sufficient to test the SSCs important to safety during the initial criticality phase of the initial test program.

14.2.12.4.3 Initial Criticality Tests

The staff reviewed the following US-APWR initial criticality test abstracts in the DCD, Revision 3:

14.2.12.2.2.1 Initial Criticality Test Sequence

14.2.12.2.2.2 Initial Criticality

14.2.12.2.2.3 Determination of Core Power Range for Physics Testing

RG 1.68, Appendix A, Section 3, “Initial Criticality,” provides recommendations for conducting initial criticality testing, including control of core reactivity and monitoring of core performance. The staff finds that the initial criticality test abstracts meet the guidance in SRP Section 14.2 and RG 1.68 and are, therefore, acceptable.

Thus, the staff concludes that initial criticality testing prerequisites, precautions, general test methods, and performance and acceptance criteria are sufficient to test the SSCs important to safety during the initial criticality phase of the initial test program.

14.2.12.4.4 Low-power Testing

The staff reviewed the following US-APWR low-power test abstracts in the DCD, Revision 3:

14.2.12.2.3.1 Low Power Test Sequence

14.2.12.2.3.2 Boron Endpoint Determination Test

14.2.12.2.3.3 Isothermal Temperature Coefficient Measurement Test

14.2.12.2.3.4 RCCA Bank Worth Measurement at Zero Power Test

14.2.12.2.3.5 Pseudo Rod Ejection Test

14.2.12.2.3.6 Operational Alignment of Nuclear Instrumentation Test

14.2.12.2.3.7 Dynamic Automatic Turbine Bypass Control Test

14.2.12.2.3.8 Pressurizer Heater and Spray Capability and Continuous Spray Flow Verification Test

14.2.12.2.3.9 Natural Circulation Test

14.2.12.2.3.10 Automatic Low Power SG Water Level Control Test

RG 1.68, Appendix A, Section 4, “Low-Power Testing,” provides recommendations for conducting low-power testing (normally at less than 5 percent power). The low-power test program should confirm the design, and to the extent practical, validate the analytical models and verify the correctness or conservatism of assumptions used in the safety analysis report.

Additionally, the low-power test program should also confirm the operability of plant systems and design features that could not be adequately tested during the preoperational test phase because of a lack of an adequate heat source for the reactor coolant system.

The low-power test recommendations described in RG 1.68, Appendix A, are cross-referenced to the DCD, Revision 3, low-power test abstracts using DCD, Revision 3, Table 14A-1. Several of the recommended RG 1.68 low-power tests are repeated at various power levels during the power ascension tests. In this case, the test abstracts are included with the power ascension tests and are so noted in DCD, Revision 3, Table 14A-1. For these cases, the test abstract objectives and/or the test methods include a note to conduct the test at 0 percent power, as well as at the applicable higher power level. The staff considers this an acceptable method for specifying the recommended low-power tests. This applicant applied this methodology to:

- Flux map test
- Biological shield survey test
- Primary and secondary chemistry test
- Ventilation capability test
- Remote shutdown test

The applicant is combining the recommended testing at low-power of the process and effluent radiation monitoring function with the power ascension test of the system as noted in DCD, Revision 3, Table 14A-1. The test abstract is outlined in DCD, Revision 3, Section 14.12.2.4.13. Pre-operational testing will have been previously performed on the system equipment during the pre-operational testing as described in DCD, Revision 3, Section 14.2.12.1.78. RG 1.68, Appendix A, states that the low-power testing of the process and effluent radiation monitoring functions should be verified by laboratory analyses of system samples to the extent possible [emphasis added]. This will be more effective after power operation. The staff accepts the combination of the low-power and power ascension tests on the process and effluent radiation monitoring functions based on acceptable pre-operational testing and the expectation of a short time frame between low-power testing and power ascension testing.

The applicant took exception to the low-power demonstration of the operability of the main and branch steamline valves and bypass valves used for protective isolation functions at rated temperature and pressure conditions recommended in RG 1.68, Appendix A. The applicant noted in DCD, Revision 3, Table 14A-1, Item 4.l, that: “the response time will not be measured because the main steam isolation valves (MSIVs) will be verified during hot functional and preoperational testing. In addition, the operability will be demonstrated during the startup test.” The staff finds that the intent of the low-power testing of the main and branch steamline valves is met by the pre-operational testing and that the exception is valid.

The applicant took exception to the demonstration of the operability of the control room computer system recommended in RG 1.68, Appendix A. The applicant noted in DCD, Revision 3, Table 14A-1, Item 4.n, that the designed “self-diagnostic feature assures the operability of the computer system. And the performance of the communication among computer systems is assured by the administrative control for the software and self-diagnosis function. Therefore this test provides no significant results.” Based on acceptance of the plant computer system self-diagnostic feature and the continuous use of the plant computer system, the staff finds that the intent of the recommended low-power test of the plant computer is met and that the exception is valid.

The staff finds that the low-power test abstracts meet the guidance in SRP Section 14.2 and RG 1.68 and are, therefore, acceptable.

Thus, the staff concludes that low-power testing prerequisites, precautions, general test methods, and performance and acceptance criteria are sufficient to test the SSCs important to safety during the initial criticality phase of the initial test program.

14.2.12.4.5 Power Ascension Tests

The staff reviewed the following US-APWR power ascension test abstracts in the DCD, Revision 3:

14.2.12.2.4.1 Power Ascension Test Sequence

14.2.12.2.4.2 Power Coefficient Determination Test

14.2.12.2.4.3 Axial Flux Difference Instrumentation Calibration Test and Axial Distribution Oscillation Test

14.2.12.2.4.4 Flux Map Test

14.2.12.2.4.5 RCCA Misalignment Measurement and Radial Power Distribution Oscillation Test

14.2.12.2.4.6 Remote Shutdown Test

14.2.12.2.4.7 Loose Parts Monitoring System Test (Continuation of 14.2.12.1.72)

14.2.12.2.4.8 Automatic Rod Control System Test

14.2.12.2.4.9 Operational Alignment of Process Temperature Instrumentation Test

14.2.12.2.4.10 Thermal Power Measurement and Statepoint Data Collection Test

14.2.12.2.4.11 Ventilation Capability Test

14.2.12.2.4.12 RCS Flow Measurement Test

14.2.12.2.4.13 Process and Effluent Radiation Monitoring System Test

14.2.12.2.4.14 Primary and Secondary Chemistry Test

14.2.12.2.4.15 Biological Shield Survey Test

14.2.12.2.4.16 Load Swing Test

14.2.12.2.4.17 Loss of Offsite Power (LOOP) at Greater Than 10 percent Power Test

14.2.12.2.4.18 Plant Trip from 100 percent Power Test

14.2.12.2.4.19 100 percent Load Rejection Test

14.2.12.2.4.20 Dynamic Response Test

14.2.12.2.4.21 Ultimate Heat Sink Heat Rejection Capability Test

14.2.12.2.4.22 Automatic High Power SG Water Level Control Test

Editorial Comment:
The actual title of this section in DCD Rev. 3 is "Operational Alignment of Process Temperature Instrumentation at Power Test (Continuation of 14.2.12.2.1.14)".

RG 1.68, Appendix A, Section 5, “Power Ascension Tests,” provides recommendations for conducting low-power testing to demonstrate that the facility operates in accordance with its design, both during normal and steady-state conditions and, to the extent practical, during and

following anticipated transients. During power ascension, tests are performed to obtain operational data and to demonstrate the operational capabilities of the plant.

The "Operational Alignment of Process Temperature Instrumentation Test" described in DCD test abstract 14.2.12.2.4.9 addresses process temperature instrumentation in the power ascension test phase. The test abstract test method indicates that certain temperature measurements should be taken at isothermal conditions prior to criticality. The applicant did not initially include a precritical test abstract that requires the gathering of this data, nor was there a similar requirement listed in any of the existing precritical test abstracts.

In **RAI 28-478, Question 14.02-20**, the staff requested that the applicant include a separate precritical test in the DCD to perform the temperature alignments at isothermal conditions prior to criticality and at approximately 75 percent power. In a July 31, 2008, response to **RAI 28-478, Question 14.02-20**, the applicant proposed to add a separate startup test to the DCD, to perform the temperature alignments at isothermal conditions prior to criticality and removed the precritical references from DCD test abstract 14.2.12.2.4.9. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 28-478, Question 14.02-20**, **resolved and closed**.

RG 1.68, Appendix A recommends a test to demonstrate that gaseous and liquid radioactive waste processing, storage, and release systems operate in accordance with design. The applicant took exception to this test as noted in DCD, Revision 3, Table 14A-1, Item 5.c, by stating that: "the gaseous and liquid radwaste systems will be tested as described in the gaseous waste processing system preoperational test abstract and the liquid waste processing system preoperational test abstract."

In **RAI 28-478, Question 14.02-21**, the staff requested that the applicant to provide evidence to document the assertion in DCD Table 14A-1 that: "Performance of these tests during the power ascension test phase would produce the same results as testing during the preoperational test phase" or revise the DCD to specify that these tests be performed at-power. In a July 31, 2008, response to **RAI 28-478, Question 14.02-21** the applicant provided explanation that the performance of these tests during the power ascension test phase would produce the same results as testing during the preoperational test phase. From the standpoint of confirming system purification performance, the Process and Effluent Radiation Monitoring System Test during the power ascension tests will provide verification of system purification performance. From above mentioned reason, the applicant understands the test of the gaseous and liquid radwaste systems during power ascension tests is not necessary if the preoperational test is performed. The staff finds the applicant response is acceptable. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, considers **RAI 28-478, Question 14.02-21**, **resolved and closed**.

RG 1.68.2, "Initial Startup Test Program to Demonstrate Remote Shutdown Capability for Water-Cooled Nuclear Power Plants," provides NRC guidance for startup test program demonstration of remote shutdown capability. The "Remote Shutdown Test" described in DCD test abstract 14.2.12.2.4.6, "Remote Shutdown Test" initially did not reference RG 1.68.2. Since DCD Table 1.9.1-1 commits to RG 1.68.2, "Initial Startup Test Program To Demonstrate Remote Shutdown Capability for Water-Cooled Nuclear Power Plants" with no exceptions, the test abstract was expected to reference RG 1.68.2.

In **RAI 28-478, Question 14.02-22**, the staff requested that the applicant revise DCD Section 14.2.12.1.76, "Remote Shutdown Preoperational Test" and DCD Section 14.2.12.2.4.6 to reference RG 1.68.2 or include the necessary information in each test to ensure that all aspects of the RG are addressed. In a July 31, 2008 response to **RAI 28-478, Question 14.02-22**, the applicant proposed to revise DCD test abstract 14.2.12.1.76 and DCD test abstract 14.2.12.2.4.6 to reference RG 1.68.2. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 28-478, Question 14.02-22**, **resolved and closed**.

A demonstration of the design capability of all systems and components provided to remove residual or decay heat from the RCS is required by RG 1.68, Appendix A, Item 5.l. This would explicitly include the residual heat removal (RHR) system. The applicant noted in DCD Table 14A-1 for test Item 5.l that the RHR capability will be demonstrated by DCD test abstract 14.2.12.2.4.6, "Remote Shutdown Test." This test demonstrates, in part, the capability to achieve and maintain the plant in hot standby condition for a minimum of 30 minutes. Hot Standby is identified as greater than or equal to 350°F per Technical Specification Table 1.1-1, "MODES," in DCD Chapter 16. However, RHR is not placed into operation until reactor coolant temperature and pressure are reduced to approximately 350°F and 400 psig, respectively per DCD Chapter 5. Therefore, it was not clear how the RHR system function would be demonstrated by DCD test abstract 14.2.12.2.4.6. The following RAI was issued to document and clarify this issue:

In **RAI 78-1190, Question 14.02-88** and **RAI 194-2034, Question 14.02-108**, the staff requested that the applicant provide additional information to indicate how the RHR decay heat removal function will be demonstrated during the "Remote Shutdown Test" described in DCD Section 14.2.12.2.4.6. RG 1.68, App A.5.l states in part that the design capability of all systems and components provided to remove residual or decay heat from the RCS, including the turbine bypass system, atmospheric steam dump valves, RHR system in steam condensing mode, and auxiliary feedwater system be demonstrated. US-APWR DCD Table 14A-1 (page 14A-18) indicates that the "Remote Shutdown Test" will meet the requirement provided in RG 1.68, App A.5.l. The "Remote Shutdown Test" demonstrates, in part, the capability to achieve and maintain the plant in hot standby condition for a minimum of 30 minutes. However, Hot Standby is identified as greater than or equal to 350°F per Technical Specification Table 1.1-1, "MODES," in DCD Chapter 16, and RHR is not placed into operation until reactor coolant temperature and pressure are reduced to approximately 350°F and 400 psig, respectively per DCD Chapter 5. The staff also requested that the applicant revise DCD Section 14.2.12.2.4.6 to specifically note that RHR decay heat removal capability must be demonstrated or a separate test for this functional demonstration should be identified. This may require an endpoint change in DCD Section 14.2.12.2.4.6 from MODE 3, Hot Standby to MODE 4, Hot Shutdown (per TS mode definitions hot shutdown is 350ºF > Tavg > 200ºF). The staff further requested that the applicant revise startup test 14.2.12.2.4.6 to include a demonstration of RCS cooldown by using the RHR system to hot shutdown conditions. The applicant agreed to revise the test per the RAI and provided draft changes to the DCD. However, the proposed DCD change is inconsistent in that the Objective change states that the test will demonstrate cooldown to cold shutdown, while the test method and acceptance criteria go to hot shutdown.

In an October 16, 2008, response to **RAI 78-1190, Question 14.02-88**, and a February 24, 2009, response to **RAI 194-2034, Question 14.02-108**, the applicant revised DCD Section 14.2.12.2.4.6 to show the potential capability to cool to cold shutdown by a 50 degree cooldown using the RHR system from 350 degrees to about 300 degrees. The staff finds the proposed DCD revisions are consistent with the guidance contained in RG 1.68, and are therefore acceptable. The staff confirmed that the DCD 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 78-1190, Question 14.02-88** and **RAI 194-2034, Question 14.02-108**, **resolved and closed**.

The applicant took exception to checking rod scram times from data recorded during scrams that occur during the startup test phase to determine that the scram times remain within allowable limits as recommended in RG 1.68, Appendix A. The applicant notes in DCD, Revision 3, Table 14A-1, Item 5.h, that "rod drop times are measured during pre-critical testing at hot full-flow conditions. There is no provision in the design of US-APWR to allow for determination of rod scram times following normal plant trips. These tests meet the intent of this item." The staff agrees with the applicant and finds that the exception is valid.

The applicant took exception to verifying by review and evaluation of printouts and/or cathode ray tube (CRT) displays that the control room or process computer is receiving correct inputs from process variables, and validating that performance calculations performed by the computer are correct as recommended in RG 1.68, Appendix A. The applicant noted in DCD, Revision 3, Table 14A-1, Item 5.r, that "self-diagnostic feature assures the operability of the computer system. And the performance of the communication among computer systems is assured by the administrative control for the software and self-diagnosis function. Therefore, this test provides no significant results." This is similar to the exception discussed previously regarding the low-power test of the plant computer. The staff agrees with the applicant and finds that the exception is valid.

The applicant took exception to verifying the automatic operation of the boron addition systems and emergency feedwater control systems as recommended in RG 1.68, Appendix A. The applicant noted in DCD, Revision 3, Table 14A-1, Item 5.s, that: "the verification of the boron addition systems and emergency feedwater control systems are not performed because the control of these systems is performed by manual control." DCD test abstract 14.2.12.1.12, "Chemical and Volume Control System (CVCS) Preoperational Test – Boric Acid Blending," verifies the ability of the boric acid blender to manually make up at design flow rates and boric acid concentrations. DCD test abstracts 14.2.12.1.24, "Motor-Driven Emergency Feedwater System Preoperational Test," and 14.2.12.1.25, "Turbine-Driven Emergency Feedwater System Preoperational Test," demonstrates the ability of the emergency feedwater system to manually supply feedwater to the SGs. The staff agrees with the applicant and finds that the exception is valid.

The applicant took exception to verifying the operability and response times of main and branch steamline isolation valves and demonstration of the dynamic response of the plant during full load rejection as recommended in RG 1.68, Appendix A. The applicant noted in DCD, Revision 3, Table 14A-1, that "the operability test of main steam isolation valves (item u) and the demonstration of the dynamic response of the plant (item mm) are not performed because similar results are obtained when the turbine trip from 100 percent power test is performed. The closure times for the main steam isolation valves is verified during hot functional and preoperational testing." The staff agrees with the applicant and finds that the exception is valid.

The applicant took exception to demonstrating that the method for initiating the pump trip or control valve closure should result in the fastest credible coastdown in flow for the system as recommended in RG 1.68, Appendix A. The applicant noted in DCD, Revision 3, Table 14A-1, Item 5.ii, that "the complete loss of flow at full-power test will not be performed. Results for RCS flow rates obtained in the flow coastdown test will verify that the RCS flow rates assumed in safety analysis (related to Chapter 15) are conservative." The required data will be obtained through another schedule test. Therefore, the staff agrees with the applicant and finds that the exception is valid.

The applicant took exception to demonstrating that the dynamic response of the plant is in accordance with design for the loss or bypass of the feedwater heater(s) from a credible single failure or operator error that would result in the most severe case of feedwater temperature reduction as recommended in RG 1.68, Appendix A. The applicant noted in DCD, Revision 3, Table 14A-1, Item 5.kk, that "the loss of or bypass of feedwater heaters test will not be performed because US APWR does not have the bypass line for feedwater heaters and feedwater temperature reduction by the loss of feedwater heater is not occurred from a credible single failure or operator error." The test exception is based on the plant design. Therefore, the staff agrees with the applicant and finds that the exception is valid.

In its response to **RAI 804-5938, Question 3.12-29**, dated November 25, 2011, the applicant proposed revisions to DCD Sections 3.12 and 14.2. The revisions included a new power ascension test, No. 14.2.12.2.4.23, titled "Confirmation of the Top Location of the Cavity Flow." The test abstract conforms to the technical discussion in Section 3.12.5.9, "Thermal Oscillations in Piping Connected to the Reactor Coolant System" and is acceptable.

The staff finds that the power ascension test abstracts meet the guidance in SRP Section 14.2 and RG 1.68 and are, therefore, acceptable.

Thus, the staff concludes that power ascension testing prerequisites, precautions, general test methods, and performance and acceptance criteria are sufficient to test the SSCs important to safety during the initial criticality phase of the initial test program.

The staff review also addressed the identification of one COL Information Item for the COL applicant, namely Item 14.2(10):

The COL applicant is responsible for the testing outside scope of the certified design in accordance with the test criteria described in DCD Section 14.2.1.

Editorial Comment:
In all other places in the SE, when the staff quotes a COL Item it is formatted in indented italics.

14.2.12.5 Combined License Information Items

Section 14.2 refers to various aspects of the test program that are the responsibility of the COL applicant or licensee, and DCD Revision 3, Section 14.2.13, contains the complete list. DCD Revision 3 identified the COL Item 14.2(10) relating to testing outside the scope of the certified design, as noted below.

Table 14.2.12-1 US-APWR Combined License Information Items		
Item No.	**Description**	**Section**
14.2(10)	The COL Applicant is responsible for the testing outside scope of the certified design in accordance with the test criteria described in Subsection 14.2.1.	14.2.12

During the review, the staff identified some issues with COL Items and submitted **RAI 271-2292, Question 14.02-114**, which requested revisions to the COL Items. Some of these changes resulted in the submission and review of MUAP-08009. This document addresses areas that had been the subject of the COL Items. This resulted in the deletion of some COL items and revision of others. These COL Items are discussed in the pertinent sections of the SER and are not repeated here.

14.2.12.6 Conclusions

The staff concludes that the information provided in Section 14.2.12 of the US-APWR DCD, Revision 3, adequately describes the US-APWR individual tests. The staff has compared the information in the application to the relevant NRC regulations, acceptance criteria defined in SRP Section 14.2, and other NRC RGs and concludes that the applicant is in compliance with the NRC regulations.

The staff has reviewed the information provided in the DCD 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) responsibilities, authorities, and qualifications; 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 except for the confirmatory items discussed above, 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.

14.3 Inspections, Tests, Analyses, and Acceptance Criteria

14.3.0.1 Introduction

This section describes the staff evaluation of the DCD Tier 1 for the US-APWR design and the review of the applicant's bases, processes, and selection criteria used to develop the Tier 1 material. It addresses the technical adequacy and completeness of the ITAAC given in DCD Tier 1. Specifically, staff reviewed of DCD Tier 1 for the type of information and the level

of detail as discussed in SRP 14.3, which states in part that the Tier 1 information is based on a graded approach commensurate with the safety significance of the structures, systems, and components (SSCs) for the design. It describes the evaluation of information contained in DCD Tier 2, Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria," and DCD Tier 1.

The Tier 1 information is derived from the US-APWR Tier 2 information. Specifically, this information includes the following:

- Definitions and general provisions
- Design descriptions
- ITAAC
- Significant site parameters
- Significant interface requirements

The applicant intends to have this Tier 1 information certified in a Design Certification (DC) rulemaking pursuant to Subpart B of 10 CFR Part 52. To be certified, the Tier 1 information must verify the complete scope of the US-APWR design and that the regulations applicable to the US-APWR scope of design are met. The amount of information in the Tier 1 design descriptions is proportional to the safety significance of the structures and systems in the standard plant design. The Tier 1 design descriptions are binding requirements for the life of a facility referencing the certified design.

The purpose of the ITAAC portion of the Tier 1 information is to verify that a facility referencing the DC is built and operates in accordance with the certified design and applicable regulations. The principle performance characteristics and safety functions of the SSCs are verified by the appropriate ITAAC.

The following table details the different aspects of the US-APWR design described by the applicant and the relationship between the DCD section numbers, NUREG-0800 (SRP) section numbers, and the DCD SER sections.

Table 14.3-1

Description	DCD Tier 1 Section	DCD Tier 2 Section	NUREG-0800 Section	SER Section
ITAAC for Site Parameters	2.1	14.3.4.1	2.0	Chapter 2
ITAAC for Structural and Systems Engineering	2.2	14.3.4.2	14.3.2	14.3.4.2
ITAAC for Piping Systems and Components	2.3	14.3.4.3	14.3.3	14.3.4.3
ITAAC for Reactor Systems	2.4	14.3.4.4	14.3.4	14.3.4.4
ITAAC for Instrumentation and Controls	2.5	14.3.4.5	14.3.5	14.3.4.5
ITAAC for Electrical Systems	2.6	14.3.4.6	14.3.6	14.3.4.6

Description	DCD Tier 1 Section	DCD Tier 2 Section	NUREG-0800 Section	SER Section
ITAAC for Plant Systems	2.7	14.3.4.7	14.3.7	14.3.4.7
ITAAC for Radiation Protection	2.8	14.3.4.8	14.3.8	14.3.4.8
ITAAC for Human Factors Engineering	2.9	14.3.4.9	14.3.9	14.3.4.9
ITAAC for Emergency Planning	2.10	14.3.4.10	14.3.10	14.3.4.10
ITAAC for Containment Systems	2.11	14.3.4.11	14.3.11	14.3.4.11
ITAAC for Physical Security Hardware	2.12	14.3.4.12	14.3.12	14.3.4.12
ITAAC for the Design Reliability Assurance Program	2.13	14.3.4.13	17.4	14.3.4.13
ITAAC for the Initial Test Program	2.14	14.3.4.14	14.2	14.2
Interface Requirements	3.0	14.3.5		

The staff evaluation of DCD Tier 2 Section 14.3.4.1, "ITAAC for Site Parameters," and corresponding DCD Tier 1 section 2.1 are included in Chapter 2.0 safety evaluation and do not have an ITAAC. The staff evaluation of DCD Tier 2 Section 14.3.4.14, "ITAAC for the Initial Test Program," and corresponding DCD Tier 1 Section 2.14 are included in the Section 14.2 safety evaluation and do not have any ITAAC. The staff evaluation of DCD Tier 2 Section 14.3.4.13, "ITAAC for Design Reliability Assurance Program" and corresponding DCD Tier1 Section 2.13 are included in the DCD Chapter 19 SE based on the guidance in SRP chapter 19. The staff notes that the general evaluation of EQ-related ITAAC is provided in Section 3.11.4.2 of this report. The staff evaluation of EQ-related ITAAC for specific systems is provided in the other sections of 14.3 of this report.

14.3.0.2 Summary of Application

DCD Tier 1: The Tier 1 information associated with Section 14.3 is discussed in the following SER sections that evaluate the different aspects of the US-APWR standard design

DCD Tier 2: The applicant has provided a Tier 2 design description in DCD Section 14.3, summarized here in part, as follows:

> This purpose of this section is to describe the bases, processes, and selection criteria used to develop the Tier 1 material (i.e., information), with emphasis on the level of detail provided in Tier 1. To this end, this section describes each section of the Tier 1 document and discusses its development.

ITAAC: The ITAAC associated with this section are discussed in the following SER sections that evaluate the different aspects of the US-APWR standard design as shown in Table 14.3-1.

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

COL information or action items: See Section 14.3.5 below.

Technical Report(s): There are no technical reports associated with this area of review.

Topical Report(s): There are no topical reports associated with this area of review.

US-APWR Interface Issues identified in the DCD: There are no US-APWR interface issues associated with this area of review.

Site Interface Requirements Identified in the DCD: There are no site interface requirements associated with this area of review.

Cross-cutting Requirements (TMI, USI/GSI, Op Ex): There are no cross-cutting issues for this area of review.

RTNSS: There are no RTNSS issues for this area of review.

10 CFR 20.1406: There are no issues related to 10 CFR 20.1406 for this area of review.

14.3.0.3 Regulatory Basis

The relevant requirements of the Commission's regulations for this area of review, and the associated acceptance criteria, are given in Section 14.3 of NUREG-0800, and are summarized below. Review interfaces with other SRP sections can be found in Section 14.3 of NUREG-0800. Acceptance criteria are based on meeting the relevant requirements of the following Commission regulations:

1. 10 CFR 52.47(b)(1), which requires that a DC application include 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 DC has been constructed and should operate in accordance with the DC, the provisions of the Atomic Energy Act, and the NRC's regulations.

2. 10 CFR 52.47(a)(26), which requires that a DC application provide 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.

Specific SRP acceptance criteria acceptable to meet the relevant requirements of the NRC's regulations identified above can be found in Part II of Section 14.3 of NUREG-0800.

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 US-APWR DCD. 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 DCD Tier 2, Section 14.3, the applicant provided the selection criteria and processes used to develop DCD Tier 1 ITAAC. The DCD 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 US-APWR rule.

14.3.0.4 Technical Evaluation

The staff reviewed DCD Tier 2, Section 14.3 for compliance with the guidance contained in SRP Section 14.3. Specifically, the staff reviewed the following Tier 1 information: Definitions and General provisions, Design descriptions, ITAAC, and Interface requirements. This section describes the staff's evaluation of the DCD Tier 1 information, which is derived from the DCD Tier 2 information.

The Tier 1 information in the US-APWR standard design is provided to the NRC for the design certification rulemaking pursuant to 10 CFR Part 52, Subpart B. To be certified, the DCD Tier 1 information must describe the US-APWR design and verify that the regulations applicable to the US-APWR design are met. The type of information and the level of detail in Tier 1 are based on a graded approach commensurate with the safety significance of the SSCs for the design as discussed in Section 14.3 of NUREG-0800. The DCD Tier 1 design descriptions and related ITAAC describes the scope of the certified design and are binding for COL applicant referencing the certified design.

The staff reviewed the DCD 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 DCD Tier 1 information in a manner similar to that used for the evolutionary designs, as described in SRP Section 14.3 as follows:

- Chapter 1.0, "Introduction," provides definitions and General Provisions applicable to the Design Descriptions and associated ITAAC.

- Chapter 2.0, "Design Description and ITAAC," provides the site parameters, Design Descriptions, and inspections, tests, analyses, and acceptance criteria (ITAAC) for the different aspects of the US-APWR standard design.

- Chapter 3.0, "Interface Requirements," provides the safety significant interface requirements between the US-APWR standard plant design and the site-specific design.

An inspectability review was performed of the Tier 1 ITAAC provided in Revision 3 of the DCD. The review primarily focused on the clarity, quality and inspectability of the ITAAC and guidance in Regulatory Issue Summary (RIS) 2008-05, Revision 1, dated September 23, 2010 (ADAMS Accession No. ML102500244). As a result of the staff's review, the following 8 RAIs totaling 105 questions were issued:

RAI 934-6458 (SRP 14.3.2, 5 Questions), **RAI 935-6464** (SRP 14.3.3, 1 Question), **RAI 936-6466** (SRP 14.3.5, 19 Questions), **RAI 937-6478** (SRP 14.3.11, 8 Questions), **RAI 941-6465** (SRP 14.3.4, 13 Questions), **RAI 942-6476** (SRP 14.3.7, 33 Questions), **RAI 945-6452** (SRP 14.3, 11 Questions), and **RAI 946-6475** (SRP 14.3.6, 15 Questions)

In **RAI 945-6452, Question 14.03-5**, the staff explained that Numerous ITAAC verifies that "Controls are provided in the MCR to open and close the remotely operated valves identified in Table XXX." The staff requested that the applicant provide specificity as to which controls in the MCR are to be used including ITAAC for starting and stopping pumps. The applicant in response to **RAI 945-6452, Question 14.03-5**, dated April 3, 2013, explained that the descriptions in all the DCD Tier 1 ITAAC which identify MCR as location of "controls" for open and close of remotely operated valves or starting and stopping of pumps will be revised to identify the name of the display unit which controls are used for verification of the design commitment of the ITAAC. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised the descriptions in all the DCD Tier 1 ITAAC which identify MCR as location of "controls" for open and close of remotely operated valves or starting and stopping of pumps. Therefore, **RAI 945-6452, Question 14.03-5** will be tracked as **Confirmatory Item 14.03-1** pending the verification of DCD Revision 4.

In **RAI 945-6452, Question 14.03-6**, the staff explained that Numerous ITAAC verify that “Alarms and displays identified in Table XXX are provided in the MCR,” and asked whether the ITAACs were meant to verify the information is retrievable on each display unit, the Safety VDUs, or the Alarm VDU. The applicant in response to **RAI 945-6452, Question 14.03-6**, dated April 3, 2013, explained that the descriptions in the DCD Tier 1 ITAAC which identify "alarms" and/or "displays" in the MCR will be revised to provide clarity by separating the "alarms" and "displays" into its own ITAAC and identify the name of the display unit used for verification of the design commitment of the ITAAC. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised the DCD Tier 1 ITAAC which identify “alarms and/or “displays” in the MCR to provide clarity by separating the “alarms” and “displays” into its own ITAAC. Therefore, **RAI 945-6452, Question 14.03-6** will be tracked as **Confirmatory Item 14.03-2** pending the verification of DCD Revision 4.

In **RAI 945-6452, Question 14.03-7**, the staff explained that Numerous ITAAC verify that Controls are provided in the remote shutdown console (RSC) to open and close the remotely operated valves identified in Table XXX, and asked the applicant to provide specificity as to which controls in the RSC are to be used including ITAAC for starting and stopping pumps. The applicant in response to **RAI 945-6452, Question 14.03-7**, dated April 3, 2013, explained that descriptions in the DCD Tier 1 ITAAC which identify RSC "controls" for opening and closing of remotely operated valves or starting and stopping of pumps will be revised to identify the name of the display unit which controls are used for verification of the design commitment of the ITAAC. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised the DCD Tier 1 ITAAC which identify RSC “controls” for opening and closing of remotely operated valves or starting and stopping of pumps to identify the name of the display unit. Therefore, **RAI 945-6452, Question 14.03-7** will be tracked as **Confirmatory Item 14.03-3** pending the verification of DCD Revision 4.

In **RAI 945-6452, Question 14.03-8**, the staff explained that Numerous ITAAC verify that "Alarms and displays identified in Table XXX are provided in the RSC,” and that Information is displayed in the RSC at several locations on various safety and operational video display units (S-VDU, O-VDU), on the Large Panel Display (LDP) and the Alarm VDU. The staff asked whether the ITAAC was meant to verify the information is retrievable on each display unit, the Safety VDUs, or the Alarm VDU. The applicant in response to **RAI 945-6452, Question 14.03-8**, dated June 7, 2013 explained that the descriptions in the DCD Tier1 ITAAC which identify "alarms" and/or "displays" in the RSC will be revised to provide clarity by separating the

"alarms" and "displays" into its own ITAAC and identify the name of the display unit used for verification of the design commitment of the ITAAC. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised the DCD Tier 1 ITAAC which identify "alarms" and/or "displays" in the RSC to provide clarity by separating the "alarms" and "displays" into its own ITAAC and identified whether alarms were displayed on the O-VDU or S-VDU. Therefore, **RAI 945-6452, Question 14.03-8** will be tracked as **Confirmatory Item 14.03-4** pending the verification of DCD Revision 4.

In **RAI 945-6452, Question 14.03-9**, the staff explained that Numerous ITAAC verify that "the piping identified in Table XXX as designed to leak before breaking meets leak-before-break (LBB) criteria," or an evaluation is performed of the protection from the dynamic effects of a rupture of the line. The staff also stated that the ITAAC was not clear as written and implies the piping designed for LBB does not have to meet the LBB requirements and requested that the applicant clearly separate the two piping categories: a) piping designated for LBB and b) piping not designed for LBB, and their associated ITA and the AC. The applicant in response to **RAI 945-6452, Question 14.03-9**, dated June 7, 2013, agreed to make the following changes to address the staff's question:

> The ITA and AC for the system ITAAC addressing LBB verification (i.e., Table 2.4.2-5, ITAAC 16, Table 2.4.4-5 ITAAC 13, Table 2.4.5-5 ITAAC 14, and Table 2.7.1.2-5 ITAAC 12) will be clarified
>
> ITAAC Table 2.3-2, Item # 2.b will be deleted and the acceptance criteria relocated to the system ITAAC for LBB verification. Tier 2, Subsections 3.6.3, 3.6.3.4.9, 3.6.3.4.10, 3.6.3.4.13 and 3.6.3.5 will be revised to address the removal of this ITAAC and clarification of the system ITAAC as mentioned in the above bullet.
>
> Tier 2, Subsection 14.3.4.3 and Appendix 14B will be revised to remove the discussion of LBB from the explanation of the Design Acceptance Criteria (DAC) ITAAC closure process.

The staff reviewed the response and found that the response with the proposed Tier 1 and Tier 2 changes were acceptable because the applicant revised the appropriate DCD Tier 1 tables to designate systems and piping as LBB as candidates for the LBB evaluation. Staff also found the response acceptable because the applicant clarified that a pipe break hazard analyses report will show that there is protection from dynamic effects of a line break for systems and piping which do not meet the LBB criteria. Therefore, **RAI 945-6452, Question 14.03-9** will be tracked as **Confirmatory Item 14.03-5** pending the verification of DCD Revision 4.

In **RAI 945-6452, Question 14.03-10**, the staff asked the applicant to explain the basis for excluding the verification of each mechanical division related to Divisions A, B, C, & D inside containment for all of the relevant ITAACs. The applicant in response to **RAI 945-6452, Question 14.03-10**, dated September 18, 2012, agreed to revise the generic separation ITAAC acceptance criteria to specify that dynamic effects (i.e., missile and pipe break hazard) internal flooding and fire are considered for physical separation and to delete Generic statements in ITAAC that exclude portions of systems inside containment from the physical separations requirements, and to make other applicable changes to Tier 1 sections, ITAAC tables, and section tables. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised the acceptance criteria for the generic separation ITAAC to specify that dynamic effects, internal flooding and fire are

considered for physical separation. . Therefore, **RAI 945-6452, Question 14.03-10** will be tracked as **Confirmatory Item 14.03-6** pending the verification of DCD Revision 4.

In **RAI 945-6452, Question 14.03-11**, the staff asked the applicant to clearly define the extent of the I&C logic testing in Section 2.5, "Instrumentation and Controls" must be carried out. The applicant in response to **RAI 945-6452, Question 14.03-11**, dated June 7, 2013, agreed to revise the ITA and AC of the following ITAAC in Tier 1 Section 2.5 to address the staff's question:

> Table 2.5.1-6 ITAAC 4, Table 2.5.1-6 ITAAC 11, Table 2.5.1-6 ITAAC 14.a, Table 2.5.1-6 #14.b, Table 2.5.1-6 ITAAC 16, Table 2.5.1-6 ITAAC 17.b, Table 2.5.1-6 ITAAC 18, Table 2.5.1-6 ITAAC 23, Table 2.5.1-6 ITAAC 25.a, Table 2.5.1-6 ITAAC 25.b, Table 2.5.1-6 ITAAC 26, Table 2.5.1-6 ITAAC 27, Table 2.5.1-6 ITAAC 29.b, Table 2.5.1-6 ITAAC 31.i, Table 2.5.1-6 ITAAC 31.ii, Table 2.5.2-3 ITAAC 1, Table 2.5.2-3 ITAAC 7, Table 2.5.3-4 ITAAC 1 .c, Table 2.5.3-4 ITAAC 1 .d, Table 2.5.5-1 ITAAC 4

The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised the ITAAC tables above to clarify the scope of I&C logic testing. Therefore, **RAI 945-6452, Question 14.03-11** will be tracked as **Confirmatory Item 14.03-7** pending the verification of DCD Revision 4.

In **RAI 945-6452, Question 14.03-12** the staff indicated that I &C logic tests in Tier 1 Section 2.5 do not consistently specify the use of simulated test signals and requested that the applicant ensure the use of test signals is specified where their use is anticipated and/or desired. The applicant in response to **RAI 945-6452, Question 14.03-12**, dated September 18, 2012, agreed to revise the ITA and AC of the following ITAAC in Tier 1 Section 2.5 to address the staff's question:

> Table 2.5.1-6 ITAAC 14.a, Table 2.5.1-6 ITAAC 14.b, Table 2.5.1-6 ITAAC 17.a, Table 2.5.1-6 ITAAC 17.b, Table 2.5.1-6 ITAAC 18, Table 2.5.1-6 ITAAC 23, Table 2.5.1-6 ITAAC 25.a, Table 2.5.1-6 ITAAC 25.b, Table 2.5.1-6 ITAAC 26, Table 2.5.1-6 ITAAC 27, Table 2.5.1-6 ITAAC 31.i, Table 2.5.2-3 ITAAC 1, Table 2.5.3-4 ITAAC 1.d

The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 Section 2.5 ITAAC shown above to clarify the use of simulated test signals. Therefore, **RAI 945-6452, Question 14.03-12** will be tracked as **Confirmatory Item 14.03-8** pending the verification of DCD Revision 4.

In **RAI 945-6452, Question 14.03-13** the staff indicated that there were several examples identified where conflicts existed as to the environmental qualification (EQ) for harsh environmental conditions for components in the Tier 1 DCD equipment tables compared with the information provided in Tier 2, Appendix 3D. The applicant in response to **RAI 945-6452, Question 14.03-13**, dated September 18, 2012, agreed to revise a number of DCD Tier 1 tables to be consistent with the updated Tier 2, Table 3D-2, "US-APWR Environmental Qualification Equipment List". The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised the following DCD Tier 1 tables to make it consistent with Tier 2 Table 3D-2: Table 2.4.4-2, Table 2.4.5-2, Table 2.4.6-2, Table 2.7.1.11-2, Table 2.7.3.1-2, Table 2.7.3.3-2, Table 2.7.3.5-2, Table2.7.5.1-1,

Editorial Comment:
Missing space between word Table and the number.

Table2.7.5.2-1, Table2.7.5.4-1, Table 2.7.6.3-1, Table 2.7.6.7-1, Table 2.11.2-1 and Table 2.11.3-2. Therefore, **RAI 945-6452, Question 14.03-13** will be tracked as **Confirmatory Item 14.03-9** pending the verification of DCD Revision 4.

Editorial Comment:
Missing the closing quote marks.

In **RAI 934-6458, Question 14.03.02-20** the staff indicated that in Tier 1 DCD Revision 3, Table 2.2-4, ITAAC 1, the term "structural configurations is undefined and that The defined term "physical arrangement" should replace the undefined term in the ITAAC's design commitment (DC), inspection, tests, and analysis (ITA), and acceptance criteria (AC). The applicant in response to **RAI 934-6458, Question 14.03.02-20**, dated June 28, 2012 agreed to revise DCD Tier 1, Subsection 2.2.3.1 and Table 2.2-4, ITAAC 1 to replace the term "structural configuration" with "physical arrangement." The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant replaced the term "structural configuration" with "physical arrangement" in Tier 1 Table 2.2-4. Therefore, **RAI 934-6458, Question 14.03.02-20** will be tracked as **Confirmatory Item 14.03.02-1** pending the verification of DCD Revision 4.

Editorial Comment:
This should be a lower case letter "t".

Editorial Comment:
This should be Tier "1", not "I".

In **RAI 934-6458, Question 14.03.02-21** the staff indicated that in Tier I DCD Revision 3, Table 2.2-4, ITAAC 1, the second part of the ITAAC (i.e., verification of wall thickness) should be separate and clearly delineated in the Design Commitment (DC)/Inspection, Tests, and Analysis (ITA)/Acceptance Criteria (AC), perhaps as a new and separate ITAAC. The applicant in response to **RAI 934-6458, Question 14.03.02-21**, dated June 28, 2012 agreed to revise DCD Tier 1 Subsection 2.2.3.1 and Table 2.2-4, ITAAC 1 to separate the verification of wall and floor thicknesses from the verification of the physical arrangement of Reactor Building (R/B) and Power Source Building (PS/B) structures. Additionally, Table 2.2-2 was changed to state that the wall and floor concrete thickness values are nominal dimensions for clarification. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised DCD Tier 1 Subsection 2.2.3.1 and Table 2.2-4, Item 1 to separate the verification of wall and floor thicknesses from the verification of the physical arrangement of R/B and PS/B structures. Therefore, **RAI 934-6458, Question 14.03.02-21** will be tracked as **Confirmatory Item 14.03.02-2** pending the verification of DCD Revision 4.

In **RAI 934-6458, Question 14.03.02-22** the staff indicated that in Tier I DCD Revision 3, Table 2.2-4, ITAACs 5 and 6, that both ITAAC should include "Inspection" in the Inspection, Tests, and Analysis (ITA), such as "Inspection and Analysis will be performed..." The applicant in response to **RAI 934-6458, Question 14.03.02-22**, dated June 28, 2012 agreed to revise DCD Tier 1, Table 2.2-4, ITAACs 5 & 6 to include "inspection" in the ITA. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised DCD Tier 1, Table 2.2-4, Items 5 and 6 to include "inspection" in the ITA to address staff's concern. Therefore, **RAI 934-6458, Question 14.03.02-22** will be tracked as a **Confirmatory Item 14.03.02-3** pending the verification of DCD Revision 4.

In **RAI 934-6458, Question 14.03.02-23** the staff indicated that in Tier 1 DCD Revision 3, Table 2.2-4, ITAAC 14 references the "design basis flood level," while ITAAC 13 only references the "flood level" and questioned whether both ITAAC should reference the same safety-related "design basis flood." The staff also asked the applicant to specify the required flood level. The applicant in response to **RAI 934-6458, Question 14.03.02-23**, dated June 28, 2012 agreed to revise DCD Tier 1, Subsection 2.2.3.1 and Table 2.2-4, ITAAC 13 to replace the term "flood level" with "design basis flood level." The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised DCD Tier 1, Subsection 2.2.3.1 and Table 2.2-4, Item 13 to replace the term "flood level" with

"design basis flood level" to address staff's concern. Therefore, **RAI 934-6458, Question 14.03.02-23** will be tracked as **Confirmatory Item 14.03.02-4** pending the verification of DCD Revision 4.

In **RAI 934-6458, Question 14.03.02-24** the staff indicated that Tier 1 DCD Revision 3, Table 2.2-4, ITAAC 17, the "and" in the 3rd line from the bottom of the Acceptance Criteria should be deleted so it will just be "to preserve..." The applicant in response to **RAI 934-6458, Question 14.03.02-24**, dated June 28, 2012 agreed to revise DCD Tier 1, Table 2.2-4, ITAAC 17 to remove the word "and" in the 3rd line from the bottom of the Acceptance Criteria. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised DCD Tier 1, Table 2.2-4, Item 17 to remove the word "and" in the 3rd line from the bottom of the Acceptance Criteria to address staff's concern. Therefore, **RAI 934-6458, Question 14.03.02-24** will be tracked as **Confirmatory Item 14.03.02-5** pending the verification of DCD Revision 4.

In **RAI 941-6465, Question 14.03.04-49** the staff identified that Tier 1 Table 2.4.4-5, ITAAC 7.b.i.a - "The water volume injected from each accumulator into reactor vessel at large flow rate (prior to flow switching to small flow rate) is > 1326.8 ft^3," and that the acceptance criteria (AC) in the ITAAC is not consistent with the Tier 2 information which specifies > 1,342 ft^3. The applicant in response to **RAI 941-6465, Question 14.03.04-49**, dated September 5, 2012, agreed to revise DCD Tier 2, Subsection 6.3.2.2.2 and Table 6.3-5, and explained that DCD Tier 2, Rev. 3, Table 6.3-5 lists the (minimum) large flow injection volume as 1326.8 ft^3 with note explaining that the nominal large flow injection volume is 1,342 ft^3. Also, that the minimum large-flow injection volume includes a margin for water-level uncertainty in the switchover from large-flow injection to small-flow injection, as discussed in the advanced accumulator topical report (MUAP-07001). The staff reviewed the response and found that the response with the proposed Tier 1 and 2 changes were acceptable because the applicant revised DCD Tier 2, Subsection 6.3.2.2.2 and Table 6.3-5 and explained that DCD Tier 2, Rev. 3, Table 6.3-5 lists the (minimum) large flow injection volume as 1326.8 ft^3 and clarified that the nominal large flow injection volume is 1,342 ft^3 to address staff's concern. Therefore, **RAI 941-6465, Question 14.03.04-49** will be tracked as **Confirmatory Item 14.03.04-4** pending the submission of DCD Revision 4.

Editorial Comment:
This should be Tier "1", not "I".

In **RAI 936-6466, Question 14.03.05-33** the staff indicated that Tier 1 Table 2.5.1-6, ITAAC 1 & 2 should be deleted because the SRP 14.3 does not require a "functional arrangement" ITAAC for I&C systems, and the system is adequately verified by logic testing. The applicant in response to **RAI 936-6466, Question 14.03.05-33** dated January 24, 2013 agreed revise Tier 1 Table 2.5.1-6 ITAAC 1 and delete Tier I Table 2.5.1-6 ITAAC 2 and included Attachment 2 – Table 14.3-8 IEEE 603-1991 Compliance Matrix by DCD Tier 1 Section (Sheet 1 of 3). The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 Table 2.5.1-6 ITAAC 1 to require verification of the minimum number and locations of sensors required for protective purposes and that have a spatial dependence, as specified in SRP Section 14.3 Appendix C. therefore, **RAI 936-6466, Question 14.03.05-33** will be tracked as **Confirmatory Item 14.03.05-1** pending the verification of DCD Revision 4.

Editorial Comment:
This word should begin with a capital letter.

In **RAI 936-6466, Question 14.03.05-34** the staff indicated , Table 2.5.1-6, should be reworded for clarity and specificity. The applicant in response to **RAI 936-6466, Question 14.03.05-34** dated January 24, 2013 agreed to revise DCD Tier 1, Subsection 2.5.1.1 and Tier 1 Table 2.5.1-6, ITAAC 4 Design Commitment to read as "Conventional PSMS

switches on the operators console in the MCR can be used to provide manual initiation for reactor trip and ESF Manual Actuations identified in Tables 2.5.1-2 and 2.5.1-3." The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised the Design Commitment of Tier 1 Table 2.5.1-6 ITAAC 4 to clarify that the Conventional PSMS switches on the operators console in the MCR can be used to provide manual initiation for reactor trip and ESF Manual Actuations. Therefore, **RAI 936-6466, Question 14.03.05-34** will be tracked as **Confirmatory Item 14.03.05-2** pending the verification of DCD Revision 4.

In **RAI 936-6466, Question 14.03.05-35** the staff asked about what was included in the Reactor trip (RT) and engineered safety features (ESF) measurement instrumentation found in Tier 1 Table 2.5.1-1 The applicant in response to **RAI 936-6466, Question 14.03.05-35** dated January 24, 2013 explained what was included in the RT and ESF measurement instrumentation and agreed to revise to DCD Tier 1 Table 2.5.1-1. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised DCD Tier 1 Table 2.5.1-1 to add notes to clarify functions of the reactor trip measurement instrumentation and engineered safety feature measurement instrumentation. Therefore, **RAI 936-6466, Question 14.03.05-35** is tracked as **Confirmatory Item 14.03.05-3** pending the verification of DCD Revision 4.

In **RAI 936-6466, Question 14.03.05-36** the staff asked whether Analysis was required, include the field instruments, and whether these be subjected to accident related hazards in ITAAC 8 of Tier 1 Table 2.5.1-6. The applicant in response to **RAI 936-6466, Question 14.03.05-36** dated January 24, 2013 explained that Analysis will be performed to verify the ITA in conjunction with inspection results. Also, agreed to revise DCD Tier 1 Table 2.5.1-6, ITAAC 8, Inspections, Tests, Analyses (ITA) to include the analysis. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 Table 2.5.1-6, ITAAC 8 to include analysis to verify the ITA in conjunction with inspection results. Therefore, **RAI 936-6466, Question 14.03.05-36** will be tracked as **Confirmatory Item 14.03.05-4** pending the verification of DCD Revision 4.

In **RAI 936-6466, Question 14.03.05-37** staff indicated that in Tier 1 Table 2.5.1-6, ITAAC 9, verification of separate power sources should be by a test signal. The applicant in response to **RAI 936-6466, Question 14.03.05-37** dated January 24, 2013 agreed to revise the Inspections, Tests, Analyses of Tier 1 Table 2.5.1-6, ITAAC 9 to read as "Tests of the as-built PSMS equipment will be performed using simulated signals produced by actuation at the feeder." The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant clarified that the PSMS equipment in Tier 1 Table 2.5.1-1 is powered from two safety-related power sources and that Tier 2 Figure 7.1-4 will be used for closure of this ITAAC. Therefore, **RAI 936-6466, Question 14.03.05-37** will be tracked as **Confirmatory Item 14.03.05-5** pending the verification of DCD Revision 4.

In **RAI 936-6466, Question 14.03.05-38** the staff indicated that Tier 1 Table 2.5.1-6, ITAAC 11 should be reworded to clarify what is being verified, how it's being verified for consistency with Acceptance Criteria (AC). The applicant in response to **RAI 936-6466, Question 14.03.05-38** dated January 24, 2013 agreed to revise the AC to match the two parts of the Inspections, Tests, Analyses and the existing Design Commitment (DC) for Tier 1 Table 2.5.1-6 ITAAC 11. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 Table 2.5.1-6 ITAAC 11 to split the inspections, tests, and analysis (ITA) into two separate part to verify that tests are performed to

confirm the bypassed and inoperable status indication (BISI) and to verify that verify that tests are performed to confirm the BISI indication on the as-built LDP by manual operation of the BISI initiation switches. Therefore, **RAI 936-6466, Question 14.03.05-38** will be tracked as **Confirmatory Item 14.03.05-6** pending the verification of DCD Revision 4.

In **RAI 936-6466, Question 14.03.05-39** the staff asked whether a simulated signal was acceptable and to define the extent to which the test is carried through in Tier 1 Table 2.5.1-6, ITAAC 14.a & b. The applicant in response to **RAI 936-6466, Question 14.03.05-39** dated January 24, 2013 explained that The tests referred to in Tier 1 Table 2.5.1-6, ITAAC 14.a are the tests performed on the as-built PSMS using simulated signals of plant process signals, to verify that the Reactor Trip (RT) breakers open and the PSMS generates the output signals to actuate the engineered safety features (ESF) functions if the simulated plant process signals exceed the predetermined limits as identified in Table 2.5.1-2 and 2.5.1-3 respectively. The applicant also agreed to clarify the intent of ITAAC 14.b by dividing it into to 14.b.i, 14.b.ii, 14.c.i and 14.c.ii. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 Table 2.5.1-6, ITAAC 14.a & b to clarify that tests referred to in Tier 1 Table 2.5.1-6, ITAAC 14.a are the tests performed on the as-built PSMS using simulated signals of plant process signals, and that the tests referred to in 14.b.i will verify that the RT breakers remain open even after the simulated signals return to a level within the predetermined limits. Therefore, **RAI 936-6466, Question 14.03.05-39** will be tracked as **Confirmatory Item 14.03.05-7** pending the verification of DCD Revision 4.

In **RAI 936-6466, Question 14.03.05-40** the staff asked the applicant to clarify what the ITAAC (Tier 1 Table 2.5.1-6, - ITAAC 16) was intended to verify (e.g. the specific instruments are not identified, is this meant to be a simple cable check or are actual inputs from the field instruments to be verified?). The applicant in response to **RAI 936-6466, Question 14.03.05-40** dated April 18, 2013, stated that the test referred to in Tier 1 Table 2.5.1-6 ITAAC-16 will involve more than a simple cable check; it will verify the electrical connectivity between the PSMS input and the RT and ESF measurement instrumentation identified in Monitored Variables column of Tables 2.5.1-2 and 2.5.1-3. The applicant also agreed to revise DCD Tier 1 Section 2.5.1.1 and Tables 2.5.1-2 and 2.5.1-3 and Table 2.5.1-6, ITAAC 16. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 Table 2.5.1-6 ITAAC-16 to clarify that the ITAAC was intended to verify electrical continuity. Therefore, **RAI 936-6466, Question 14.03.05-40** will be tracked as **Confirmatory Item 14.03.05-8** pending the verification of DCD Revision 4.

In **RAI 936-6466, Question 14.03.05-41** the staff asked the applicant to clarify the term “Timely” and indicated that the Design Commitment (DC) and Acceptance Criteria (AC) should match for Tier 1 Table 2.5.1-6, ITAAC 17.a. The applicant in response to **RAI 936-6466, Question 14.03.05-41** dated January 24, 2013 agreed to revise the DC as "The PSMS has self-diagnostic functions to facilitate recognition, location, replacement, repair and adjustment of malfunctioning components or modules", the Inspection, Tests, Analyses to add "using simulated failure condition"; and the Acceptance Criteria to match DC in DCD Tier 1 Table 2.5.1-6 ITAAC 17.a for clarity. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 Table 2.5.1-6 ITAAC 17.a to delete the word “timely” to make both the Design Commitment and Acceptance Criteria consistent. Therefore, **RAI 936-6466, Question 14.03.05-41** will be tracked as **Confirmatory Item 14.03.05-9** pending the verification of DCD Revision 4.

In **RAI 936-6466, Question 14.03.05-42** the staff asked the applicant whether simulated signals were going to be used in Tier 1 Table 2.5.1-6, ITAAC 18 & 29.a. The applicant in response to **RAI 936-6466, Question 14.03.05-42** dated January 24, 2013 agreed to revise DCD Tier 1 Table 2.5.1-6, ITAAC 18 and to delete Table 2.5.1-6, ITAAC 29.a to address staff's question. The staff reviewed the response and found that the response with the proposed Tie were acceptable because the applicant revised ITAAC 2.5.1-6, ITAAC 18 and dele 29.a to clarify the use of the simulated signals. Therefore, **RAI 936-6466, Question 14.03.05-42** will be tracked as **Confirmatory Item 14.03.05-10** pending the verification of DCD Revision 4.

Editorial Comment:
This should be Tier "1", not "I".

In **RAI 936-6466, Question 14.03.05-43** the staff asked the applicant to define extent to which the test is carried through and whether simulated signals were acceptable for Tier I Table 2.5.1-6, ITAAC 29.b. The applicant in response to **RAI 936-6466, Question 14.03.05-42** dated January 24, 2013 agreed to revise DCD Tier 1 Table 2.5.1-6, ITAAC 29.b and explained that the test referred to in ITAAC 29.b involves verifying the protection and safety monitoring system (PSMS) generates output signals for ESF functions identified in Table 2.5.1-3 using conventional ESF manual actuation switches, under the condition of the RPS being offline. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 Table 2.5.1-6, ITAAC 29.b to clarify that the tests involves verifying the PSMS generates output signals for ESF functions identified in Table 2.5.1-3 using conventional ESF manual actuation switches. Therefore, **RAI 936-6466, Question 14.03.05-43** will be tracked as **Confirmatory Item 14.03.05-11** pending the verification of DCD Revision 4.

In **RAI 936-6466, Question 14.03.05-44** the staff asked the applicant whether Tier 1 Table 2.5.2-3, ITAAC 6 should be deleted since SRP 14.3 does not require "functional arrangement" ITAAC for I&C systems and the system is adequately verified by logic testing. The applicant in response to **RAI 936-6466, Question 14.03.05-44** dated April 18, 2013, stated that they will delete ITAAC 2.5.2-3 #6 because the physical/electrical separation of the SLS and HSIS is verified in existing ITAAC such as Table 2.5.1-6 ITAAC #8 and #10.a. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant deleted Tier 1 Table 2.5.2-3, ITAAC 6 to address staff's concern about "functional arrangement" ITAAC for I&C systems. Therefore, **RAI 936-6466, Question 14.03.05-44** will be tracked as **Confirmatory Item 14.03.05-12** pending the verification of DCD Revision 4.

In **RAI 936-6466, Question 14.03.05-45** the staff asked the applicant to define the extent to which the test in Tier 1 Table 2.5.2-3, ITAAC 7 is carried through. The applicant in response to **RAI 936-6466, Question 14.03.05-45** dated April 18, 2013, stated that he test referred to in this ITAAC is performed by initiating a manual trip at the safety VDU and operational VDU on the remote shutdown console (RSC) and verifying the PSMS generates output signals for the reactor trip and turbine trip functions. The applicant agreed to add Table 2.5.2-3 ITAAC 7, inspection, tests, and analysis (ITA) and acceptance criteria (AC) and a new ITAAC 8 and Table 2.5.1-6 ITAAC 4 to clarify the manual initiation testing for RT and ESF actuation identified in Table 2.5.1-3 from the safety and operational VDUs in the remote shutdown console. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 Table 2.5.2-3, ITAAC 7 to clarify that the test will be performed on the as-built PSMS by initiating a manual reactor trip at the as-built safety VDU on the as-built RSC. Therefore, **RAI 936-6466, Question 14.03.05-45** will be tracked as **Confirmatory Item 14.03.05-13** pending the verification of DCD Revision 4.

In **RAI 936-6466, Question 14.03.05-46** the staff indicated that Tier 1 Table 2.5.3-4, ITAAC 1 should be deleted because SRP 14.3 does not require a "functional arrangement" ITAAC for I&C systems and the system is adequately verified by testing. The applicant in response to **RAI 936-6466, Question 14.03.05-46** dated August 24, 2012, stated that Tier 1 Table 2.5.3-4, ITAAC 1 .a, which describes "functional arrangement", will be deleted. In addition, they will move the description of Tier 1 Figure 2.5.3-1, which is originally referred to in this deleted ITAAC, to Tier 1 Subsection 2.5.3.1 to describe the DAS configuration to be referred for the extent of tests for ITAACs such as 1 c and 1 d. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant deleted Tier 1 Table 2.5.3-4, ITAAC 1 to address staff's concern about "functional arrangement" ITAAC for I&C systems. Therefore, **RAI 936-6466, Question 14.03.05-46** will be tracked as **Confirmatory Item 14.03.05-14** pending the verification of DCD Revision 4.

In **RAI 936-6466, Question 14.03.05-47** the staff asked the applicant to define extent to which the test is carried through and to identify the location of the controls in Tier 1 Table 2.5.3-4, ITAAC 1 .c & 1.d. The applicant in response to **RAI 936-6466, Question 14.03.05-47** dated January 24, 2013 agreed to revise DCD Tier 1 Table 2.5.3-4, ITAAC 1 .c & 1.d and to add the description of Figure 2.5.3-1 in Tier 1 Subsection 2.5.3.1. The applicant and also explained that test referred to in ITAAC 1.c will be performed to verify the manual Diverse Actuation System (DAS) operation from the DHP and the test referred to in ITAAC 1.d will be performed to verify the automatic DAS operation. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 Table 2.5.3-4, ITAAC 1.c and 1.d to clarify the extent to which each test is carried through. Therefore, **RAI 936-6466, Question 14.03.05-47** will be tracked as **Confirmatory Item 14.03.05-15** pending the verification of DCD Revision 4.

In **RAI 936-6466, Question 14.03.05-48** the staff asked the applicant to specify seismic event referred to in the ITAAC, Tier 1 Table 2.5.3-4, ITAAC 1.e. The applicant in response to **RAI 936-6466, Question 14.03.05-48** dated January 24, 2013 explained that the term "seismic event" refers to the "Safe Shutdown Earthquake" (SSE) level event and agreed to replace the term "seismic event" in Tier 1 Table 2.5.3-4, ITAAC 1.e with "SSE". The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant changed the term "seismic event" to "Shutdown Earthquake" to clarify the seismic event in Tier 1 Table 2.5.3-4, ITAAC 1.e. Therefore, **RAI 936-6466, Question 14.03.05-48** will be tracked as **Confirmatory Item 14.03.05-16** pending the verification of DCD Revision 4.

In **RAI 936-6466, Question 14.03.05-49** the staff indicated that Tier 1 Table 2.5.5-1, ITAAC 1 should be deleted because SRP 14.3 does not require a "functional arrangement" ITAAC for I&C systems and the system is adequately verified by testing. The applicant in response to **RAI 936-6466, Question 14.03.05-49** dated August 24, 2012, stated that they will delete Tier 1 Table 2.5.5-1, ITAAC 1 and Tier 1 Table 2.5.5-2 referred to in ITAAC 1. The staff review the response determined that Tier 1 Table 2.5.5-1, ITAAC 1 should be modified to eliminate the use of functional arrangement and Tier 1 Tier 1 Table 2.5.5-2 should be modified. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant deleted Tier 1 Table 2.5.5-1, ITAAC 1 and eliminated the reference to functional arrangement. Therefore, **RAI 936-6466, Question 14.03.05-49** will be tracked as **Confirmatory Item 14.03.05-17** pending the verification of DCD Revision 4.

In **RAI 936-6466, Question 14.03.05-50** the staff asked the applicant whether Tier 1 Table 2.5.6-1, ITAAC 1 should be deleted since SRP 14.3 does not require "functional arrangement" ITAAC for I&C systems and the system is adequately verified by testing. The applicant in response to **RAI 936-6466, Question 14.03.05-50** dated April 18, 2013, stated that they will delete the ITAAC because existing ITAAC verifies physical configuration, separation and communication independence such as Table 2.5.6-1 ITAAC 3, 4 and 6. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant deleted Tier 1 Table 2.5.6-1, ITAAC 1 to address staff's question associated with the term "functional arrangement." Therefore, **RAI 936-6466, Question 14.03.05-50** will be tracked as **Confirmatory Item 14.03.05-18** pending the verification of DCD Revision 4.

In **RAI 936-6466, Question 14.03.05-51** the staff asked the applicant to add Analysis to the Inspections, Tests, Analyses (ITA) of ITAAC 4, in Tier 1 Table 2.5.6-1. The applicant in response to **RAI 936-6466, Question 14.03.05-51** dated January 24, 2013 agreed to revise ITA to read "Inspection and analyses will be performed on the safety-related portion of the as-built DCS equipment" and the Acceptance Criteria to add "A report exists and concludes that" in Tier 1 Table 2.5.6-1, ITAAC 4. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised ITA Table 2.5.6-1 to add analysis in addition to inspection. Therefore, **RAI 936-6466, Question 14.03.05-51** will be tracked as **Confirmatory Item 14.03.05-19** pending the verification of DCD Revision 4.

Editorial Comment:
This should be Tier "1", not "I".

In **RAI 946-6475, Question 14.03.06-29** the staff asked the applicant to clarify that swap only occurs if unit auxiliary transformer (UAT) bus power is available for ITAAC 6.b in Tier I Table 2.6.1-3. The applicant in response to **RAI 946-6475, Question 14.03.06-29** dated August 17, 2012 agreed to revise DCD Tier 1, Table 2.6.1-3, ITAAC 6.b inspection, tests, and analysis (ITA) and Acceptance Criteria to clarify that if power through the Reserve Auxiliary Transformers (RATs) is not available, each Class 1E medium voltage bus is automatically transferred to the UATs only if UAT power is available. Since the applicant has revised ITAAC 6.b in Tier 1, Table 2.6.1-3, to clarify that the swap over to the UAT only occurs if power is available , and the response conforms with relevant NRC guidance in SRP, Section 14.3.6, staff finds that the applicant has adequately addressed this item and the information submitted is acceptable. Therefore, **RAI 946-6475, Question 14.03.06-29** will be tracked as **Confirmatory Item 14.03.06-2** pending the verification of DCD Revision 4.

In **RAI 946-6475, Question 14.03.06-30** the staff asked the applicant to clarify ITAAC 7 and 8 in DCD Tier 1 Table 2.6.1-3, with respect to the electrical fault occurring in one device or several devices simultaneously. The applicant in response to **RAI 946-6475, Question 14.03.06-30** dated August 17, 2012 agreed to revise DCD Tier 1, Table 2.6.1-3, ITAACs 7 and 8, the Design Commitment, inspection, tests, and analysis (ITA) and Acceptance Criteria text to read, "...electrical fault in either main transformer (MT), main generator (MG), generator load break switch (GLBS), UATs, or associated equipment and circuits...". The applicant also revised Tier 1, Section 2.6.1.1, Design Description, ITAACs 7 and 8. Since the applicant has revised DCD, Tier 1, Table 2.6.1-3, ITAACs 7 and 8, to clarify the intent of ITAACs 7 and 8, and the response conforms with relevant NRC guidance in SRP, Section 14.3.6, staff finds that the applicant has adequately addressed this item and the information submitted is acceptable.. Therefore, **RAI 946-6475, Question 14.03.06-30** will be tracked as **Confirmatory Item 14.03.06-3** pending the verification of DCD Revision 4.

Editorial Comment:
Delete extra period.

In **RAI 946-6475, Question 14.03.06-31** the staff asked the applicant to add inspection, tests, and analysis (ITA) and acceptance criteria (AC) for a battery load test to verify the as-built battery can carry the max load as required in Tier 1 Table 2.6.2-2, ITAAC 3. The applicant in response to **RAI 946-6475, Question 14.03.06-31** dated August 16, 2012 agreed to revise DCD Tier 1 ITAAC Table 2.6.2-2, ITAAC 3.ii, ITA and AC to replace the inspection with a test that will verify the capacity of each as-built Class 1E battery. Since the applicant has revised DCD, Tier 1, Table 2.6.2-2, ITAAC 3.ii, to address staff's concern about verification of the as-built battery to carry the maximum load via testing, and the response is in conformance with relevant NRC guidance in SRP, Section 14.3.6, the staff finds that the applicant has adequately addressed this item and the information submitted is acceptable. Therefore, **RAI 946-6475, Question 14.03.06-31** will be tracked as **Confirmatory Item 14.03.06-4** pending the verification of DCD Revision 4.

In **RAI 946-6475, Question 14.03.06-32** the staff asked the applicant to add inspection, tests, and analysis (ITA) and acceptance criteria (AC) to test that each as-built battery charger performs as required under load In Tier 1 Table 2.6.2-2, ITAAC 6. The applicant in response to **RAI 946-6475, Question 14.03.06-32** dated August 16, 2012 agreed to revise DCD Tier 1 ITAAC Table 2.6.2-2, ITAAC 6.ii, ITA and AC, to replace the inspection with a test that will verify the capacity of each as-built Class 1 E battery charger. Since the applicant has revised DCD, Tier 1, Table 2.6.2-2, ITAAC 6.ii, to test each as-built battery charger to verify that it performs under load, and the response is in conformance with relevant NRC guidance in SRP, Section 14.3.6, staff finds that the applicant has adequately addressed this item and the information submitted is acceptable. Therefore, **RAI 946-6475, Question 14.03.06-32** will be tracked as **Confirmatory Item 14.03.06-5** pending the verification of DCD Revision 4.

In **RAI 946-6475, Question 14.03.06-33,** the staff asked the applicant to explain what verifies the non-Class 1E spare battery chargers (AB & CD) that tie into the Class 1E system in Tier 1 Table 2.6.2-2, ITAAC 9. The applicant in response to **RAI 946-6475, Question 14.03.06-33** dated May 29, 2013 explained that the non-Class 1E spare battery chargers (AB & CD) are not safety significant and are not required to support Class 1E system operation, therefore, they are outside the scope of Tier 1. These charges are typically only used during maintenance on Class 1E battery chargers. The applicant also agreed to revise DCD Tier 2, Section 8.3.2.2.2 to state that the AB and CD battery chargers are non safety-related and are typically only used during maintenance on the Class 1E battery chargers. Since the applicant has clarified that the function of the non-Class 1 E spare battery chargers (AB & CD), has revised DCD, Tier 2, Section 8.3.2.2.2, to explain the use of the non-Class 1E battery chargers, and has submitted the information in conformance with relevant NRC guidance in SRP, Section 14.3.6, staff finds that the applicant has adequately addressed this item and the information submitted is acceptable. Therefore, **RAI 946-6475, Question 14.03.06-33** will be tracked as **Confirmatory Item 14.03.06-6** pending the verification of DCD Revision 4.

In **RAI 946-6475, Question 14.03.06-34,** the staff identified that in Tier 1 Table 2.6.3-3, ITAAC 2, the Design Commitment (DC) and Acceptance Criteria (AC) were not aligned with the inspection, test, and analysis (ITA) for worst case load currents. The applicant in response to **RAI 946-6475, Question 14.03.06-34** dated April 2, 2013 agreed to revise the Design Commitment and ITA text in DCD Tier 1, Table 2.6.3-3, ITAAC 2 and the Design Description in Section 2.6.3.1. Since the applicant has revised DCD, Tier 1, Table 2.6.3-3, ITAAC 2, to make sure that the Design Commitment and the Acceptance Criteria were aligned with the ITA for worst case load currents, and has submitted the information in conformance with relevant NRC guidance in SRP, Section 14.3.6, staff finds that the applicant has adequately addressed this

Editorial Comment:
This should be Tier "1", not "I".

item and the information submitted is acceptable. Therefore, **RAI 946-6475, Quest 34** will be tracked as **Confirmatory Item 14.03.06-7** pending the verification of DCD Revision 4.

In **RAI 946-6475, Question 14.03.06-35,** the staff indicated that the Acceptance Criteria (AC) in Tier 1 Table 2.6.4-1, ITAAC 11 was not adequately defined. The applicant in response to **RAI 946-6475, Question 14.03.06-35** dated April 2, 2013 agreed to revise DCD Tier I Table 2.6.4-1, ITAAC 11 to confirm that key design features depicted on Tier 2 Figure 9.5.8-1 regarding the relative locations of the Class 1E EPS air intakes and engine exhausts, to preclude degradation of the Class 1E EPS power output due to recirculation of the exhaust gases. Since the applicant has revised DCD, Tier 1, Table 2.6.4-1, ITAAC 11, to define the AC to confirm that key design features depicted on Tier 2 Figure 9.5.8-1 regarding the relative locations of the Class 1E EPS air intakes and engine exhausts, and has submitted the information in conformance with relevant NRC guidance in SRP, Section 14.3.6, staff finds that the applicant has adequately addressed this item and the information submitted is acceptable. Therefore, **RAI 946-6475, Question 14.03.06-35** will be tracked as **Confirmatory Item 14.03.06-8** pending the verification of DCD Revision 4.

In **RAI 946-6475, Question 14.03.06-36** the staff indicated that ITAAC 14.b in Tier 1 Table 2.6.4-1 was not adequate and should define the required conditions for whether the bus is de-energized and loads shed or not de-energized. The applicant in response to **RAI 946-6475, Question 14.03.06-36** dated August 16, 2012 agreed to revise DCD Tier I Section 2.6.4.1 and the Design Commitment and Acceptance Criteria in Tier 1, Table 2.6.4-1, ITAAC 14.b to state that the Class 1E EPS circuit breaker automatically closes after loads are shed when its respective division Class 1E medium-voltage bus is de-energized. Since the applicant has revised DCD, Tier 1, Table 2.6.4-1, ITAAC 14.b, to clarify when the Class 1E bus sheds its load and is de-energized, and has submitted the information in conformance with relevant NRC guidance in SRP, Section 14.3.6, staff finds that the applicant has adequately addressed this item and the information submitted is acceptable. Therefore, **RAI 946-6475, Question 14.03.06-36** will be tracked as **Confirmatory Item 14.03.06-9** pending the verification of DCD Revision 4.

In **RAI 946-6475, Question 14.03.06-37** the staff indicated that inspection, tests, and analysis (ITA), Design Commitment (DC), and Acceptance Criteria for ITAAC 17 in Tier 1 Table 2.6.4-1 were inconsistent and asked whether the emergency power system (EPS) could respond to an auto start in the test mode. The applicant in response to **RAI 946-6475, Question 14.03.06-37** dated August 16, 2012, agreed to revise DCD Tier 1, Table 2.6.4-1, ITAAC 17, DC and AC and the applicable Tier 2, Figure 8.3.1-2, logic diagrams for the Class 1 E GTG starting initiation and circuit breaker closing. Since the applicant has revised DCD Tier 1, Table 2.6.4-1, ITAAC 17, and DCD, Tier 2, Figure 8.3.1-2, to for consistency and to clarify that the ITAAC related to the EPS in the test mode, and has submitted the information in conformance with relevant NRC guidance in SRP, Section 14.3.6, staff finds that the applicant has adequately addressed this item and the information submitted is acceptable. Therefore, **RAI 946-6475, Question 14.03.06-37** will be tracked as **Confirmatory Item 14.03.06-10** pending the verification of DCD Revision 4.

In **RAI 946-6475, Question 14.03.06-39** the staff asked the applicant to change the inspection, tests, and analysis (ITA) to a test in Tier 1 Table 2.6.4-1, ITAAC 31. The applicant in response to **RAI 946-6475, Question 14.03.06-39** dated August 16, 2012 agreed to revise DCD Tier 1, Table 2.6.4-1, ITAAC 31 to replace the verification method in the ITA from an inspection to a test. Since the applicant has revised the DCD, Tier 1, Table 2.6.4-1, ITAAC 31 and changed

the verification method to a test to satisfy staff's concern, and has submitted the information in conformance with relevant NRC guidance in SRP, Section 14.3.6, staff finds that the applicant has adequately addressed this item and the information submitted is acceptable. Therefore, **RAI 946-6475, Question 14.03.06-39** will be tracked as **Confirmatory Item 14.03.06-11** pending the verification of DCD Revision 4.

In **RAI 946-6475, Question 14.03.06-41,** the staff asked the applicant to add an inspection, tests, and analysis (ITA) and Acceptance Criteria (AC) to the test so that the SSCs can perform their intended function in Tier 1 Table 2.6.5-1, ITAAC 13. The applicant, in response to **RAI 946-6475, Question 14.03.06-41**, dated May 29, 2013, agreed to revise DCD Tier 1 Table 2.6.5-1, ITAAC 13.i, to state that tests will be performed to verify each as-built alternate alternating current (AAC) power source output bounds the analysis. Also agreed to revise DCD Tier 1 Table 2.6.4-1, ITAAC 9 will be revised to state that tests will be performed to verify that each as-built Class 1E EPS output bounds the analysis for consistency. Since the applicant has revised the DCD, Tier 1, Table 2.6.5-1, ITAAC 13.i, to add a test to verify that each as-built AAC power source output bounds the analysis, and DCD, Tier 1, Table 2.6.4-1, ITAAC 9, to state that tests will be performed to verify that each as-built Class 1E EPS output bounds the analysis for consistency, and has submitted the information in conformance with relevant NRC guidance in SRP, Section 14.3.6, staff finds that the applicant has adequately addressed this item and the information submitted is acceptable. Therefore, **RAI 946-6475, Question 14.03.06-41** will be tracked as **Confirmatory Item 14.03.06-12** pending the verification of DCD Revision 4.

In **RAI 946-6475, Question 14.03.06-42** the staff stated that testing should be performed in Tier 1 Table 2.6.6-1, ITAAC 3, 4, 6 and asked the applicant about the verification of light illumination in the proper target areas. The applicant in response to **RAI 946-6475, Question 14.03.06-42** dated August 16, 2012 agreed to revise DCD Tier 1, Table 2.6.6-1, ITAACs 3, 4 and 6 to replace the verification method in the inspection, tests, and analysis (ITA) from an inspection to a test. Since the applicant has revised the DCD, Tier 1, Table 2.6.6.1, ITAACs 3, 4, and 6, has used a test instead of inspection to verify the illumination in the target areas, and has submitted the information in conformance with relevant NRC guidance in SRP, Section 14.3.6, staff finds that the applicant has adequately addressed this item and the information submitted is acceptable. Therefore, **RAI 946-6475, Question 14.03.06-42** will be tracked as **Confirmatory Item 14.03.06-13** pending the verification of DCD Revision 4.

In **RAI 946-6475, Question 14.03.06-43** the staff stated that there should be some type of Acceptance Criteria (AC) in accordance with the design in Tier 1 Table 2.6.7-1, ITAAC 2. The applicant in response to **RAI 946-6475, Question 14.03.06-43** dated August 16, 2012 agreed will revise the Acceptance Criteria in DCD Tier 1, Table 2.6.7-1, ITAAC 2 to indicate the AC is in accordance with the design. Since the applicant has revised the DCD, Tier 1, Table 2.6.7-1, ITAAC 2, to indicate that the Acceptance Criteria is in accordance with the design, and has submitted the information in conformance with relevant NRC guidance in SRP, Section 14.3.6, staff finds that the applicant has adequately addressed this item and the information submitted is acceptable. Therefore, **RAI 946-6475, Question 14.03.06-43** will be tracked as **Confirmatory Item 14.03.06-14** pending the verification of DCD Revision 4.

In **RAI 942-6476, Question 14.03.07-60** the staff stated that Tier 1 Table 2.7.1.1-1, ITAAC 2 - Inspection and analysis are required in the ITA (Inspection, Tests, and Analysis). The applicant in response to **942-6476, Question 14.03.07-60** dated August 20, 2012 stated that the ITA for DCD Tier 1 ITAAC 2 of Table 2.7.1.1-1 will be revised in response to **RAI 782-5910, Question 14.03.07-58** to require a turbine missile generation probability reconciliation analysis. The

applicant in a revised response to **RAI 782- 5910, Question 14.03.07-58** dated June 26, 2013 revised Tier 1 ITAAC 2 of Table 2.7.1.1-1 to state that turbine rotor integrity will be verified by reconciliation analysis between the information assumed in the submitted technical report and the corresponding as-built information. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 ITAAC 2 of Table 2.7.1.1-1 for verification of the turbine rotor integrity by reconciliation analysis. Therefore, **RAI 942-6476, Question 14.03.07-60** will be tracked as **Confirmatory Item 14.03.07-3** pending the verification of DCD Revision 4.

In **RAI 942-6476, Question 14.03.07-63** the staff asked the applicant to explain the need for Analysis and to specify the intent of the analysis as specified. The applicant in response to **942-6476, Question 14.03.07-63** dated August 20, 2012 agreed to delete the "Analyses" from the inspection, tests, and analysis (ITA) of Tier 1 Table 2.7.1.2-5, ITAAC 13.a.ii, because according to ASME Code Section III a "test" is sufficient to verify set pressure of the ASME Code Section III safety valves identified in Table 2.7.1.2-2. The applicant also agreed to revise the AC text to be consistent with the revised ITA. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant deleted the “Analysis” aspect of the ITAAC to address the staff’s questions as to whether analysis was needed. Therefore, **RAI 942-6476, Question 14.03.07-63,** will be tracked as **Confirmatory Item 14.03.07-4** pending the verification of DCD Revision 4.

In **RAI 942-6476, Question 14.03.07-65** the staff asked the applicant to correct a typographical error in Tier 1 Table 2.7.1.10-4, ITAAC 14.ii. The applicant in response to **942-6476, Question 14.03.07-65** dated August 20, 2012 agreed to correct Tier 1 Table 2.7.1.10-4, ITAAC 14.ii. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised the ITAAC to correct the typographical error. Therefore, **RAI 942-6476, Question 14.03.07-65,** will be tracked as **Confirmatory Item 14.03.07-5** pending the verification of DCD Revision 4.

In **RAI 942-6476, Question 14.03.07-66** the staff asked the applicant to correct a typographical error in Tier 1 Table 2.7.1.11-5, ITAAC 1.d. The applicant in response to **942-6476, Question 14.03.07-66** dated August 20, 2012 agreed to correct Tier 1 Table 2.7.1.11-5, ITAAC 1.d. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised the ITAAC to correct the typographical error. Therefore, **RAI 942-6476, Question 14.03.07-66,** will be tracked as **Confirmatory Item 14.03.07-6** pending the verification of DCD Revision 4.

In **RAI 942-6476, Question 14.03.07-68**, the staff asked the applicant to align the Design Commitment (DC) with the Acceptance Criteria (AC) in Tier 1 Table 2.7.1.11-5, ITAAC 13 to clarify the useable volume of each emergency feedwater (EFW) pit. The applicant in response to **942-6476, Question 14.03.07-68** dated August 20, 2012 agreed to revise the DC of Tier 1, Section 2.7.1.11 and the DC of Table 2.7.1.11-5, ITAAC 13 to specify the usable water volume for each EFWS pit. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1, Section 2.7.1.11 and the Table 2.7.1.11-5, ITAAC 13 to make sure that the design commitment and the acceptance criteria in the ITAAC were consistent. Therefore, **RAI 942-6476, Question 14.03.07-68** will be tracked as **Confirmatory Item 14.03.07-7** pending the verification of DCD Revision 4.

In **RAI 942-6476, Question 14.03.07-69** the staff asked applicant to clarify the wording in Tier 1 Table 2.7.3.1-5, ITAAC 1 .b. The applicant in response to **942-6476, Question 14.03.07-69** dated August 20, 2012 referred to the response to **RAI 945-6452, Question 14.03-10**. The staff reviewed the response to **RAI 945-6452, Question 14.03-10** and found that the response with the proposed Tier 1 changes were acceptable as discussed in **RAI 945-6452, Question 14.03-10** above. Therefore, since staff has accepted the response to **RAI 945-6452, Question 14.03-10,** which included revision to Tier 1 Table 2.7.3.1-5, ITAAC 1 .b to address **Question 14.03.07-69, RAI 942-6476, Question 14.03.07-69** will be tracked as **Confirmatory Item 14.03.07-8** pending the verification of DCD Revision 4.

In **RAI 942-6476, Question 14.03.07-70** the staff asked the applicant to specify the pump requirements and to clarify whether the ITAAC is referring to each pump or a combination of pumps in Tier 1 Table 2.7.3.1-5, ITAAC 7. The applicant in response to **942-6476, Question 14.03.07-70** dated August 20, 2012 agreed to revise DCD Tier 1, ITAAC Table 2.7.3.1-5, ITAAC 7, Acceptance Criteria (AC) to specify that each as-built ESW pump delivers the required flow. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 Table 2.7.3.1-5, ITAAC 7 to clarify that the ITAAC was for each pump. Therefore, **RAI 942-6476, Question 14.03.07-70** will be tracked as **Confirmatory Item 14.03.07-9** pending the verification of DCD Revision 4.

In **RAI 942-6476, Question 14.03.07-71** the staff asked applicant to clarify the wording in Tier 1 Table 2.7.3.3-5, ITAAC 1 .b. The applicant in response to **942-6476, Question 14.03.07-71** dated August 20, 2012 refer to the response to **RAI 945-6452, Question 14.03-10** and also explained that Tier 1 Section 2.7.3.3.1 has been revised in response to DCD RAI 571-4365, Question 9.02.02-68 (ML11304A049). The staff reviewed the response to **RAI 945-6452, Question 14.03-10** and **RAI 571-4365, Question 9.02.02-68** and found that the response to **942-6476, Question 14.03.07-71** with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 Table 2.7.3.3-5, ITAAC 1 .b. and Tier 1 Section 2.7.3.3.1 in response to **RAI 945-6452, Question 14.03-10** and **RAI 571-4365, Question 9.02.02-68** and these changes satisfies the staff's concern in **Question 14.03.07-71**. Therefore, **RAI 942-6476, Question 14.03.07-71** will be tracked as **Confirmatory Item 14.03.07-10** pending the verification of DCD Revision 4.

In **RAI 942-6476, Question 14.03.07-72** the staff asked applicant to clarify the wording in Tier 1 Table 2.7.3.5-5, ITAAC 1 .b. The applicant in response to **942-6476, Question 14.03.07-72** dated August 20, 2012 referred to the response to **RAI 945-6452, Question 14.03-10**. The staff reviewed the response to **RAI 945-6452, Question 14.03-10** and found that the response with the proposed Tier 1 changes were acceptable as discussed in **RAI 945-6452, Question 14.03-10** above. Therefore, since staff has accepted the response to **RAI 945-6452, Question 14.03-10,** which included revision to Tier 1 Table 2.7.3.5-5, ITAAC 1 .b to address **Question 14.03.07-72, RAI 942-6476, Question 14.03.07-72** will be tracked as **Confirmatory Item 14.03.07-11** pending the verification of DCD Revision 4.

In **RAI 942-6476, Question 14.03.07-73** the staff asked the applicant to specify the pump requirements and to clarify whether it is for each pump or a combination of pumps in Tier 1 Table 2.7.3.5-5, ITAAC 7. The applicant in response to **942-6476, Question 14.03.07-73** dated August 20, 2012 agreed to revise DCD Tier 1 Table 2.7.3.5-5 and explained that the design flow rate referred to in ITAAC 7.ii and specified in DCD Tier 2 Table 9.2.7-1 is for each ECW pump. The applicant also explained that Tests of each ECW pump will be performed to verify that each pump is capable of supplying its design flow rate identified in Table 9.2.7-1. The staff reviewed

the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 Table 2.7.3.5-5, ITAAC 7 by clarifying that the design flow rate in the ITAAC was for each ECW pump for consistency with Tier 2 Table 9.2.7-1. Therefore, **RAI 942-6476, Question 14.03.07-73** will be tracked as **Confirmatory Item 14.03.07-12** pending the verification of DCD Revision 4.

In **RAI 942-6476, Question 14.03.07-74** the staff explained to the applicant that for Tier 1 Table 2.7.4.1-1, ITAAC 6, analysis is required to determine the required media and volume necessary to meet the Design Commitment and then inspection and analysis is required to verify the media type and required volume are in the vessels. The applicant in response to **942-6476, Question 14.03.07-74** dated August 20, 2012, stated that in the revised response to **RAI 523-4246, Question 11.02-32**, the applicant had revised DCD Tier 1 Table 2.7.4.1-1, ITAAC 6, to include inspections and analyses. The staff has reviewed the Tier 1 changes associated with the revised response to **RAI 523-4246, Question 11.02-32** and finds the response to **942-6476, Question 14.03.07-74** acceptable because the applicant revised Tier 1 Table 2.7.4.1-1, ITAAC 6 as part of the response to **RAI 523-4246, Question 11.02-32,** and this change addresses the staff's concern in this RAI question. Therefore, **RAI 942-6476, Question 14.03.07-74** will be tracked as **Confirmatory Item 14.03.07-13** pending the verification of DCD Revision 4.

In **RAI 942-6476, Question 14.03.07-75** the staff asked the applicant to modify the Acceptance Criteria (AC) in Tier 1 Table 2.7.5.1-3, ITAAC 4.b.ii as follows: The as-built MCR HVAC system provides filtered air intake flow of </= 1200 cfm with two MCR emergency filtration units operating, filtered air recirculation flow of **>/=** 2400 cfm with one emergency filtration unit operating, and maintains positive pressure in the as-built CRE relative to all adjacent areas to the CRE boundary in the emergency pressurization mode with one emergency filtration unit operating. The applicant in response to **942-6476, Question 14.03.07-75** dated August 20, 2012 agreed to revise DCD Tier 1 Table 2.7.5.1-3 ITAAC 4.b.ii to be consistent with the response to **RAI 827-5812, Question 09.04.01-28** dated August 27, 2012, which addresses the staff's concern. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 Table 2.7.5.1-3 ITAAC 4.b.ii by clarifying the Acceptance Criteria of the ITTAC and explained the operation and capacity of the two emergency filtration units. Therefore, **RAI 942-6476, Question 14.03.07-75** will be tracked as **Confirmatory Item 14.03.07-14** pending the verification of DCD Revision 4.

In **RAI 942-6476, Question 14.03.07-76** the staff asked the applicant to clarify for MCR isolation signal and smoke detection signal in Tier 1 Table 2.7.5.1-3, ITAAC 5.c. The applicant in response to **942-6476, Question 14.03.07-76** dated August 20, 2012 agreed to revise Tier 1 Table 2.7.5.1-3, ITAAC 5.c by splitting into parts 5.c.i and 5.c.2 and explained that closing time of the dampers required for MCR isolation and smoke isolation will be tested separately. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 Table 2.7.5.1-3, ITAAC 5.c and clarified that there are two separate tests for the MCR and smoke isolation. Therefore, **RAI 942-6476, Question 14.03.07-76** will be tracked as **Confirmatory Item 14.03.07-15** pending the verification of DCD Revision 4.

In **RAI 942-6476, Question 14.03.07-78** the staff stated that Tier 1 Table 2.7.5.1-3, ITAAC 5.f does not adequately test the tornado dampers and that Tornado dampers should be tested for both the closure function and automatic re-opening. The applicant in response to **942-6476, Question 14.03.07-78** dated April 3, 2013 agreed to revise the tornado damper entry in DCD Tier 1, Table 2.7.5.1-1 to add the active safety function of transferring open after a tornado

condition and to clarify the tornado dampers are not remotely operated. The applicant also agreed to revise DCD Tier 1, Table 2.7.5.1-3, ITAAC 5.f.ii to specify type tests or a combination of type test and analysis to verify that the dampers can perform their active safety function under design tornado conditions. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 Table 2.7.5.1-1 to address staff's concern about testing the tornado dampers for both the closure and automatic re-opening. Therefore, **RAI 942-6476, Question 14.03.07-78** will be tracked as **Confirmatory Item 14.03.07-16** pending the verification of DCD Revision 4.

In **RAI 942-6476, Question 14.03.07-79** the staff asked the applicant to clarify the Inspection, Tests, and Analysis (ITA) and Acceptance Criteria (AC) requirements for Tier 1 Table 2.7.5.2-3, ITAAC 4.b thru 4.f. and asked whether the ITAAC was referring to each division. The applicant in response to **942-6476, Question 14.03.07-79** dated August 20, 2012 agreed to revise the AC of Tier 1 Table 2.7.5.2-3, ITAAC 4.b thru 4.f to state that each of the Class 1E electrical room HVAC system divisions is capable of providing conditioned air to the rooms described in Tier 1 Section 2.7.5.2.1.2. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 Table 2.7.5.2-3, ITAAC 4.b thru 4.f to clarify the ITA and AC requirements for the Class 1E electrical room HVAC system divisions. Therefore, **RAI 942-6476, Question 14.03.07-79** will be tracked as **Confirmatory Item 14.03.07-17** pending the verification of DCD Revision 4.

In **RAI 942-6476, Question 14.03.07-81** the staff stated that Tier 1 Table 2.7.5.2-3, ITAAC 5.e does not adequately test the tornado dampers and that Tornado dampers should be tested for both the closure function and automatic re-opening. The applicant in response to **942-6476, Question 14.03.07-81** dated April 3, 2013 agreed to revise the tornado damper entry in DCD Tier 1, Table 2.7.5.2-1 to add the active safety function of transferring open after a tornado condition and to clarify the tornado dampers are not remotely operated. The applicant also agreed to revise DCD Tier 1, Table 2.7.5.2-3, ITAAC 5.e.ii to specify type tests or a combination of type test and analysis to verify that the dampers can perform their active safety function under design tornado conditions. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1, Table 2.7.5.2-1 and Tier 1, Table 2.7.5.2-3, ITAAC 5.e.ii to address staff's concern about testing the tornado dampers for both the closure and automatic re-opening. Therefore, **RAI 942-6476, Question 14.03.07-81** will be tracked as **Confirmatory Item 14.03.07-18** pending the verification of DCD Revision 4.

In **RAI 942-6476, Question 14.03.07-83** the staff asked the applicant whether the refueling and fuel handling machines where precluded from lifting dummy cells or whether it was incapable of lifting dummy cells for Tier 1 Table 2.7.6.4-2, ITAAC 3.c and 6.c. The applicant in response to **942-6476, Question 14.03.07-83** dated August 20, 2012 agreed to revise the Acceptance Criteria for ITAAC 3.c and 6.c in DCD Tier 1 Table 2.7.6.4-2 to clearly indicate the function of the interlock, and explained that the machines have enough capacity to lift a dummy fuel assembly in the absence of the interlock. The applicant also explained that tests are to be performed to ensure proper function of electrical interlocks which prevent the refueling machine or the fuel handling machine from lifting a load heavier than the nominal fuel assembly. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 Table 2.7.6.4-2, ITAAC 3.c and 6.c to clarify the function of the fuel handling machines and the electrical interlock. Therefore, **RAI 942-6476, Question 14.03.07-83** will be tracked as **Confirmatory Item 14.03.07-19** pending the verification of DCD Revision 4.

Editorial Comment:
Missing period between these two sentences.

In **RAI 942-6476, Question 14.03.07-84** the staff asked the applicant to indicate where the critical welds term was defined as it relates to Tier 1 Table 2.7.6.5-1, ITAAC 2.c.i & 2.c.ii. The applicant in response to **942-6476, Question 14.03.07-84** dated August 20, 2012 explained that "Critical welds" are defined as all weld joints whose failure could result in the drop of a critical load, and will be nondestructively examined in accordance with Article 2.6 of NUREG-0554. The applicant agreed to revise the descriptions in the third paragraph of DCD Tier 2 Subsection 9.1.5.4 to clarify the definition of critical welds. The staff reviewed the response and found that the response with the proposed Tier 2 changes were acceptable because the applicant revised Tier 2 Subsection 9.1.5.4 to clarify the definition of critical welds. Therefore, **RAI 942-6476, Question 14.03.07-84** will be tracked as **Confirmatory Item 14.03.07-20** pending the verification of DCD Revision 4.

In **RAI 942-6476, Question 14.03.07-85** the staff asked the applicant to simplify travel limits for the Acceptance Criteria (AC) in Tier 1 Table 2.7.6.5-1, ITAAC 3. The applicant in response to **942-6476, Question 14.03.07-85** dated August 20, 2012 agreed to revise ITAAC 3 in DCD Tier 1 Table 2.7.6.5-1 by deleting "safety-related SSCs" in the Acceptance Criteria. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 Table 2.7.6.5-1, ITAAC 3 to make the acceptance criteria specific to travel limits instead of travel limits or safety related SSCs. Therefore, **RAI 942-6476, Question 14.03.07-85** will be tracked as **Confirmatory Item 14.03.07-21** pending the verification of DCD Revision 4.

In **RAI 942-6476, Question 14.03.07-86** the staff stated that Tier 1 Table 2.7.6.7-5, ITAAC 6.a.i - MOV-052-A, B, C, and D, are identified as not being qualified for a harsh environment yet the same values are identified in APP D3 as being in a harsh radiation environment. The applicant in response to **942-6476, Question 14.03.07-86** dated August 20, 2012 stated that DCD Tier 1 Table 2.7.6.7-1 will be revised in response to **RAI 945-6452, Question 14.03-13**. The staff reviewed the response to **RAI 945-6452, Question 14.03-13** and finds that the response to **RAI 942-6476, Question 14.03.07-86** is acceptable because the applicant revised Tier 1 Table 2.7.6.7-1 to address staff's concern as part of the response to **Question 14.03-13**b Therefore, **RAI 942-6476, Question 14.03.07-86** will be tracked as **Confirmatory Item 14.03.07-22** pending the verification of DCD Revision 4.

In **RAI 942-6476, Question 14.03.07-87** the staff indicated to the applicant that both Inspection and analysis are required in Tier 1 Table 2.7.6.9-2, ITAAC 4.a. The applicant in response to **942-6476, Question 14.03.07-87** dated August 20, 2012 agreed to revise DCD Tier 1 Table 2.7.6.9-2, ITAAC 4.a to include Inspection and Analysis. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 Table 2.7.6.9-2, ITAAC 4.a to include analysis in addition to inspection for the ITAAC. Therefore, **RAI 942-6476, Question 14.03.07-87** will be tracked as **Confirmatory Item 14.03.07-23** pending the verification of DCD Revision 4.

In **RAI 942-6476, Question 14.03.07-89** the staff explained to the applicant that the Acceptance Criteria for Tier 1 ITAAC Table 2.7.5.1-3 Item 4c should read as follows: A report exists and concludes that the as-built CRE unfiltered in-leakage is </= 110 cfm with the MCR HVAC system operation (i.e., single train of MCREFS) in emergency pressurization mode. The applicant in response to **942-6476, Question 14.03.07-89** dated August 20, 2012 agreed to revise DCD Tier 1 Table 2.7.5.1-3 ITAAC 4.c to address the staff's concern and make sure that the changes were consistent with the response to **RAI 827-5812, Question 09.04.01-28** dated

August 27, 2012. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 Table 2.7.5.1-3 ITAAC 4.c to specify leakage for one MCR emergency air filtration unit and for consistency with the response to **RAI 827-5812, Question 09.04.01-28**. Therefore, **RAI 942-6476, Question 14.03.07-89** will be tracked as **Confirmatory Item 14.03.07-24** pending the verification of DCD Revision 4.

In **RAI 942-6476, Question 14.03.07-90** the staff asked the applicant to specify the separation requirements (fire, missile, etc.) for Tier 1 ITAAC Table 2.7.5.1-3 Item 1.b. The applicant in response to **942-6476, Question 14.03.07-90**, dated August 20, 2012 refer to the response to **RAI 945-6452, Question 14.03-10**. The staff reviewed the response to **RAI 945-6452, Question 14.03-10** and found that the response to **RAI 942-6476, Question 14.03.07-90** with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 ITAAC Table 2.7.5.1-3 Item 1.b as part of the response to **Question 14.03-10,** and this change addresses the staff's question related to separation requirements. Therefore, **RAI 942-6476, Question 14.03.07-90** will be tracked as **Confirmatory Item 14.03.07-25** pending the verification of DCD Revision 4.

In **RAI 942-6476, Question 14.03.07-91** the staff asked the applicant to define the separation criteria being met (fire, pipe whip, etc.) for Tier 1 ITAAC Table 2.7.5.2-3 Items 1.b, 1.c, 1.d, 1.e, and 1.f. The applicant in response to **942-6476, Question 14.03.07-91**, dated August 20, 2012 refer to the response to **RAI 945-6452, Question 14.03-10**. The staff reviewed the response to **RAI 945-6452, Question 14.03-10** and found that the response to **RAI 942-6476, Question 14.03.07-91** with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 ITAAC Table 2.7.5.2-3 Items 1.b, 1.c, 1.d, 1.e, and 1.f as part of the response to **Question 14.03-10,** and this change addresses the staff's question related to separation criteria. Therefore, **RAI 942-6476, Question 14.03.07-91** will be tracked as **Confirmatory Item 14.03.07-25** pending the verification of DCD Revision 4.

Editorial Comment:
Both Q 14.03.07-90 and 14.03.07-91 are current assigned CI No. 14.03.07-25.

In **RAI 937-6478, Question 14.03.11-44** the staff stated that the term "physical arrangement" is more appropriate than "functional arrangement" and explained that the part of the ITAAC for verification of dimensions should clearly delineate in the Design Commitment (DC), Inspection, Tests, and Analysis (ITA), and Acceptance Criteria (AC) in Tier I Table 2.11.1-1, ITAAC 3. The applicant in response to **RAI 937-6478, Question 14.03.11-44** dated August 23, 2012 agreed to revise the term "functional arrangement" to state "physical arrangement" in DCD Tier 1 Subsection 2.11.1.1 ITAAC 3, and DCD Tier 1 Table 2.11.1-2, ITAAC 3, DC and AC. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised the applicable ITAACs by changing the term "functional arrangement" to "physical arrangement". Therefore, **RAI 937-6478, Question 14.03.11-44** will be tracked as **Confirmatory Item 14.03.11-2** pending the verification of DCD Revision 4.

Editorial Comment:
This should be Tier "1", not "I".

In **RAI 937-6478, Question 14.03.11-45** the staff explained to the applicant that Tier 1 Table 2.11.1-1, ITAAC 4 lacks specificity as to the number, location, and size of the required drain lines. The applicant in response to **RAI 937-6478, Question 14.03.11-45** dated March 11, 2013, stated that DCD Tier 1 Table 2.11.1-2, ITAAC 4, was revised to provide the specificity of this ITAAC as part of letter UAP-HF-12135, Transmittal of the US-APWR DCD GSI-191 Tracking Report, (May 2012 Version), dated, June 1, 2012, Enclosure 1, Proposed Changes for GSI-191 Closure Activities. The staff reviewed the response and found that the response with the Tier 1 changes were acceptable because the applicant clarified that the details about Tier 1

Table 2.11.1-1, ITAAC 4 was provided as part of the GSI-191 Tracking Report . Therefore, **RAI 937-6478, Question 14.03.11-45** will be tracked as **Confirmatory Item 14.03.11-3** pending the verification of DCD Revision 4.

In **RAI 937-6478, Question 14.03.11-46** the staff explained to the applicant that ITAAC lacks specificity and a diagram should be provided with the necessary details to verify its adequacy in Tier 1 Table 2.11.1-1, ITAAC 5. The applicant in response to **RAI 937-6478, Question 14.03.11-46** dated August 23, 2012 agreed to revise DCD Tier 1 Subsection 2.11.1.1 Item 5**,** and the Design Commitment (DC) and Acceptance Criteria (AC) for DCD Tier 1, Table 2.11.1-2, ITAAC 5, to refer to DCD Tier 1 Figure 2.2-10. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 Table 2.11.1-2, ITAAC 5 with reference to Tier 1 Figure 2.2-10 for clarity. Therefore, **RAI 937-6478, Question 14.03.11-46** will be tracked as **Confirmatory Item 14.03.11-4** pending the verification of DCD Revision 4.

In **RAI 937-6478, Question 14.03.11-47** the staff asked the applicant to explain the intent of the Analysis in Tier 1 Table 2.11.1-1, ITAAC 6. The applicant in response to **RAI 937-6478, Question 14.03.11-47** dated August 23, 2012 agreed to revise DCD Tier 1, Table 2.11.1-2, ITAAC 6, ITA to delete "and analysis" and explained that simple hand calculations are used for determining the as-built reactor cavity floor area and depth based on the as-built dimensions of the reactor cavity area. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant made the necessary revisions to Tier 1 Table 2.11.1-1, ITAAC 6 to eliminate “analysis.” Therefore, **RAI 937-6478, Question 14.03.11-47** will be tracked as **Confirmatory Item 14.03.11-5** pending the verification of DCD Revision 4.

In **RAI 937-6478, Question 14.03.11-48** the staff asked the applicant to clarify the fact that Tier 1 Table 2.11.2-2, ITAAC 6.a.i - Table 2.11.2-1 identifies RMS-MOV-003 as not required to be qualified for a Harsh Environment but Appendix 3D Table 2D-2 identifies the valve is in a harsh radiation environment. The applicant in response to **RAI 937-6478, Question 14.03.11-48** dated August 23, 2012 agreed to revise DCD Tier 1, Table 2.11.2-1 (Sheet 5 of 10), to clarify the harsh environment classification for the equipment and to provide additional changes related to this question in the response to **RAI 945-6452, Question 14.03-13**. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1, Table 2.11.2-1 in order to clarify the harsh environment classification for the equipment. Therefore, **RAI 937-6478, Question 14.03.11-48** will be tracked as **Confirmatory Item 14.03.11-6** pending the verification of DCD Revision 4.

In **RAI 937-6478, Question 14.03.11-49** the staff asked the applicant to clarify whether the MOVs fail as is with loss of motive in Tier 1 Table 2.11.2-2, ITAAC 14. The applicant in response to **RAI 937-6478, Question 14.03.11-49** dated August 23, 2012 agreed to revise DCD Tier 1, Table 2.11.2-2, ITAAC 14 and explained that the MOV valves indicated in DCD Tier 1, Table 2.11.2-2, ITAAC 14 AC do fail "As-Is" as specified in DCD Tier 1, Tables 2.4.6-2 and 2.11.2-1. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1, Table 2.11.2-2, ITAAC 14 and explained that the MOV valves fail “As-Is.” Therefore, **RAI 937-6478, Question 14.03.11-49** will be tracked as **Confirmatory Item 14.03.11-7** pending the verification of DCD Revision 4.

In **RAI 937-6478, Question 14.03.11-50** the staff explained to the applicant that Tier 1 Table 2.11.2-2, ITAAC 15 should be verified by test not inspection. The applicant in response to **RAI**

937-6478, Question 14.03.11-50 dated August 23, 2012 agreed to revise ITA of DCD Tier 1, Table 2.11.2-2, ITAAC 15, to state "Tests of the remotely operated CIVs located inside and outside the containment in series on the same penetration will be performed." The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 Table 2.11.2-2, ITAAC 15 to remove the inspection component of the ITAAC. Therefore, **RAI 937-6478, Question 14.03.11-50** will be tracked as **Confirmatory Item 14.03.11-8** pending the verification of DCD Revision 4.

In **RAI 937-6478, Question 14.03.11-51** the staff explained to the applicant that DCD Tier 1, Table 2.11.4-1, ITAAC 6, should be verified by test not inspection. The applicant in response to **RAI 937-6478, Question 14.03.11-51** dated August 23, 2012, agreed to revise DCD Tier 1, Table 2.11.4-1, ITAAC 6, as new ITAAC 6.a and 6.b and explained that DCD Tier 1, Table 2.11.4-1, ITAAC 6, DC and AC were previously revised by the response to **RAI 871-6121, Question 19-560**, dated June 27, 2012. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable because the applicant revised Tier 1 Table 2.11.4-1, ITAAC 6 to be a new ITAAC with a 6.a and 6.b component to address staff's concern . Therefore, **RAI 937-6478, Question 14.03.11-51** will be tracked as **Confirmatory Item 14.03.11-9** pending the verification of DCD Revision 4.

14.3.0.5 Combined License Information Items

The COL information items for DCD Section 14.3 are discussed in the SER sections that evaluate the different aspects of the US-APWR standard design. There are none for this specific area of review.

COL information items not identified in Table 1.8-2 of the DCD: None.

14.3.0.6 Conclusions

The staff has reviewed the applicant's criteria and methodology for selecting the SSCs to be included and described in DCD Tier 1, as well as their associated ITAAC in accordance with SRP Section 14.3. This review included an evaluation of DCD 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, design descriptions, ITAAC, significant site parameters, and significant interface requirements, In addition, the staff reviewed the DCD 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 confirmatory items discussed above, the staff concludes that information provided in the DCD describes an acceptable criteria and methodology for selecting the SSCs to be included and described in DCD Tier 1, and their associated ITAAC; and that the requirements in 10 CFR 52.47(b)(1) and 10 CFR 52.47(a)(26) are satisfied.

14.3.1 Reserved

14.3.2 ITAAC for Structural and Systems Engineering

14.3.2.1 Introduction

14.3.2.2 Summary of Application

14.3.2.3 Regulatory Basis

14.3.2.4 Technical Evaluation

14.3.2.5 Combined License Information

14.3.2.6 Conclusions

14.3.3 ITAAC for Piping Systems and Components

14.3.3.1 Introduction

SRP 14.3.3 addresses the review of ITAAC for piping systems and components for the US-APWR. 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.

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

- Piping design
- Component and system design
  a. Safety classification of structures, systems, and components
  b. Welding
  c. Hydrostatic testing
  d. Dynamic qualification
  e. Treatment of valves

14.3.3.2 Summary of Application

DCD Tier 1: The applicant has provided design descriptions for piping systems and components, simplified drawings, and ITAAC in DCD Tier 1, Chapter 2.

DCD Tier 2: DCD Tier 2, Chapter 14.3 provides a general description of the US-APWR ITAAC including its relationship to other DCD Tier 1 information, the selection criteria and content.

ITAAC: The ITAAC associated with Tier 1, Section 2.3 is given in Tier 1, Section 2.3.2.

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

COL information or action items: See Section 14.3.4.3.5 below.

Technical Report(s): There are no technical reports associated with this area of review.

Topical Report(s): There are no topical reports associated with this area of review.

US-APWR Interface Issues identified in the DCD: There are no US-APWR interface issues associated with this area of review.

Site Interface Requirements Identified in the DCD: There are no site interface requirements associated with this area of review.

Cross-cutting Requirements (TMI, USI/GSI, Op Ex): None identified.

RTNSS: There are no RTNSS issues for this area of review.

10 CFR 20.1406: There are no issues related to 10 CFR 20.1406 for this area of review.

14.3.3.3 Regulatory Basis

The relevant Commission regulations for this area of review, and the associated acceptance criteria, are summarized in Section 14.3.3 of NUREG-0800. The guidance listed in NUREG-0800, Section 14.3.3 that is related to the technical adequacy of the ITAAC are not included here, as they are addressed in other sections of this SER.

Paragraph (b)(1) of 10 CFR 52.47 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 will have been constructed and will operate in accordance with the design certification, the provisions of the Atomic Energy Act, and the NRC's regulations.

14.3.3.4 Technical Evaluation

14.3.3.4.1 Piping Design Completion

As defined in SECY-92-053, Design Acceptance Criteria (DAC) are “a set of prescribed limits, parameters, procedures, and attributes upon which the NRC relies, in a limited number of technical areas, in making a final safety determination to support a design certification.” RG 1.206 identifies piping as one area where the use of DAC is acceptable because completing the final design is impractical given the unavailability of sufficient as-built or as-procured information.

In **RAI 892-6169, Question 14.03.03-27**, the staff requested the applicant to make clear in the US-APWR DCD, whether the piping design, including pipe break hazard analysis, will be completed before design certification, or if DAC will be utilized. In addition, if DAC is used, a section needs to be included in DCD Tier 2 to discuss the DAC closure process, as well as the COL items that must be completed by COL applicants before a final safety conclusion can be reached on the COL application.

In its responses to **RAI 892-6169, Question 14.03.03-27**, dated February 27, 2012, and October 25, 2012, the applicant clarified that it uses DAC for piping systems and components design, as stated in UAP-HF-11135, “Revised Design Completion Plan for US-APWR Piping Systems and Components,” dated May 12, 2011. As requested, the applicant added a discussion in Tier 2, Chapter 14, Appendix 14.B.1 describing the DAC ITAAC closure process. The staff has reviewed this description of DAC ITAAC closure process and finds that the three

provided closure options are acceptable. As requested, the applicant also added COL Item "COL 14.3(4)" to DCD Tier 2, Section 14.3.4.3 to provide a DAC ITAAC closure schedule and to declare whether the standard approach is used for closure of DAC ITAAC, as described in Appendix 14.B.1. Furthermore, Tier 1, Table 2.3-2 ITAAC wording was revised by the applicant for consistency with UAP-HF-11135 and to remove unnecessary exceptions. The staff finds this clarification of the DAC closure process to be consistent with that defined in Nuclear Energy Institute (NEI) 08-01, which was endorsed in Regulatory Guide 1.215, Guidance for ITAAC Closure Under 10 CFR Part 52. It is therefore, acceptable. **RAI 892-6169, Question 14.03.03-27** will be tracked as a **Confirmatory Item** pending DCD Revision 4.

Editorial Comment:
No unique identification number was provided for this Confirmatory item.

14.3.3.4.2 Generic Piping Design

During the review of previous design certification applications, the staff worked with industry to edit ITAAC pertaining to design and construction of American Society for Mechanical Engineer (ASME) Code Section III piping systems and components. For clarity and inspectability, the staff determined that a set of three ITAAC that cover 1) design, 2) as-built reconciliation, and 3) fabrication and installation activities for piping or components would be necessary and sufficient scope of ITAAC to ensure that the piping systems and components will be properly designed and constructed in accordance with ASME Code Section III requirements.

In the US-APWR DCD Tier 1, Table 2.3-2 lists the design ITAAC for all piping systems and components that contain ASME Code Class 1, 2 and 3 piping and/or components. The as-built reconciliation and the fabrication and installation ITAAC for all systems that contain ASME Code Class 1, 2 and 3 piping and/or components are detailed in the ITAAC tables for their respective systems.

Design

For piping systems and components designated as ASME Code Section III Class 1, 2 or 3, the Acceptance Criteria (AC) column for ITAAC Items 1 and 3 in DCD Tier 1, Table 2.3-2, "Piping Systems and Components Inspections, Tests, Analyses, and Acceptance Criteria" require that the piping systems and components have been designed in accordance with the ASME Code Section III requirements. It was not clear to the staff how the results of the analysis would be documented and what type of report would exist. 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 to ensure that piping is designed to retain its pressure integrity and functional capability, and that the design complies with the design specifications. The staff, in **RAI 242-2153, Question 14.03.03-03** and **RAI 404-3063, Question 14.03.03-19**, requested the applicant revise the AC in the ITAAC table to identify the certified ASME Code design report as discussed in ASME Code Section III Subarticle NCA-3550 or other appropriate design documents, as well as to state that "ASME Code certified design report(s) (NCA-3550) (certified, when required by ASME Code) exist and conclude that ASME Code Section III Class 1 piping systems and components comply with the requirements of ASME Code Section III." In addition, the staff found that Inspections, Tests, Analyses (ITA) column, for ITAAC Items 1 and 3 did not adequately describe the inspection activities. The Inspections, Tests, Analyses column of these ITAACs should require the inspection of design documents required by ASME Code Section III, Subarticle NCA-3550. The staff requested the applicant make appropriate changes to the ITA to reflect that an inspection will be conducted.

In its responses to **RAI 242-2153, Question 14.03.03-03** dated April 27, 2009, and **RAI 404-3063, Question 14.03.03-19** dated July 31, 2009, the applicant explained its approach regarding referencing documents in the design ITAAC. In particular, the applicant agreed to provide stress reports during the design phase to satisfy design ITAAC. The stress reports will be prepared in accordance with ASME Code Section III Subarticles NCA-3350 and NCA-3550. The staff found the response acceptable because the stress reports are the essential portions of the design reports for ASME Class 1, 2, and 3 piping systems and components and provide assurance that requirements of ASME Code Section III have been met and that the design complies with the design specifications. The staff confirmed that the DCD has been revised accordingly and therefore, **RAI 242-2153, Question 14.03.03-03** and **RAI 404-3063, Question 14.03.03-19** are closed.

Pipe Break Hazard Analysis

SRP 14.3.3 specifies that an ITAAC for a pipe break hazard analysis must exist and document the SSCs that are required to be functional during and following a SSE to have adequate high-energy pipe break mitigation features. In addition, if the design of the piping uses the Leak Before Break (LBB) method, an additional ITAAC should be specified for a LBB evaluation report to exist for the as-built piping and piping materials.

DCD Tier 1, Table 2.3-2, ITAAC Items 4 and 5 provide the non-system based ITAAC for as-designed and as-built pipe break hazard analysis reports, respectively. Based on review of the information included in Items 4 and 5 of this ITAAC and the pertinent information provided in DCD Tier 2, Section 3.6.2.6, Outline of Pipe Break Hazard Analysis Report(s), the staff found ITAAC Items 4 and 5 for pipe break hazard analysis acceptable because the completion of these two items will ensure that safety-related SSCs are protected or qualified to withstand both the dynamic and environmental effects of postulated failures. The staff evaluation of the outline of the pipe break hazard analysis report is provided in Section 3.6.2.4.6 of this report.

As stated above, both as-designed and as-built pipe break hazard analysis reports are addressed in ITAAC Items 4 and 5 in DCD Tier 1, Table 2.3-2. However, in DCD Tier 2, Section 14.3.4.3 Generic ITAAC, only the as-built pipe break hazard analysis report is discussed. Therefore, in **RAI 892-6169, Question 14.03.03-26**, the staff requested the applicant to correct this inconsistency between DCD Tier 1, Table 2.3.2 and DCD Tier 2, Section 14.3.4.3. Specifically, DCD Tier 2, Section 14.3.4.3 should address both as-designed and as-built pipe break hazard analysis reports. In addition, in **RAI 935-6464, Question 14.03.03-28**, the staff requested the applicant to add a requirement for inspection to the ITA of the ITAAC related to Pipe Break Hazard Analysis in DCD Tier 1, Table 2.3-2.

In its responses to **RAI 892-6169, Question 14.03.03-26** dated February 27, 2012, and July 25, 2012, as well as its response to **935-6464, Question 14.03.03-28**, dated December 12, 2012, the applicant revised DCD Tier 2, Section 14.3.4.3 Generic ITAAC, to provide consistency with DCD Tier 1, Table 2.3-2 ITAAC, by addressing both as-designed and as-built pipe break hazard analyses. This revision specifies that the pipe break hazard analysis report reconciles the differences between the as-designed and as-built configurations, if any. Furthermore, the ITAAC in DCD Tier 2, Section 14.3.4.3 for ASME Code Section III piping systems and components reconciliation and LBB evaluation are moved from “Generic ITAAC” to “ITAAC for specific systems” for consistency with Tier 1. In addition, a requirement for inspection of the pipe rupture location was added to the ITA column for ITAAC Item 5 and its corresponding design commitment, and the as-designed and as-built pipe break hazard analysis reports are

clarified for ITAAC Items 4 and 5. These revisions correct the inconsistencies identified by the staff, and are acceptable. **RAI 892-6169, Question 14.03.03-26 and RAI 935-6464, Question 14.03.03-28** will be tracked as **Confirmatory Items 14.03.03-3 and 14.03.03-4 respectively,** pending verification of DCD Revision 4.

The staff evaluation of ITAAC for a pipe break hazard analysis, i.e., ITAAC Items 4 and 5 in DCD Tier 1, Table 2.3-2, from the perspective of protection of SSCs from postulated pipe failures in fluid systems outside containment is provided in Section 3.6.1.4.3 of this report. The staff general evaluation of ITAAC for LBB is provided in Section 3.6.3.4.1 of this report. The staff evaluation of the application of LBB to specific systems or piping is provided in the other sections of 14.3 of this report.

As-Built Reconciliation and Fabrication and Installation

As described in SRP Section 14.3.3, one ITAAC item that should be included requires that a report documenting an as-built reconciliation analysis exists and concludes that the final piping systems have been built in accordance with the ASME Code certified stress reports. As described above, three distinct ITAAC covering 1) design, 2) as-built reconciliation, and 3) fabrication and installation activities for piping or components would encompass the complete scope of ITAAC needed to ensure that the piping systems and components are properly designed and constructed in accordance with ASME Code Section III requirements.

In **RAI 242-2153, Question 14.03.03-06** and **RAI 404-3063, Question 14.03.03-21**, referring to DCD Tier 1, Table 2.4.2-5, "Reactor Coolant System Inspections, Tests, Analyses, and Acceptance Criteria" ITAAC Item 4.b for the reactor coolant system (RCS), the staff requested the applicant to provide two separate ITAAC for 1) fabrication and installation to ensure that the as-built piping of the RCS, including supports, is fabricated, installed, and inspected in accordance with ASME Code Section III requirements; and 2) as-built reconciliation to ensure that the as-built piping of the RCS, including supports, is reconciled with the design requirements. The design commitment (DC) for these two ITAAC need to have separate entries so that there are two distinct commitments demonstrating that the piping of the RCS, including supports, are fabricated, installed, and inspected in accordance with ASME Code Section III requirements, and will be reconciled with design requirements. This request is also applicable to other systems in DCD Tier 1.

In addition, the term "piping of the RCS, including supports" was used in the DC while the term "piping system" was used in the ITA and AC. To enhance consistency, the same terminology should be used in the ITA and AC. The following additional concerns were identified by the staff and were also applicable to other systems in DCD Tier 1:

1) For fabrication and installation, Item 4.b.i in DCD Tier 1, Table 2.4.2-5, the applicant modified the AC to include ASME Code Section III data reports. To avoid ambiguity, the staff requested the applicant to modify the AC to "ASME Code data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude…"

2) For as-built reconciliation, Item 4.b.ii in DCD Tier 1, Table 2.4.2-5, the applicant revised the AC to include ASME Code Section III design reports. Three minor modifications were suggested to clarify the statements in the ITA and AC: 1) revise the ITA statement to "A reconciliation analysis of the piping system of the RCS, including supports, using

as-designed and as-built information and ASME Code certified design report (NCA-3550) will be performed"; 2) modify the AC to reference ASME Code design reports; and 3) modify the statement in the AC to reflect that the report will document the results of the reconciliation analysis.

In its responses to **RAI 242-2153, Question 14.03.03-06** dated April 27, 2009, and **RAI 404-3063, Question 14.03.03-21** dated July 31, 2009; the applicant revised the ITAAC in DCD Tier 1, Table 2.4.2-5, Items 4.b.i and 4.b.ii to account for two activities, the fabrication and installation and the as-built reconciliation. The applicant revised the ITAAC to separate the DC such that there are two distinct commitments demonstrating that the piping: 1) are fabricated, installed, and inspected in accordance with ASME Code Section III requirements; and 2) will be reconciled with design requirements. In addition, the wording in the ITA and AC were modified to address the staff's concern regarding clarity and consistency. The staff found the response acceptable because two distinct ITAAC are required to ensure that the as-built piping systems, including supports: 1) are fabricated, installed and inspected in accordance with ASME Code Section III requirements, and 2) will be reconciled with the design requirements. The staff confirmed that the DCD has been revised accordingly and therefore, **RAI 242-2153, Question 14.03.03-06** and **RAI 404-3063, Question 14.03.03-21 are closed**.

Pressure Boundary Weld and Hydrostatic Test

Based on the guidance summarized in SRP Section 14.3.3, the piping pressure boundary and structural integrity are to be maintained because they are directly involved in preventing or mitigating an accident or event under the defense-in-depth principle. ITAAC for pressure boundary welds and hydrostatic tests for ASME Code Section III piping systems are provided in DCD Tier 1, Chapter 2 in their respective sections. Using DCD Tier 1, Table 2.4.2-5, Items 5.a and 5.b for the RCS as example, the ITAAC stated that with inspection of the as-built pressure boundary welds, the ASME Code Section III requirements are met for non-destructive examination of the as-built pressure boundary welds. In **RAI 242-2153, Question 14.03.03-08**, the staff raised a concern as to how the proposed AC can be met by the ITA. Specifically, the staff requested the applicant to add the sentence "An ASME Code report exists and concludes" to the beginning of the AC to clarify the ITAAC.

In its response to **RAI 242-2153, Question 14.03.03-8** dated April 27, 2009, the applicant revised the wording in the ITA and AC to be consistent with other ITAAC that reference an ASME Code report and included the sentence "ASME Code report exists and concludes" in the AC. The staff found the response acceptable because ITAAC are provided to verify that welding inspection will be performed in accordance with the DC. The staff confirmed that the DCD has been revised accordingly and therefore, **RAI 242-2153, Question 14.03.03-08 is closed**.

In addition to the ITAAC for pressure boundary weld, the staff found the ITAAC for hydrostatic tests provided in Items 6.a and 6.b in DCD Tier 1, Table 2.4.2-5 for the RCS acceptable because the ITA specifies that a hydrostatic test will be performed, while the AC details that an ASME Code data report exists and concludes that the results of the hydrostatic test conform to the requirements of the ASME Code Section III.

Verification of ASME Code Class 2 and 3 Piping and Components

The applicant identified piping and component design ITAAC in DCD Tier 1, Section 2.3. This design ITAAC encompasses the design of Class 1, 2, and 3 piping and components. In particular, in Item 3 of DCD Tier 1, Table 2.3.2, the applicant stated in the ITA that an analysis of representative ASME Code Section III Class 2 and 3 piping systems and components that significantly contribute to risk will be performed. The AC further identified that the result of the analysis of those representative piping systems and components concluded that the design requirements of the ASME Code Section III are met for Class 2 and 3 piping systems and components. However, the design completion of those remaining Class 2 and 3 risk-significant piping systems and components as well as all Class 2 and 3 non risk-significant piping systems and components were not discussed in this ITAAC. The staff does not consider the design of representative Class 2 and 3 piping systems and components to constitute the complete design of all Class 2 and 3 piping systems and components. Therefore, the staff, in **RAI 242-2153, Question 14.03.03-02** and **RAI 404-3063, Question 14.03.03-18**, requested the applicant to modify the ITAAC to reflect that all Class 2 and 3 piping system and component design will meet the requirements of the ASME Code Section III.

In its responses to **RAI 242-2153, Question 14.03.03-02** dated April 27, 2009, and **RAI 404-3063, Question 14.03.03-18** dated July 31, 2009, the applicant discussed a graded approach for the design of Class 2 and 3 piping systems and components and proposed to have the following documents available for NRC audit: 1) design reports of representative risk significant Class 2 and 3 piping systems and components and; 2) design specifications of all Class 2 and 3 piping systems and components. The staff found the response unacceptable, and a public meeting was scheduled with the applicant on November 16, 2009, to discuss the issue. One of the objectives of the meeting was to establish a common understanding as to how the applicant would 1) plan to resolve the piping system and component design; 2) have the design specifications and design reports available to staff for audit; and 3) propose ITAAC plan for piping systems and components.

During the public meeting on November 16, 2009, the applicant and the staff agreed that the ITAAC should encompass all Class 1, 2 and 3 piping systems and components. The staff issued **RAI 499-4060, Question 14.03.03-23** to request the applicant submit the modified piping systems and components ITAAC that would address the staff's concern, as discussed during the public meeting.

In its response to **RAI 499-4060, Question 14.03.03-23** dated December 16, 2009, the applicant indicated that ITAAC Item 3 in DCD Tier 1, Table 2.3-2, "Piping Systems and Components Inspections, Tests, Analyses, and Acceptance Criteria" will be revised to encompass all Class 2 and 3 piping systems and components. The staff found the response acceptable because, as discussed in SRP Section 14.3.3, the ITAAC ensure the design process for piping systems and components occurs as described in the DC, which encompasses all Class 2 and 3 piping systems and components. The staff confirmed that the DCD has been revised accordingly; therefore, **RAI 242-2153, Question 14.03.03-02**, **RAI 404-3063, Question 14.03.03-18** and **RAI 499-4060, Question 14.03.03-23 are closed**.

Fatigue Requirement

In DCD Tier 2, Section 3.12.5.7, "Fatigue Evaluation of ASME Code Class 1 Piping" the applicant identified that the guidance in RG 1.207 concerning environmental impact on fatigue of ASME Code Section III Class 1 piping will be followed. In particular, RG 1.207 provides guidance to determine the acceptable fatigue life using a light-water reactor environment. The

guidance in RG 1.207 is more stringent than the design criteria in ASME Code Section III. In DCD Tier 1, Table 2.3-2, the applicant stated in the ITAAC that Class 1 piping systems and components will be designed to meet ASME Code Section III requirements. However, the guidance related to fatigue design in RG 1.207 was not addressed. The staff, in **RAI 242-2153, Question 14.03.03-01** and **RAI 404-3063, Question 14.03.03-17**, requested the applicant to modify the ITAAC such that requirements of the ASME Code Section III as well as the guidance provided in RG 1.207 would be met.

In its responses to **RAI 242-2153, Question 14.03.03-01** dated April 27, 2009, and **RAI 404-3063, Question 14.03.03-17** dated July 31, 2009, the applicant expressed concern that potential future improvements in addressing environmental effects of fatigue may be unduly burdensome to implement if RG 1.207 is directly referenced in DCD Tier 1. The applicant further explained that if an acceptable alternative to RG 1.207 is developed, its use should not require an exemption from the certification information, but should be subjected to the change process delineated in Section VIII.B of a design certification rule, which addresses changes to DCD Tier 2 and DCD Tier 2* information. The applicant believes that this approach is consistent with the concept that DCD Tier 2 information, including RG positions, are evaluated as the bases underlying the DCD Tier 1 certification information, and are considered in the determination of whether ITAAC would have been successfully completed. The applicant proposed to revise the AC to specifically evaluate fatigue usage factors both in air and in reactor coolant environments as discussed in RG 1.207.

The staff agreed with the applicant's concern that by including RG 1.207 in DCD Tier 1, potential future improvements in addressing environmental effects of fatigue would be hindered in cases where ITAAC Item 1 in Table 2.3-2 are not closed out prior to design certification, an amendment to the DCD would be required to change DCD Tier 1 information. Since the applicant specifically revised the ITAAC in DCD Tier 1, Table 2.3-2 to evaluate fatigue usage factors in both air and reactor coolant environments, consistent with the guidance in RG 1.207, the staff found the responses to **RAI 242-2153, Question 14.03.03-01** and **RAI 404-3063, Question 14.03.03-17** acceptable and confirmed that the DCD has been revised accordingly; thus, these two RAIs are **closed**.

14.3.3.4.3 Verifications of Components and Systems

In addition to addressing piping design, the staff confirmed that US-APWR DCD Tier 1 addresses verification of component classification, fabrication, dynamic and seismic qualification, and selected testing and performance requirements through specific ITAAC in the individual DCD Tier 1 systems. During the review of previous design certifications, the staff worked to edit ITAAC pertaining to design and construction of ASME Code Section III components, echoing the changes made for piping systems as discussed in Section 14.3.3.4.2 of this Safety Evaluation Report.

Design

The applicant's approach for design ITAAC for piping systems and components is for a single ITAAC in DCD Tier 1 Table 2.3-2, Item 1 to verify ASME Code Section III design compliance for all systems involving ASME Code Class 1, 2 and 3 piping systems and components. As discussed in **RAI 242-2153, Question 14.03.03-03** and **RAI 404-3063, Question 14.03.03-19** in the above sections, the staff found the design ITAAC acceptable because the ITAAC ensures

the design process of piping systems and components follows the requirements set forth in the ASME Code Section III.

As-Built Reconciliation and Fabrication and Installation

As described in Section 14.3.3.4.2 of this report for piping systems, three distinct ITAAC covering 1) design, 2) as-built reconciliation, and
3) fabrication and installation activities for piping or components would encompass the complete scope to ensure that the piping systems and components are properly designed and constructed in accordance with ASME Code Section III requirements. In **RAI 242-2153, Question 14.03.03-05** and **RAI 404-3063, Question 14.03.03-20**, referring to DCD Tier 1, Table 2.4.1-2, "Reactor System Inspections, Tests, Analyses, and Acceptance Criteria" ITAAC Item 5 for the reactor system, the staff raised similar concerns as discussed in Section 14.3.3.4.2 of this report for the as-built reconciliation and the fabrication and installation ITAAC for piping, and requested the applicant to provide two distinct ITAAC for 1) fabrication and installation to reflect that an inspection of the components will be conducted and a certified ASME Code data report exists; and 2) as-built reconciliation using as-designed and as-built information for all applicable components in DCD Tier 1.

In its response to **RAI 242-2153 Question 14.03.03-05** dated April 27, 2009, and **RAI 404-3063, Question 14.03.03-20** dated July 31, 2009, the applicant revised the ITAAC in DCD Tier 1, Table 2.4.1-2, Item 5 to account for two activities: the fabrication and installation inspection of the components, and the as-built reconciliation of the components. The activities include distinct commitments demonstrating that the components 1) are fabricated, installed, and inspected in accordance with ASME Code Section III requirements; and 2) will be reconciled with design requirements. In addition, the wording in the inspection, tests, and analysis (ITA) and acceptance criteria (AC) was modified to address staff concerns regarding clarity and inspectability. The staff found the response acceptable because as stated above, two distinct ITAAC are necessary to ensure that the as-built components are 1) fabricated, installed and inspected in accordance with ASME Code Section III requirements, and 2) reconciled with design requirement. The staff confirmed that the DCD has been revised accordingly and therefore, **RAI 242-2153, Question 14.03.03-05** and **RAI 404-3063, Question 14.03.03-20** are **closed**.

Pressure Boundary Weld and Hydrostatic Test

As discussed in Section 14.3.3.4.2 of this report for pressure boundary weld and hydrostatic test for piping systems and its associated RAI, the staff found the ITAAC related to components pressure boundary weld and hydrostatic test acceptable.

Equipment Seismic and Dynamic Qualification

The ITAAC for equipment seismic qualification inspection should verify the capability of mechanical and electrical components in an as-built condition, including anchorages, to perform safety functions during and following an SSE. Detailed supporting information for seismic qualification records is found in DCD Tier 2, Chapter 3. The applicant provided separate ITAAC for seismic qualification of equipment and piping: 1) Item 5.a for seismic Category I equipment and 2) Item 5.b for seismic Category I piping.

Table 2.4.4-3, "Emergency Core Cooling System Piping Characteristics" of DCD Tier 1, Chapter 2 identifies the emergency core cooling system piping that is classified as seismic Category I. In the ITAAC Table 2.4.4-5, "Emergency Core Cooling System Inspections, Tests, Analyses, and Acceptance" of DCD Tier 1, Chapter 2, the applicant provided ITAAC Item 5.b for seismic Category I piping. In the DC, the phrase "seismic category lines" was used while in the ITA and AC, the phrases "as-built piping" and "seismic category piping" were used respectively. However, seismic Category I is the only seismic classification identified in DCD Tier 1, Section 2.4.4, "Emergency Core Cooling System" ITAAC. . In order to render all of the entries in the ITAAC consistent as well as to clarify the seismic category of the piping systems, in **RAI 242-2153, Question 14.03.03-09**, the staff requested the applicant to change the words "seismic category lines" and "seismic category piping" to "seismic Category I piping." This request is also applicable to other systems in DCD Tier 1.

In addition, the AC stated that the as-built seismic Category I piping identified in DCD Tier 1, Table 2.4.4-3, "Emergency Core Cooling System Piping Characteristics," meets the seismic Category I requirements. However, it was not clear to the staff how the proposed AC could be met by the ITA. The staff, in **RAI 242-2153, Question 14.03.03-09**, requested the applicant to append the phrase "Report(s) documents that" to the beginning of the AC. This request is also applicable to other systems in DCD Tier 1.

In its response to **RAI 242-2153, Question 14.03.03-9** dated April 27, 2009, the applicant revised the ITAAC to provide consistency in the terminology used. The applicant also revised the ITAAC for all seismic Category I piping to ensure that as-built seismic Category I piping meets seismic Category I piping requirements, and this finding is documented in a report as part of the AC. The staff found the response acceptable because the change adequately ensures that the seismic Category I piping, including supports, is supported by a seismic Category I structures. The staff confirmed that the DCD has been revised accordingly. Therefore, **RAI 242-2153, Question 14.03.03-9 is closed**.

14.3.3.4.4 Other ITAAC for ASME Code Systems

The staff identified several issues during its review of ITAAC for systems designed to meet the requirements of ASME Code Section III, and requested greater clarity, consistency, and organizational separation of the design information and installation verification activities in the ITAAC tables. The staff identified issues with the format, content, and consistency of the ITAAC for ASME Code systems and structures, as well as a lack of necessary ITAAC for systems that are classified as either seismic Category I or ASME Code Section III. **RAI 242-2153, Questions 14.03.03-14**, **14.03.03-16** and **RAI 743-5392, Question 14.03.03-24**, along with the applicant responses, are discussed in the following.

Emergency Power Sources (EPS)

In DCD Tier 1, Section 2.6.4, under Item 7 of the ITAAC Table 2.6.4-1, "EPS Systems Inspections, Tests, Analyses, and Acceptance Criteria", the DC stated that the support systems for piping required to performing the safety functions of starting and operating the Class 1E EPS are classified as ASME Code Section III. However, the staff was concerned that simply confirming the classification of the support system was not sufficient to ensure that the ASME Code Section III piping would be fabricated, installed and reconciled to the ASME Code Section III requirements. For ASME Code Section III piping, there should be two separate ITAAC entries to encompass the as-built reconciliation and the fabrication and installation of ASME

Code Section III piping. Therefore, in **RAI 242-2153, Question 14.03.03-14**, the staff requested the applicant to provide appropriate ITAAC in Table 2.6.4-1 for the ASME Code Section III piping.

In its response to **RAI 242-2153, Question 14.03.03-14** dated April 27, 2009, the applicant stated that ITAAC in DCD Tier 1, Table 2.6.4-1 will be revised to address the support system piping and components that are required to support the safety functions of starting and operating the Class 1E EPS. These revisions will be consistent with the ITAAC for other US-APWR ITAAC for ASME Code Section III piping systems and components. The revision to ITAAC Item 7 will include a separate hydrostatic test ITAAC for EPS support system piping and components. The ITAAC will also include more detailed information with respect to the system support function and use terminology consistent with other hydrostatic test ITAAC for ASME Code Section III systems. The requested ITAAC to encompass the fabrication and installation and the as-built reconciliation of EPS support system piping and components will be consistent with the ITAAC in other systems that contain ASME Code Section III piping systems and components. The staff found the response acceptable because as stated above, separate ITAAC are necessary to ensure ASME Code Section III piping systems and components will be fabricated, installed and reconciled to the ASME Code Section III requirements. The staff confirmed that the DCD has been revised accordingly and therefore, **RAI 242-2153, Question 14.03.03-14 is closed**.

Emergency and Floor Drainage System

In DCD Tier 1, Section 2.7.6.8, Equipment and Floor Drainage System, the applicant stated that the seismic category and ASME Code Section III requirements are applied to those isolation valves installed in the drainage piping from the ESF equipment rooms. The staff recognized that the isolation valves installed to provide isolation for the containment are addressed in DCD Tier 1, Section 2.11.2. However, there are no ITAAC associated with these isolation valves installed in the drainage piping from ESF equipment rooms. In order to provide assurance that the as-built drainage isolation valves are able to perform their safety function, the staff, in **RAI 242-2153, Question 14.03.03-16**, requested the applicant to 1) provide appropriate ITAAC to address the design of these seismic category equipment or justification for not including an ITAAC; 2) provide appropriate ITAAC to address the as-built reconciliation of ASME Code Section III components or justification for not including an ITAAC; 3) identify any ASME Code Section III piping in the drainage piping from ESF equipment rooms. If there is ASME Code Section III piping, appropriate ITAAC should also be included.

In its responses to **RAI 242-2153, Question 14.03.03-16** dated April 27, 2009, and December 17, 2012, the applicant added ITAAC to address the staff's concerns regarding seismic concerns, design, fabrication and installation, and isolation capability of ASME Code Section III components. The applicant further explained that there is no ASME Code Section III piping in the equipment and floor drainage system since piping is not required to prevent backflow into the ESF equipment rooms. The staff found the response acceptable because the added ITAAC provide for overall verification by inspection and testing that the as-built drainage isolation valves are fabricated, installed, inspected and reconciled to the certified design commitments, are seismically qualified, and are capable of isolation. **RAI 242-2153, Question 14.03.03-16** will be tracked as a **Confirmatory Item 14.03.03-1** pending the incorporation of the revisions described in the December 17, 2012 response into DCD Revision 4.

Seismic Category Definition in DCD Tier 2

DCD Tier 2, Table 14.3-2 lists examples of ITAAC wording used in DCD Tier 1.
In **RAI 452-3297, Question 14.03.02-12**, the staff requested the applicant to modify the ITAAC entries regarding the seismic category. In its response to **RAI 452-3297, Question 14.03.02-12** dated October 1, 2009, the applicant agreed to revise Item 5b in the ITAAC Table 14.3-2. However, the revised change in Revision 3 of the DCD states "seismic category" instead of "seismic Category I." Therefore, in **RAI 743-5392, Question 14.03.03-24**, the staff requested the applicant to revise the DCD from "seismic category" to "seismic Category I."

In its response to **RAI 743-5392, Question 14.03.03-24** dated May 26, 2011, the applicant explained that the omitted classification of "I" was a typographical error that was not corrected in Revision 3 of the DCD. The applicant agreed to revise the DCD to make the correction. Therefore, **RAI 242-2153, Question 14.03.03-12** is **closed** and **RAI 743-4392, Question 14.03.03-24** will be tracked as **Confirmatory Item 14.03.03-2**.

14.3.3.4.5 Verification of Treatment of Valves

Section 3.9.6 of this SER addresses the staff review of US-APWR ITAAC for the verification of the treatment of valves.

14.3.3.5 Combined License Information Items

There are no COL items identified in Table 1.8-2 of the DCD Tier 2 that reference this section.

14.3.3.6 Conclusions

Based on the staff's review in accordance with SRP Section 14.3.3, the staff review of the applicant's implementation of the selection criteria and methodology for the development of the DCD Tier 1 information in Section 14.3 of US-APWR DCD Tier 2, and on the preceding discussions of RAIs and RAI responses, the staff finds that the top-level design features and performance characteristics of the SSCs are appropriately described in DCD Tier 1 and that the DCD Tier 1 information associated with the scope of SRP Section 14.3.3 is acceptable. Furthermore, the staff finds that the DCD Tier 1 design descriptions associated with the scope of SRP Section 14.3.3 can be verified adequately by ITAAC. Therefore, the staff concludes that the ITAAC and piping DAC associated with the scope of SRP Section 14.3.3 are necessary and sufficient to provide reasonable assurance that if the ITA are performed and the AC met, then a facility referencing the certified US-APWR design can be constructed and operated in compliance with the design certification and applicable regulations, as summarized in Section 14.3.3 of NUREG-0800.

14.3.4 ITAAC for Reactor Systems

14.3.4.1 Introduction

This SER section addresses ITAAC related to reactor systems. The scope of "reactor systems" encompasses the reactor core, fuel, control rods, reactor vessel, reactor coolant system, loose parts monitoring system, and emergency core cooling systems (active and passive) that are significantly related to normal operation, transients, and accidents.

The staff reviewed 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 DC is built and will operate in accordance with the DC, the Atomic Energy Act, and the NRC's regulations. In addition, the staff reviews the justification that compliance with the interface requirements is verifiable through ITAAC, and also reviews the method that is to be used for verification of the interface requirements.

14.3.4.2 Summary of Application

DCD Tier 1: The Tier 1 information associated with this section is found in Tier 1, Section 2.4, "Reactor Systems," of the DCD.

US-APWR DCD (Revision 3) Tier 1, Section 2.4 addresses reactor systems which includes the Reactor System, Reactor Coolant System (RCS), Emergency Core Cooling System (ECCS), Containment Spray System (CSS), Residual Heat Removal System (RHRS) and Chemical and Volume Control System (CVCS). For each system, descriptions including tables and figures are provided. ITAAC are presented in the following tables:

- Table 2.4.1-2 Reactor System ITAAC,
- Table 2.4.2-5 Reactor Coolant System ITAAC,
- Table 2.4.4-5 Emergency Core Cooling System ITAAC,
- Table 2.4.5-5 Residual Heat Removal System ITAAC, and
- Table 2.4.6-5 Chemical and Volume Control System ITAAC.

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, and controls, logic for system actuation, interlocks, 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 Design Commitment column of the ITAAC tables listed above.

The applicant organized its Tier 1 information in a manner similar to that used for the evolutionary designs described in SRP Section 14.3 and RG 1.206 Section C.II.1-1. The ITAAC tabular format and content for the reactor systems follows the NRC recommended format described and presented in RG 1.206, Table C.II.1-1, "Sample ITAAC Format." The ITAAC are presented in a three-column table that includes the proposed commitment to be verified (column 1), method by which the licensee will verify (column 2), and specific acceptance criteria for the inspections, tests, or analyses (column 3) that, if met, demonstrate the licensee has met the design requirements/commitment in column 1.

DCD Tier 2: The applicant has provided a Tier 2 design description in DCD Section 14.3.4.4, summarized here in part, as follows:

> ITAAC for reactor systems focus mainly on reactor design including the reactor core, fuel, control rods, reactor vessel, reactor coolant system, loose parts monitoring system, and emergency core cooling systems (active and passive) that are significantly related to normal operation, transients, and accidents. These ITTAC for reactor systems are provided to verify the following:

- Important input parameters used in the transient and accident analyses for the facility design.
- Net positive suction head for key pumps.
- Elevation differences between the reactor core and storage pools (pits) and/or tanks credited in the safety analyses for passive plants.
- The design pressures of the piping systems that interface with the reactor coolant boundary to validate intersystem LOCA analyses.

The applicant stated that the ITAAC for reactor systems were prepared in accordance with the guidance in RG 1.206, Section C.II.1, "Inspections, Tests, Analyses, and Acceptance Criteria"; NUREG-0800 SRP Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria"; and NUREG-0800 SRP Section 14.3.4 "Reactor Systems – Inspections, Tests Analyses, and Acceptance Criteria."

ITAAC: The ITAAC associated with Tier 1, Section 2.4 are given in Tier 1, Sections 2.4.1.2, 2.4.2.2, 2.4.3.2, 2.4.4.2, 2.4.5.2, and 2.4.6.2.

The ITAAC associated with Tier 1, Section 2.4 are given in Tier 1, Section 2.4, as listed in Tier 2 DCD Table 14.3-3, "Reactor Systems" and are provided below:

- 2.4.1 Reactor System
- 2.4.2 Reactor Coolant System (RCS)
- 2.4.4 Emergency Core Cooling System (ECCS)
- 2.4.5 Residual Heat Removal System (RHRS)
- 2.4.6 Chemical and Volume Control System (CVCS)

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

COL information or action items: See Section 14.3.4.4.5 below.

Technical Report(s): There are no technical reports associated with this area of review.

Topical Report(s): There are no topical reports associated with this area of review.

US-APWR Interface Issues identified in the DCD: There are no US-APWR interface issues associated with this area of review.

Site Interface Requirements Identified in the DCD: There are no site interface requirements associated with this area of review

Cross-cutting Requirements (TMI, USI/GSI, Op Ex): None identified.

RTNSS: There are no RTNSS issues for this area of review.

10 CFR 20.1406: There are no issues related to 10 CFR 20.1406 for this area of review.

14.3.4.3 Regulatory Basis

The relevant Commission regulations for this area of review, and the associated acceptance criteria, are given in Section 14.3.4 of NUREG-0800 and are summarized below. Review interfaces with other SRP sections can be found in Section 14.3.4 of NUREG-0800. Acceptance criteria are based on meeting the relevant requirements of the following Commission regulation:

> 10 CFR 52.47(b)(1), which requires that a DC application include 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 DC has been constructed and will operate in accordance with the DC, the provisions of the Atomic Energy Act, and the NRC's regulations.

Specific SRP acceptance criteria acceptable to meet the relevant requirements of the NRC's regulation identified above can be found in Part II of Section 14.3.4 of NUREG-0800.

14.3.4.4 Technical Evaluation

Introduction

The staff reviewed the ITAAC of the systems in US-APWR DCD (Revision 3) Tier 1, Section 2.4, “Reactor Systems” to confirm that the applicant has proposed adequate inspections, tests, analyses, and acceptance criteria in compliance with the guidance provided in RG 1.206, Section C.II.1, “Inspections, Tests, Analyses, and Acceptance Criteria,” SRP Section 14.3, “Inspections, Tests, Analyses, and Acceptance Criteria,” and SRP Section 14.3.4 “Reactor Systems - Inspections, Tests, Analyses, and Acceptance Criteria.”

ITAAC Development Criteria

RG 1.206 Section C.II.1.2.4, “ITAAC for Reactor Systems” describes the ITAAC development for reactor systems and identifies the aspects to be verified through ITAAC. These are related to the reactor design, such as core components, fuel, control rods, reactor coolant system, emergency core cooling system, residual heat removal system, chemical and volume control system, and loose parts monitoring system.

Since the features for ITAAC development criteria listed in DCD Tier 2 Section 14.3.4.4 are identical to those listed in Regulatory Guide 1.206 Section C.II.1.2.4 for an active plant, the staff concludes that the applicant adequately identified the general aspects to be verified through ITAAC in DCD Tier 2 section 14.3.4.4 including the ITAAC to verify the top level design features.

Design Descriptions and Figures

The staff reviewed the US-APWR DCD (Revision 2) of the reactor systems in Tier 1 using the guidance provided in SRP Section 14.3 including Appendix C, “Detailed Review Guidance, Fluid Systems Review Checklist,” and SRP Section 14.3.4.

In **RAI 191- 2048, Question 14.03.04-09**, **RAI 198-2069, Question 14.03.04-20**, **RAI 198-2069, Question 14.03.04-21**, and **RAI 198-2069, Question 14.03.11-22**, the staff requested the applicant to add additional Tier 2 design description information into Tier 1. In response to these RAIs, the applicant revised the US-APWR Tier 1 design description information and the staff confirmed that these changes were reflected in the US-APWR DCD (Revision 3) Tier 1 section, and these RAIs were closed. Therefore, based on review of information provided in the US-APWR DCD (Revision 3), the staff concludes that the US-APWR Tier 1, "Reactor Systems" descriptions and figures are acceptable, because they comply with the guidance in SRP Sections 14.3 and 14.3.4.

Standard and System Specific ITAAC Entries

The staff reviewed the US-APWR DCD (Revision 2) Tier 1 ITAAC Entries in Section 2.4 using the guidance provided for standard and system specific ITAAC entries contained in SRP Sections 14.3 and 14.3.4.

Reactor Systems Tier 1 Section 2.4

The staff reviewed the US-APWR Tier 1 ITAAC entries to identify generic issues affecting all ITAAC tables in Section 2.4 using the guidance provided for reactor systems ITAAC entries provided in RG 1.206 Section C.II.1.2.4, "Reactor Systems."

The staff's review identified that the Class 1E separation criteria as defined in the "design commitment" is concerned with separation between Class 1E divisions and between those divisions and non-class 1 E cable; whereas, the acceptance criterion is concerned only with raceways. However, the staff interprets the "design commitment" as being more generic to include not only the raceways but also inside the panels, switchgear, and at the components. Therefore, in **RAI 191- 2048, Question 14.03.04-09**, the staff requested that the applicant address its concerns regarding separation throughout the complete cable run.

In a letter dated April 7, 2009, the applicant responded to **RAI 191- 2048, Question 14.03.04-09** that ITAAC "to verify physical separation of the Class1 E divisions' cables and the separation of Class 1E divisions' cables from non-Class 1E cables, will be revised to be more generic." The staff found the applicant's response to the staff concerns acceptable because the revised ITAAC acknowledge the separation criteria from the beginning to the end of the cable routing. The staff confirmed that the changes were incorporated in the US-APWR DCD (Revision 3) Tier 1 section, and therefore, the staff considered **RAI 191- 2048, Question 14.03.04-09 resolved and closed**.

In addition, the staff found that the ability of the as-built equipment to perform the designated safety function for a minimum required time period is not captured in the design commitment or acceptance criteria for Class 1E/qualified items which require wiring, cables, or terminations that are located in a harsh environment. Therefore, in **RAI 193-1842, Question 14.03.04-22**, the staff requested that the applicant assess whether the ITAAC for equipment in a harsh environment adequately address the minimum required time period to perform its designed safety functions.

In a letter dated April 9, 2009, the applicant responded to **RAI 193-1842, Question 14.03.04-22** that the "ITAAC will be revised to include inspections, tests and analyses to verify that the equipment is qualified for harsh environments." The staff found the applicant's response acceptable because it included the condition that equipment in a harsh environment would satisfy the required time to perform its designed safety functions following a design basis accident. The staff confirmed that the changes were incorporated in the US-APWR DCD (Revision 3) Tier 1 section, and therefore **RAI 193-1842, Question 14.03.04-22** is considered **resolved and closed**.

In regard to verifying that each Class 1E components are independently powered from their respective Class 1E division power source, the staff identified the need to establish that simulated test signals exist only at the Class 1E equipment under test. Therefore, the staff in **RAI 193-1842, Question 14.03.04-23** requested the applicant to reassess the instructions in the "inspection, tests, and analysis" and "acceptance criteria" columns to indicate that only the equipment for each Class 1E division, when it is tested, receives power from a power supply in the same division.

In a letter dated April 9, 2009, the applicant responded to **RAI 193-1842, Question 14.03.04-23** by stating that the "design commitments for ITAAC of this type require that the Class 1E components are powered from their respective Class 1E division." The design commitment may be shown to be satisfied by verifying that a simulated test signal that is injected, only in the division under test, is detected at the equipment under test. Therefore, the applicant will revise each reactor system ITAAC table to include the requirement that the simulated test signal is only detected in the Class 1E division under test. The staff found that the revised ITAAC acceptable because it met the requirement of separation of each Class 1E division power source. The staff confirmed the revision was incorporated in the US-APWR DCD (Revision 3) Tier 1 section for each reactor system such that the staff considered **RAI 193-1842, Question 14.03.04-23 resolved and closed**.

As part of the overall ITAAC process, the staff reviewed each reactor system ITAAC identified in Tier 1 Section 2.4 for technical coherence to ensure that the "design commitment," "inspections, tests, and analysis," and "acceptance criteria" are properly interfaced to provide an understandable and achievable measureable method to produce accurate test results to compare against the acceptance criteria to determine that the reactor system designed safety functions are acceptable. Therefore, the staff in **RAI 193-1842, Question 14.03.04-19** requested the applicant to reassess the identified ITAAC instructions for all reactor systems in the US-APWR DCD (Revision 3) Tier 1 Section 2.4.

In a letter dated April 9, 2009, the applicant responded to **RAI 193-1842, Question 14.03.04-19** that the ITAAC in APWR DCD (Revision 3) Tier 1 Section 2.4 will be revised. The staff confirmed the revision was incorporated in the US-APWR DCD (Revision 3) Tier 1 section for each reactor system such that the staff considered **RAI 193-1842, Question 14.03.04-19 resolved and closed**.

In the review of ITAAC Item 12.a in Table 2.4.2-5, the staff found that the "design commitment" required additional clarification to understand the commitment requirement of the motor operated valves safety function. Therefore, the staff in **RAI 193-1842 Question 14.03.04-28** requested clarification from the applicant about the design commitment of the following: ITAAC

Item 12.a in Table 2.4.2-5, ITAAC Items 9.a in Table 2.4.4-5, 10.a in Table 2.4.5-5, and 10.a in Table 2.4.6-5.

In a letter dated April 9, 2009, the applicant responded to **RAI 193-1842, Question 14.03.04-28** that editorial corrections will be made to the ITAAC Items cited in the question to clarify that the design commitments require the valves to perform an active safety function to change position as indicated in the appropriate ITAAC tables. The staff found the response acceptable, confirmed the changes, and considered **RAI 193-1842, Question 14.03.04-28 resolved and closed**.

The staff reviewed ITAAC Item 13.b in Table 2.4.2-5 in reference to the Logic subsection of Tier 1 Subsection 2.4.2.1 (DCD Revision 1) that indicates the reactor coolant pumps trip upon a simultaneous transmission from emergency core cooling system accumulation signal and reactor trip signal. The staff concludes that specific trip signals should be identified and simulated independently to fully evaluate the pump trip function. The applicant should identify the source of the trip signal in all columns and clarify the design commitment listed for ITAAC Item 13.b. Also, the applicant should address the need to include reactor coolant pumps in Table 2.4.2-4 where the pump breakers and pump instrumentation are listed. In addition, the staff noted that the aspect of about no pumps being in Table 2.4.2-4 also applies to ITAAC Item 13.a, ITAAC Items 10.a and b in Table 2.4.4-5, "Emergency Core Cooling System ITAAC," and ITAAC Items 11 .a and b in Table 2.4.6-5, "Chemical and Volume Control System ITAAC." Therefore, the staff submitted **RAI 193-1842, Question 14.03.04-29** for the applicant to address their concerns.

In a letter dated April 9, 2009, the applicant responded to **RAI 193-1842, Question 14.03.04-29,** the applicant provided revisions to address the staff concerns. The staff found the response acceptable, confirmed the revisions in the three reactor system subsections, and concluded that **RAI 193-1842, Question 14.03.04-29 is resolved and closed**.

The staff reviewed the ITAAC Items related to the alarms, displays, and control functions for both main control room (MCR) and remote shutdown console (RSC) panels as listed in Table 2.4.2-4. The staff concluded that both of these panels would have all of these alarms, displays, and control functions and, if this is the case, should be included in ITAAC Items 14 and 15. Therefore, the staff submitted **RAI 193-1842, Question 14.03.04-30** to the applicant requesting a review and, if necessary, revision to the applicable ITAAC Items along with Table 2.4.2-4, "Reactor Coolant System Equipment Alarms, Displays, and Control Functions." Also, the staff noted that this RAI is applicable to ITAAC Items 11 and 12 in Table 2.4.4-5, ITAAC Items 12 and13 in Table 2.4.5-5, and ITAAC Items 12 and 13 in Table 2.4.6-5 along with their respective alarms, displays, and control functions tables.

In a letter dated April 9, 2009, the applicant responded to **RAI 193-1842, Question 14.03.04-30,** the applicant provided revisions to address the staff concerns. To summarize, the applicant will revise Table 2.4.2-5 and other similar tables that indicate alarms, displays and controls to "indicate that the alarms and displays are located at MCR and the alarms, displays and controls are located at RSC." The applicant also clarified that controls from the MCR are identified in Table 2.4.2-5 and therefore, do not need to be included in Table 2.4.2-5, ITAAC Item 14. The staff found the response acceptable, confirmed the revisions in the four reactor system subsections, and concluded that **RAI 193-1842, Question 14.03.04-30 is resolved and closed**.

Reactor Systems ITAAC, Table 2.4.1-2

The reactor system is a safety-related system with the following primary functions to provide: (1) heat by a controlled nuclear fission process, (2) barriers to contain radioactivity during reactor operations, and (3) the means for controlling reactivity including shutting down the reactor.

The reactor system includes the reactor internals consisting of upper and lower assemblies, the fuel assemblies, the control rods, the reactor vessel, in-core thermocouples and neutron detectors, and the control rod drive mechanisms.

The staff review of the reactor system focused primarily on ITAAC that verify the top-level design aspects of the reactor internals. This included ITAAC applicable to the functional arrangement, seismic and ASME Code classification, weld quality and pressure boundary integrity, valve qualification and operation, controls, alarms, and displays, logic and interlocks, equipment qualification for harsh environments, interface requirements with other systems, and Class 1E electrical power sources and divisions.

The staff's review identified that the fracture toughness requirements of 10 CFR 50, Appendix G were not specifically included in the "design commitment" and "acceptance criteria" for Item 4 of the US-APWR DCD Tier 1 Table 2.4.1-2; however, this requirement is identified in the design commitments in Tier 1 page 2.4-1 (Revision 3). Also, the "design commitment" and "acceptance criteria" of Item 4 included a vague general statement referring to "any additional requirements" which were not identified in this section; consequently, it would not be possible for an inspector to verify that the acceptance criterion for Item 4 in US-APWR DCD Tier 1 Table 2.4.1-2 is met as written. Therefore, the staff submitted **RAI 193-1842, Question 14.03.04-20** to the applicant to include the fracture toughness requirements and remove the vague statement or provide and justify the any additional requirements.

In a letter dated April 9, 2009, the applicant responded to **RAI 193-1842, Question 14.03.04-20** that the Item 4 ITAAC will be revised to include the fracture toughness requirements of 10 CFR 50, Appendix G and remove the vague statement. The staff found the applicant's response acceptable because the revision included the fracture toughness requirements and specifically state the requirements. Thus, the staff confirmed that the changes were incorporated in the US-APWR DCD (Revision 3) Tier 1 section, and therefore **RAI 193-1842, Question 14.03.04-20** is considered **resolved and closed**.

In ITAAC Item 8, the staff noted that the seismic Category I Reactor Systems equipment, identified in Table 2.4.1-1, is designed to withstand seismic design basis loads without loss of safety function. However, the staff found no sub-step with separate "inspection, test, analysis" and "acceptance criteria" for an inspection to verify that the equipment was installed and bounded by an analysis. Therefore, the staff submitted **RAI 193-1842, Question 14.03.04-21** to the applicant to assess the need for a sub-step to verify that the installed equipment is bounded by an analysis.

In a letter dated April 9, 2009, the applicant responded to **RAI 193-1842, Question 14.03.04-21** that ITAAC Item 8 will be revised to include a sub-step to verify that the installed equipment is bounded by an analysis. The staff found the applicant's response acceptable because the

revision included a sub-step to verify that the installed equipment is bounded by an analysis. Also, the staff confirmed that the changes were included in the US-APWR DCD (Revision 3) Tier 1 section, and therefore, **RAI 193-1842, Question 14.03.04-21** is considered **resolved and closed**.

In ITAAC Item 12, the staff identified a concern that the "design commitment" refers to non-Class 1E divisions but the "acceptance criteria" does not indicate or verify that non-class 1 E cables are routed in their own raceways. In addition, the staff found that there was no method to verify that only cables from a certain division are routed in crowded raceways. Therefore, the staff submitted **RAI 193-1842, Question 14.03.04-24** to the applicant to address the two concerns described above.

In a letter dated April 9, 2009, the applicant responded to **RAI 193-1842, Question 14.03.04-24** that ITAAC Item 12 was addressed in **RAI 191-2048, Question No. 14.03.04-09** in which the applicant stated that the ITAAC "to verify physical separation of the Class1 E divisions' cables and the separation of Class 1E divisions' cables from non-Class 1E cables, will be revised to be more generic." In addition, the applicant stated that inspection "of raceways is facilitated by color coding of Class 1E cables and raceways to indicate their division, as described in DCD Tier 2, Subsection 8.3.1.1.8, "Electrical Equipment Layout." The staff considered the applicant's response acceptable and confirmed the revisions in the US-APWR DCD (Revision 3) Tier 1 section; for that reason, the staff considered **RAI 193-1842, Question 14.03.04-24 resolved and closed**.

The staff identified that ITAAC Item 14 "acceptance criteria" did not provide the minimum number of required capsules with material surveillance specimens to satisfy the "design commitment." Based on the minimum number of required capsules as stated in Tier 2 Section 5.1.3.1.6, the staff submitted **RAI 193-1842, Question 14.03.04-25** for the applicant to include the number of required capsules in the "acceptance criteria" of ITAAC Item 14.

In a letter dated April 9, 2009, the applicant responded to **RAI 193-1842, Question 14.03.04-25** that ITAAC Item 14 "acceptance criteria" will be restated to include "a minimum of three as-built surveillance capsules are provided." The staff considered the applicant's response acceptable and confirmed the revisions in the US-APWR DCD (Revision 3) Tier 1 section. Thus, the staff considered **RAI 193-1842, Question 14.03.04-25 resolved and closed**.

However, upon further review of Tier 2 Section 5.1.3.1.6, the staff confirmed the capsules location and orientation are required to ensure "that the lead factors (ratio of the neutron flux at the location of the capsule to that at the reactor vessel inner surface at the peak fluence location) of the surveillance capsules are between 2 and 3" for analysis of the embrittlement properties of the reactor vessel materials. In addition, the staff stated that the Tier 1 Table 2.4.1-2, ITAAC Item 14 lacks sufficient details/specificity to assure successful completion (e.g., required location of the specimen guides on the RV). Therefore, the staff submitted **RAI 941-6465, Question 14.03.04-43** to the applicant to address these concerns and, if applicable, add a sub-step to ITAAC Item 14 "acceptance criteria" to verify the location and orientation of the capsules.

The applicant responded to **RAI 941-6465, Question 14.03.04-43,** in a letter dated September 5, 2012, ITAAC Item 14 will be revised to verify the surveillance guide baskets are attached to the core barrel and hold the surveillance specimens. This revision includes changes to the

inspections, tests, and analysis (ITA) and acceptance criteria (AC) into two separate parts as follows: (1) inspection to verify that the four as-built surveillance capsule guide baskets are attached to the as-built core barrel in accordance with the design basis (DCD Tier 2 Figure 5.3-1), (2) determine that the surveillance capsules are in the locations required the by analyses, and (3) inspect and verify that the six as-built surveillance capsules are placed at the required location in the as-built surveillance capsule guide baskets. In addition, DCD Tier 2 Figure 5.3-1 will be revised to illustrate the location of the four surveillance capsule guide baskets based on the design analysis. The staff considered the applicant's response acceptable and status of **RAI 941-6465, Question 14.03.04-43** as a **Confirmatory Item 14.03.04-1** pending the verification of DCD Revision 4.

Reactor Coolant System ITAAC, Table 2.4.2-5

The primary function of the reactor coolant system is to provide reactor cooling by transferring the heat generated in the reactor core through the primary side to the secondary side of steam generators (SGs). Besides providing reactor core cooling, another primary purpose of the reactor coolant system is to safely provide large amounts of heat in a control effective manner to the SG for steam production to the turbines for electrical production.

The RCS is a safety-related system providing the following additional safely significant functions:

- Reactor coolant pressure boundary,
- Overpressure protection via the pressurizer safety valves,
- Depressurization during design bases events,
- Coastdown flow by reactor coolant pump (RCP) rotating inertia, and
- Containment isolation functions as described in Subsection 2.11.2.

Following the guidance provided in RG 1.206, C.II.1.2.4 and SRPs 14.3 and 14.3.4, the staff performed a thorough ITAAC evaluation with special attention to: (1) seismic and ASME Code classification, (2) weld quality and pressure boundary integrity, (3) valve qualification and operation, (4) controls, alarms, and displays, (5) logic and interlocks, (6) equipment qualification for harsh environments, (7) design pressures of the piping systems that interface with the reactor coolant boundary to validate intersystem LOCA analyses, and (8) system operation in various modes.

In the review of ITAAC Item 9.c in regard to the separation criteria between Class 1 E divisions and between those divisions and non-class 1 E cable, the staff found that the design commitment refers to non-Class 1E divisions; however, the acceptance criterion does not indicate that the non-class 1E cables are routed in their own raceways. The staff concern is that inspections will not be able to verify only cables from a certain division are routed in crowded raceways. Therefore, staff submitted **RAI 193-1842, Question 14.03.04-24** requesting the applicant to address their concerns regarding inspection capability of verifying separation of non-Class 1E cables routed in crowded raceways.

In a letter dated September 4, 2009, the applicant responded to **RAI 193-1842, Question 14.03.04-24** that the ITAAC sited will be revised as described in the previous **RAI 191- 2048, Question 14.03.04-09.** Also, the applicant stated that "Inspectability of raceways is facilitated

by color coding of Class 1E cables and raceways to indicate their division, as described in DCD Tier 2, Subsection 8.3.1.1.8 Electrical Equipment Layout." The staff found the RAI response acceptable and confirmed that the changes were incorporated in the US-APWR DCD (Revision 3) Tier 1 section. Therefore, the staff considered **RAI 193-1842, Question 14.03.04-24 resolved and closed**.

In the review of ITAAC Items 7 and 8, the staff noted that Table 2.4.2-3 refers to piping while Table 2.4.2-2 refers to major system equipment but also includes piping associated with this equipment; therefore, the staff believes that the piping identified in ITAAC Item 8 should be included in ITAAC Item 7 or another ITAAC similar to Item 7 should be developed. Therefore, staff submitted **RAI 193-1842, Question 14.03.04-26** requesting the applicant to address their piping concerns.

In a letter dated September 4, 2009, the applicant responded to **RAI 193-1842, Question 14.03.04-26** that "the current description of Item 8 is reasonable. The ITAAC for the location of the piping is essentially same as ITAAC item 2. Therefore, ITAAC for Item 7.i is included in ITAAC Item 2." Also, the applicant stated that ITAAC Items 7.ii and 7.iii analyses or inspections are included in ITAAC Item 8. However, design commitment of ITAAC Item 2 refers to Subsection 2.4.2.1, Design Description, but it does not clearly state the piping location. Therefore, the applicant will revise Subsection 2.4.2.1, Location and Functional Arrangement, to add the reference of Table 2.4.2-1. After review of the response, the staff found the response acceptable and changed the status of **RAI 193-1842, Question 14.03.04-26 to resolved and closed**.

In review of the reactor coolant pump rotating inertia requirement, ITAAC Item 10.c, the staff found that no value was provided in the acceptance criteria to represent the value used in the safety evaluation. In addition, the staff believes that the specified acceptance criteria do not provide a basis for evaluating the acceptability of the tests and analyses. Additionally, the staff recommends that a pump flow coastdown curve to be generated as part of the test for Item 10.c and evaluated. If a pump flow coastdown curve is to be generated, it should be noted in the Inspections, Tests, Analyses column. Therefore, the staff submitted **RAI 193-1842, Question 14.03.04-27** to the applicant to address these concerns.

In a letter dated September 4, 2009, the applicant responded to **RAI 193-1842, Question 14.03.04-27** that the reactor coolant pump rotating inertia of each as-built reactor coolant pump will be confirmed to be no less than the required value used in the safety evaluation which is 1153301b-ft2. The staff agreed that the response was reasonable and **RAI 193-1842, Question 14.03.04-27** status was changed to **resolved and closed**.

In ITAAC Item 10.a.i, the staff noted that the acceptance criteria for the sum of the safety valves relieving capacity must exceed 1.728 x 10^6 lb/hr. The staff submitted **RAI 373-2826, Question 14.03.04-36** to the applicant to provide the basis for the number and where it is documented.

In a letter dated June 16, 2009, the applicant responded to **RAI 373-2826, Question 14.03.04-36** by providing the basis as described in DCD Subsection 5.2.2.4 that the "total capacity of the pressurizer safety valves is determined from the maximum surge rate resulting from complete loss of load with only main steam safety valves actuation." Furthermore, the applicant identified that the total relieving capacity was the sum of the minimum required capacity per valve as

documented in DCD Table 5.2.2-1. The staff found the response acceptable and changed the status of **RAI 373-2826, Question 14.03.04-36 to resolved and closed.**

From ITAAC Item 10.a.ii Acceptance Criteria that the safety valve set point is less than or equal to 2485 pounds per square inch gauge (psig) or approximately 2500 pounds per square inch absolute (psia) and in the loss of load accident the safety valves are assumed to open at 2515 psia and be fully open by 2575 psia, the staff could not determine the valve set point uncertainty value. **RAI 373-2826, Question 14.03.04-37** was submitted to the applicant requesting an explanation of how the valve set point uncertainty value is determined. In addition, the staff requested information in regard to the 2500 psia Acceptance Criteria as being an open or fully open position pressure.

In response to **RAI 373-2826, Question 14.03.04-37**, the applicant explained that the requirement for the pressurizer safety valve set point uncertainty value is less than +/- 1 percent which complies with ASME Code, Section III, NB 7500 requirements. In addition, the acceptance criterion value of 2500 psia is the pressure required for the valve to start opening. Also, the applicant explained that for conservatism, the pressurizer safety valve open pressure at “loss of load analysis” is assumed to occur at 2525 psia, not 2515 psia as previously calculated. The applicant stated that no revisions would be made to the DCD. The staff found the response to be acceptable and changed the status of **RAI 373-2826, Question 14.03.04-37 to resolved and closed**.

In **RAI 941-6465, Question 14.03.04-44** the staff identified in Tier 1 Table 2.4.2-5, ITAAC 10.a.ii that "Tests and analyses in accordance with ASME Code Section III of the pressurizer safety valves identified in Table 2.4.2-2 will be performed to confirm set pressure." The staff questioned why analysis was needed when it appears that testing was sufficient to satisfy the ITA (Inspection, Tests, and Analysis) part of the ITAAC. The applicant in response to **RAI 941-6465, Question 14.03.04-44**, dated September 5, 2012 agreed to delete "Analyses" from the ITA of Tier 1 Table 2.4.2-5, ITAAC 10.a.ii, because according to ASME Code Section III a "test" is sufficient to verify the set pressure of the ASME Code Section III safety valves identified in Table 2.4.2-2. The staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable and determined that **RAI 941-6465, Question 14.03.04-44** is **Confirmatory Item 14.03.04-2** pending the verification of DCD Revision 4.

In review of ITAAC Table 2.4.4-5, the staff had determined that the accumulator and N2 header relief valves were not included as part of the ITAAC verification process. Therefore, the staff submitted **RAI 941-6465, Question 14.03.04-54** to the applicant to provide justification for not including the accumulator and N2 header relief valves components in their ITAAC program.

In a letter dated May 21, 2012, the applicant responded to **RAI 941-6465, Question 14.03.04-54** that the accumulator and N2 header relief valves are not required to be in the scope of the ITAAC because the accumulator and N2 header relief valves do not perform an active safety function and there will be no revision to include them. For a full explanation, see **Question 14.03.04-46** response. Thus, in conjunction with **Question 14.03.04-46** response, the staff found **RAI 941-6465, Question 14.03.04-54** response acceptable.

Emergency Core Cooling System ITAAC, Table 2.4.4-5

The primary purpose of the emergency core cooling system is to remove stored energy and fission product decay heat from the reactor core following an accident. The safety related system performs important functions which ensure that (1) fuel cladding temperature, oxidation and hydrogen production limits are not exceeded, (2) "coolable" core geometry is maintained, (3) long term core cooling is available, and (4) capable of providing containment isolation as described in Section 2.11.2, for piping penetrating the containment. In conjunction with control rod insertion, the emergency core cooling system is designed to shut down and cool the reactor during the following accidents: (1) LOCAs, (2) ejection of a control rod cluster assembly, (3) secondary steam system piping failure, (4) inadvertent operation of the main steam relief or safety valve, and (5) SG tube failure.

In review of ITAAC Item 1.b, the staff could not determine how the acceptance criteria satisfy the design commitment. The design commitment calls for each emergency core cooling system mechanical division to be physically separated. The acceptance criteria states that the physical separation can be structural or by a fire barrier. However, a fire barrier does not necessarily infer physical separation between components of different emergency core cooling system divisions as required by the design commitment. The design commitment statement only appears in Tier 1 Table 2.4.4-5 and is not expanded on or amplified in Tier 1 Section 2.4.4 in a text discussion or a tabular form. This concern is also applicable to ITAAC Item 1.b in Table 2.4.5-5. Therefore, the staff submitted **RAI 192-1847, Question 14.03.04-10** to the applicant to explain how the acceptance criteria meet the design commitment for Item 1.b.

In a letter dated April 10, 2009, the applicant responded that the acceptance criteria will be revised to state (1) that the physical separation is provided by using structural barriers and (2) the Tier 1 Design Description will state that structural barriers also serve as fire barriers and to identify any exceptions or clarifications. The staff found the applicant's response acceptable, confirmed the changes made to this ITAAC Item, and re-status **RAI 192-1847, Question 14.03.04-10** to **resolved and closed**. (This RAI question is also applicable to ITAAC Item 1.b in Residual Heat Removal System Table 2.4.5-5.)

In review of ITAAC Item 7.d, the staff found several issues that needed to include additional information regarding the injection tests into the reactor coolant system. These issues included the need to: (1) clarify the reactor coolant system pressure conditions at the time of the injection tests, (2) explain whether the reactor coolant system pressure have an effect on the injection tests results, (3) if the reactor coolant system pressure impacts the injection test results, discuss the analysis to verify the water volumes injected during the large flow stage and the small flow stage, (4) clarify the water volume to be established in the accumulators prior to the injection test, (5) clarify that the test description states that each as-built accumulator will be "partially" filled with water. Explain if each accumulator will be filled with water to within the normal operating band or if analyses will be used to establish the water volumes injected during the large flow stage and the small flow stage, and (6) the design commitment discusses makeup, do any of the acceptance criteria address that function? Therefore, the staff submitted **RAI 192-1847, Question 14.03.04-11** to the applicant to address these concerns.

In a letter dated April 10, 2009, the applicant provided an explanation that addressed the staff concerns including a revision to ITAAC Item 7.d. The applicant revised the inspections, tests, and analyses column to include the effect on the analyses for net positive suction head available by referring to the (1) pressure losses in piping and components, (2) low suction level of the refueling water storage pit, (3) pressure loss in strainers due to blockage, as applicable,

and (4) vendor test results of net positive suction head. The staff found the applicant's response acceptable, confirmed the changes made to this ITAAC Item, and re-status **RAI 192-1847, Question 14.03.04-11 to resolved and closed**. (This RAI question is also applicable to ITAAC Item 8.f in Residual Heat Removal System Table 2.4.5-5.)

US-APWR DCD Tier 1, Table 2.4.4-5, "Emergency Core Cooling System Inspections, Tests, Analyses, and Acceptance Criteria," in ITAAC 1.a references Figure 2.4.4-1, "Emergency Core Cooling System," for the functional arrangement of the ECCS. In **RAI 941-6465, Question 14.03.04-45**, the staff requested that the US-APWR design certification applicant address the consistency of Figure 2.4.4-1 with the guidance in the SRP to ensure that all appropriate components (e.g., ASME BPV Code, Section III, Class 2 Seismic Category 1 relief valves; hand control valves [HCVs]; and important alarms and instrumentation) are included in the figure.

In a letter dated September 5, 2012, the applicant stated that ASME BPV Code, Section III, Class 2 Seismic Category 1 relief valves, HCVs, and certain alarms and instrumentation were not incorporated in Figure 2.4.4-1 because of the following reasons: (1) Table 2.4.4-4, "Emergency Core Cooling System Equipment, Alarms, Displays and Control Functions," lists equipment, including alarms and instruments for verification of their function, which will be verified by ITAAC 2.4.4-5 Items 1.a, 8, 11, 12.i and 12.ii; (2) the ECCS has two remote manual control valves (SIS-HCV-017 and SIS-HCV-089) of which neither has an active safety function nor receives a safety injection signal; and (3) the five ECCS relief valves do not have specific active safety functions and their risk significance has been determined to be low.

In a revised response to **RAI 941-6465, Question 14.03.04-45**, dated June 26, 2013, the applicant provided additional information on the basis for excluding these components from Figure 2.4.4-1. In its RAI response, the applicant referenced the guidance in SRP 14.3, Appendix C, "Detailed Review Guidance" I. B. ix, which states that figures for safety-related systems should include most of the valves on the DCD Tier 2 Piping and Instrumentation Diagram (P&ID) except for items, such as fill, drain, test tees, and maintenance isolation valves. The SRP also states that the scope of valves to be included in the figures includes those motor operated valves (MOVs), power operated valves (POVs), and check valves with a safety-related active function. The SRP then states that valves remotely operable from the Control Room should be shown if their mispositioning could affect system safety function. The SRP indicates that other valves are evaluated for exclusion on a case-by-case basis. The staff continued its review with further interactions with the applicant because the basis for excluding components from Figure 2.4.4-1 was not completely described in the response to **RAI 941-6465, Question 14.03.04-45**.

In another revised response to **RAI 941-6465, Question 14.03.04-45**, dated November 8, 2013, the US-APWR design certification applicant provided updated bases for not including specific alarms and instrumentation, HCVs, and ASME BPV Code, Section III, Class 2, Seismic Category I relief valves in DCD Tier 1, Figure 2.4.4-1. Regarding alarms and instruments, the applicant stated that SRP 14.3 indicates that instruments required to perform tasks outlined in the Generic Technical Guidelines should be shown on the figures, or described in the design descriptions. The applicant also stated that instrument connection configurations may change as detailed engineering progresses. Regarding HCVs, the applicant stated that the ECCS has two remote HCVs that have not been included in DCD Tier 1. In particular, the applicant stated that the 1-inch accumulator makeup flow control valve SIS-HCV-089 is normally closed, does not have a safety function, does not adversely affect system safety function, and does not fall within the ASME BPV Code boundary. The applicant stated that the 1-inch nitrogen discharge

pressure control valve SIS-HCV-017 could not affect system safety function because SIS-MOV-125A, B, C, and D, which have active safety functions in the IST program, could be operated to prevent accidental discharge of nitrogen into containment. Regarding ASME BPV Code, Section III, Class 2, Seismic Category I relief valves, the applicant stated that it excluded these relief valves from Tier 1 if they met all of the following attributes: (1) are not ASME BPV Code, Section III, Class 1 components; (2) have no safety function assumed in the accident analysis; (3) are not risk-significant components; (4) are not containment isolation valves; and (5) have no operational capability from the MCR. The applicant stated that the five ECCS relief valves (SIS-SRV-116 and SIS-SRV-126 A to D) meet these criteria.

The staff finds that the US-APWR design certification applicant has justified the exclusion of specific components from DCD Tier 1, Figure 2.4.4-1 consistent with the guidance in SRP Section 14.3, Appendix C I. B. ix because these components do not provide or have any effect on the safety function of the ECCS. Therefore, **RAI 941-6465, Question 14.03.04-45** is **resolved and closed**.

In **RAI 941-6465, Question 14.03.04-46**, the staff requested that the US-APWR design certification applicant address its basis for excluding specific alarms and instrumentation, HCVs, and ASME BPV Code, Section III, Class 2, Seismic Category I relief valves from DCD Tier 1, Table 2.4.4-2, "Emergency Core Cooling System Equipment Characteristics."

In a letter dated September 5, 2012, the applicant provided information to support omission of specific alarms and instrumentation, HCVs, and ASME BPV Code, Section III, Class 2, Seismic Category I relief valves from Tier 1, Table 2.4.4-2 similar to that provided in response to **RAI 941-6465, Question 14.03.04-45**. In a revised response to **RAI 941-6465, Question 14.03.04-46**, dated June 26, 2013, the applicant provided additional information on the basis for excluding the components from Table 2.4.4-2. In its RAI response, the applicant referenced the guidance in SRP 14.3, Appendix C I. B. ix and provided the same reasons for excluding the components from Table 2.4.4-2 as they did in the response to **RAI 941-6465, Question 14.03.04-45.** The staff continued its review with further interactions with the applicant because the basis for excluding components from Figure 2.4.4-2 were not completely described in the response to **RAI 941-6465, Question 14.03.04-46**.

In a revised response to **RAI 941-6465, Question 14.03.04-46**, dated November 8, 2013, the US-APWR design certification applicant provided updated reasons for not including specific alarms and instrumentation, HCVs, and ASME BPV Code, Section III, Class 2, Seismic Category I relief valves in DCD Tier 1, Table 2.4.4-2. The staff finds that the justification provided by the US-APWR design certification applicant to exclude the components from DCD Tier 1, Table 2.4.4-2 to be consistent with the guidance in SRP Section 14.3, Appendix C I. B. ix because these excluded components do not provide or have any effect on safety function of the ECCS. Therefore, **RAI 941-6465, Question 14.03.04-46** is **resolved and closed**.

In review of Tier 1 Table 2.4.4-3, the staff found that the 4th row does not contain all required piping. Therefore, **RAI 941-6465 Question 14.03.04-47** was submitted to the applicant to justify the SSCs omission in Table 2.4.4-3 or otherwise, correct.

In a letter dated September 5, 2012, the applicant provided additional information to clarify the staff concerns: 1) all of the piping shown on Tier 2 Figure 6.3-2 is included in either the 2nd or 4th row of Tier 1 Table 2.4.4-3, (2) comparison of the 4th row of Tier 1 Table 2.4.4-3 and Tier 2

Figure 6.3-2 shows that no piping in the segment has been omitted from the 4th row in Table 2.4.4-3 piping upstream of but excluding the 4 motor operated valves. This segment represents the piping between the MOVs and the branch from the safety injection system reactor vessel direct injection lines. The staff found the response acceptable and re-status **RAI 941-6465 Question 14.03.04-47 as closed and resolved**.

In **RAI 941-6465, Question 14.03.04-48** the staff indicated that in Tier 1 Table 2.4.4-5, ITAAC 7.b.i.a, "An injection test with low tank pressure condition for each as-built accumulator will be conducted. The test will be initiated by opening isolation valve(s) in the piping being tested. Each as-built accumulator will be partially filled with water and pressurized with nitrogen. All valves in these lines will be open during the test. An analysis will be performed to determine the water volume injected." The ITA description lacks specificity to ensure a successful test (e.g. low tank pressure, partially filled). The applicant in response to **RAI 941-6465, Question 14.03.04-48**, dated June 26, 2013, the applicant agreed to replace Tier 1 Table 2.4.4·5 ITAAC 7.b.i.a with an ITAAC that requires a dimensional inspection of the flow damper regions of the accumulator that are critical to accumulator performance at vendor shop prior to the preoperational test stage. The applicant also agreed to add a new table based on MUAP-07001-P, Revision 4 Table 3.3-1, which identifies accumulator dimensions including the flow damper and the addition of text to Tier 2 Section 6.3.2.1.2 to refer to the topical report table and the associated figure. Staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable and determined that **RAI 941-6465, Question 14.03.04-48** is **Confirmatory Item 14.03.04-3** pending the verification of DCD Revision 4.

In review of ITAAC Item 7.b.i.b, the staff found the ITAAC Item refers to Tier 1 Table 2.4.4-6, which contains formulas for accumulator resistance coefficients with an uncertainty factor require additional clarification. Therefore, in **RAI 941-6465 Question 14.03.04-50,** the staff requests the applicant to explain: (1) what constitutes the uncertainty (percent), (2) what are the conditions for the test, and (3) is this DAC?

In a letter dated September 5, 2012, the applicant provided an explanation to clarify the staff concerns in regard to accumulator resistance coefficients and uncertainty factor. Table 2.4.4-6 includes requirements for the accumulator system resistance, which includes the advanced accumulator as well as the attached injection piping and valves. The applicant stated that “The advanced accumulator resistance is calculated from the characteristic equation as a function of the cavitation factor and was developed from tests of its hydraulic performance as discussed in MUAP-07001 Revision 4. MUAP-07001, Sections 5.1 and 5.4**,** discuss the components of the accumulator uncertainty.” Furthermore, pre-operational test conditions for ITAAC Item 7.b.i.b will be similar to those used for Case 7 in the advanced accumulator topical report MUAP-07001. The accumulator test conditions, level and pressure, will be lower than the conditions expected during normal operations with a single injection. Based on the accumulator tank pressure, flow rate, and injection pipe discharge pressure measurements, the applicant will perform an analysis to calculate the system resistance coefficients to demonstrate that the as-built accumulator system resistance is within the uncertainty band of the accumulator hydraulic performance characteristic equation. The applicant stated that the “characteristic equation and its uncertainty are not part of the design acceptance criteria since neither is dependent on the as-built equipment” as documented in MUAP-07001. Therefore, the applicant will revise the resistance coefficient of the accumulator system in Table 2.4.4-6 to use consistent terminology as in MUAP-07001. In addition, MUAP-07001 will be revised to include a discussion of the resistance and uncertainty range for the as-built full-scale accumulator. The staff agreed with

the applicant and determined that **RAI 941-6465, Question 14.03.04-50** is **Confirmatory Item 14.03.04-5** pending the verification of DCD Revision 4.

The staff found that inspections, tests, analysis for ITAAC Item 7.b.ii lacked specificity to assure a successful test. Therefore, the staff submitted **RAI 941-6465, Question 14.03.04-51** for the applicant to address the following: (1) the minimum flow rate, (2) pressure with the RV filled (i.e., is there any backpressure), and (3) discuss the applicability of specified acceptance criteria for the design condition.

In a letter dated September 5, 2012, the applicant provided an explanation to address the staff concerns that the intent of the analysis is to convert measured test values into pump differential head (i.e., in order to calculate differential total pressure), therefore, the test condition and the design condition are the same. The bases to evaluate the safety injection flow rate in the safety analyses and the Safety Injection Pump differential head and flow rate requirements are provided by Tier 2 Figure 6.3-4 (safety injection pump flow performance requirements) and Figure 6.3-15 and Figure 6.3-16 (safety injection flow characteristics for minimum and maximum safeguards). The applicant proposed a revision to "inspections, tests, analysis" to clarify the purpose of the analysis. The staff agreed with the proposed change and re-status **RAI 941-6465, Question 14.03.04-51** as **Confirmatory Item 14.03.04-6** pending the verification of DCD Revision 4.

In **RAI 941-6465, Question 14.03.04-52** the staff indicated that performance of the ITAAC should be completed by a vendor test measuring the amount of water to fill it for Tier 1 Table 2.4.4-5, ITAAC 7.b.iii.a. The applicant in response to **RAI 941-6465, Question 14.03.04-52,** dated June 26, 2013**,** agreed to replace Tier 1 Table 2.4.4·5 ITAAC 7.b.iii.a with an ITAAC requiring dimensional inspection of each accumulator, including the flow damper, by the vendor to verify critical dimensions are consistent with the design basis of the accumulator. The applicant also agreed to add a new table, based on MUAP-07001-P, Revision 4 Table 3.3-1, which identifies the accumulator including the flow damper and the addition of text to Tier 2 Section 6.3.2.1.2 to refer to the topical report table. Staff reviewed the response and found that the response with the proposed Tier 1 changes were acceptable and determined that **RAI 941-6465, Question 14.03.04-52** is **Confirmatory Item 14.03.04-7** pending the verification of DCD Revision 4.

In review of Tier 1 ITAAC Item 7.b.iii.b, the staff wanted additional information on how the applicant will account for the materials/components of the RWSP and submitted **RAI 941-6465 Question 14.03.04-53**. In response to **RAI 941-6465 Question 14.03.04-53**, the applicant proposed a changed to ITAAC Item 7.b.iii.b that each as-built Refueling Water Storage Pit (RWSP) will be measured and the analyses will be used determine the net volume of the RWSP. Thus, the verification ensures that the as-built RWSP have appropriate volume as specified in the acceptance criteria. The staff agreed with the proposed change and determined that **RAI 941-6465 Question 14.03.04-53** is **Confirmatory Item 14.03.04-8** pending the verification of DCD Revision 4.

Residual Heat Removal System ITAAC, Table 2.4.5-5

The residual heat removal system cools the reactor core by removing decay heat and other residual heat from the reactor coolant system during normal plant shutdown and cooldown conditions. Any two of the four divisions have a 100 percent capability for safe shutdown.

When required, the residual heat removal system provides cooling for the in-containment reactor water storage pit during normal plant operation and a portion of the reactor coolant system flow to the chemical and volume control system during normal plant startup and cooldown operations to control reactor coolant system pressure. Also, the residual heat removal system can operate during mid-loop or drain down to perform inspection and maintenance activities. In addition, during refueling operation activities, the residual heat removal system can transfer borated water from the reactor water storage pit to the refueling cavity.

The residual heat removal system is a safety-related system with portions of the system (i.e., heat exchangers and pumps) shared with the CSS. The residual heat removal system provides the containment isolation function, as described in Section 2.11.2, for the piping that penetrates the containment. In case all safety injection systems fail, the residual heat removal system can be used as an alternate for core cooling /injection.

In review of ITAAC Item 1.b, the staff could not determine how the acceptance criteria satisfy the design commitment. The design commitment calls for each emergency core cooling system mechanical division to be physically separated. The acceptance criteria states that the physical separation can be structural or by a fire barrier. However, a fire barrier does not necessarily infer physical separation between components of different emergency core cooling system divisions as required by the design commitment. The design commitment statement only appears in Tier 1 Table 2.4.5-5 and is not expanded or amplified in Tier 1 Section 2.4.5 in a text discussion or a tabular form. This concern is also applicable to ITAAC Item 1.b in Table 2.4.4-5. Therefore, the staff submitted **RAI 192-1847, Question 14.03.04-10** to the applicant to explain how the acceptance criteria meet the design commitment for Item 1.b.

In a letter dated April 10, 2009, the applicant responded that the acceptance criteria will be revised to state (1) that the physical separation is provided by using structural barriers and (2) the Tier 1 Design Description will state that structural barriers also serve as fire barriers and to identify any exceptions or clarifications. The staff found the applicant's response acceptable, confirmed the changes made to this ITAAC Item, and re-status **RAI 192-1847, Question 14.03.04-10** to **resolved and closed**. (This RAI question is also applicable to ITAAC Item 1.b in Emergency Core Cooling System Table 2.4.4-5.)

In review of DCD Tier 1 ITAAC Table 2.4.5-5, Item 8.f, the staff found several issues that required additional information in regard to the analysis to verify adequate net positive suction head (NPSH) for the safety injection pumps injection tests into the reactor coolant system. These issues included (1) assumptions regarding the need to determine the effects of inlet piping and component pressure losses, (2) supply tank water level, (3) suction strainer blockage, (4) fluid temperature, (5) containment pressure, and (6) vendor test results establishing minimum NPSH which should be clearly identified in the Inspections, Tests, Analysis column. Therefore, the staff submitted **RAI 192-1847, Question 14.03.04-11** to the applicant to address these concerns.

In a letter dated April 10, 2009, the applicant provided an explanation that addressed the staff concerns including a revision to ITAAC Item 8.f. The applicant revised the inspections, tests, analyses column to include the effect on the analyses for net positive suction head available by referring to the (1) pressure losses in piping and components, (2) low suction level of the refueling water storage pit, and (3) pressure loss in strainers due to blockage, as applicable,

and (4) vendor test results of net positive suction head. The staff found the applicant's response acceptable, confirmed the changes made to this ITAAC Item, and re-status **RAI 192-1847, Question 14.03.04-11 to resolved and closed**. (This RAI question is also applicable to ITAAC Item 7.d in Emergency Core Cooling System Table 2.4.4-5.)

In review of ITAAC Item 8.f, the staff found several issues that need additional information regarding the injection tests into the reactor coolant system. Therefore, the staff submitted **RAI 373-2826, Question 14.03.04-39** requesting information related to the following questions: 1) is the NPSH of 17.9 feet at 3650 gallons per minute (gpm) determined by the RHR or CSS need, 2) if determined by RHR need, what is the containment spray NPSH and flow rate required values, and 3) when system is aligned for containment spray, what NPSH loss is assumed for degraded sump strainer performance?

In a letter dated June 16, 2009, the applicant provided an explanation that addressed the staff concerns: 1) the NPSH of 17.9 feet at 3650 gpm is determined by the CSS need, 2) not applicable because NPSH and flow rate are determined by CSS not RHR, and 3) the maximum NPSH loss is assumed to be 4.7 feet for degraded sump strainer performance. Therefore, no revision to the DCD was required; thus there was no impact on the DCD. The staff agreed with the applicant's response and re-status **RAI 373-2826, Question 14.03.04-39** as **resolved and closed**.

Chemical and Volume Control System ITAAC, Table 2.4.6-5

The purpose of the chemical and volume control system (CVCS) is to maintain the coolant inventory of the reactor coolant system and to provide chemical and radioactive cleanup of the reactor coolant system. Some components of the CVCS, such as the containment isolation valves, are safety-related, while other CVCS components, such as the volume control tank, boric acid blender and seal water heat exchanger, are non-safety-related. The chemical and volume control system safety functions include: 1) maintaining the reactor coolant pressure boundary, 2) providing the containment isolation function, as described in Section 2.11.2, 3) providing isolation of a source of water connected to the reactor coolant system to prevent inadvertent dilution of boron in the coolant, and 5) providing isolation of the charging line.

In review of ITAAC Item 5.i, the staff wanted clarification of the term "nuclear island" used in the inspections, tests, analyses column because it was not defined in the Tier 1 list of definitions. **RAI 192-1847, Question 14.03.04-12** was submitted to the applicant for clarification of the term "nuclear island."

In a letter dated April 10, 2009, the applicant proposed to replace the term "nuclear island" with "in the containment or reactor building" as shown in **RAI 192-1847, Question 14.03.04-13** response. The staff agreed with the proposed change, and determined that **RAI 192-1847, Question 14.03.04-12 is resolved and closed**.

In review of ITAAC Item 5, the seismic piping verification ITAAC for the CVCS system components identified in Table 2.4.6-3 under Seismic Category I, the staff found that numerous CVCS lines are listed in Table 2.4.6-3 with Seismic Category I requirements. However, the staff found no CVCS piping seismic design commitments referencing Table 2.4.6-3 and subsequent piping inspection in Table 2.4.6-5. Therefore, the staff submitted **RAI 192-1847, Question 14.03.04-13** to the applicant for an explanation of this finding.

In a letter dated April 10, 2009, the applicant stated that the ITAAC item for verifying Seismic Category I piping was inadvertently omitted from Table 2.4.6-5 but will be revised to include the omitted Seismic Category I piping. The staff found the RAI response acceptable, confirmed the changes, and determined that **RAI 192-1847, Question 14.03.04-13** as **resolved and closed**.

In review of ITAAC Item 6.a, the staff found inconsistencies between Table 2.4.6-2 and Table 3D-2 in Tier 2 related to harsh environment. For example, Table 3D-2 identifies CVS-MOV-151 & 152 as being EQ for a harsh radiation environment yet Table 2.4.6-2 identifies them as not being qualified for a harsh environment. The staff submitted **RAI 941-6465, Question 14.03.04-55** for clarification in the differences between the tables.

In a letter dated September 5, 2012, the applicant stated that **RAI 941-6465 Question 14.03.04-55** is addressed in the response to **RAI 945-6452, Question 14.03-13**; whereupon, the applicant proposed revisions to correct the discrepancies. The staff found response acceptable and determined that **RAI 941-6465 Question 14.03.04-55** is **Confirmatory Item 14.03.04-9** pending the verification of the corrections of DCD Revision 4.

14.3.4.5 Combined License Information Items

There are none for Section 14.3.4.4.

Editorial Comment:
Should this say "None"

COL information items not identified in Table 1.8-2 of the DCD:

14.3.4.6 Conclusions

The staff reviewed the ITAAC applicable to the reactor systems design in the US-APWR DCD Revision 2 and 3 and evaluated its compliance with 10 CFR 52.47(b)(1) and its conformance with relevant guidance in NUREG-0800, Section 14.3. The staff has determined that the applicant's Reactor Systems ITAAC have satisfied the requirements of 10 CFR 52.47(b)(1) and guidance in NUREG-0800, Section 14.3 because the ITAAC descriptions as proposed are sufficient in detail to adequately test those details of the basic design features and any design related interfaces as they relate to reactor systems. Except for **Confirmatory Items 14.03.04-1, 2, 3, 4, 5, 6, 7, 8, and 9** identified above, 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 and applicable regulations.

14.3.5 ITAAC for Instrumentation and Control Systems

14.3.5.1 Introduction

Section 14.3.5 of the SRP provides guidance for reviewing ITAAC for Instrumentation and Control (I&C) systems. The staff reviewed the proposed US-APWR ITAAC to determine whether a plant that incorporates the US-APWR design certification can be built and operated in accordance with the design certification and the NRC regulations.

The scope of I&C ITAAC review includes information in Section 2.5 of the US-APWR DCD, Tier 1 and the interface between this section and Chapter 7 of the US-APWR DCD, Tier 2 and its referenced technical and TRs.

14.3.5.2 Summary of Application

DCD Tier 1: The Tier 1 information associated with this section is found in Tier 1, Section 2.5, "Instrumentation and Controls," of the DCD. The Tier 1 information associated with I&C is documented in DCD Tier 1 Sections 2.5.1 through 2.5.6 as follows:

2.5.1 - Reactor Trip System and Engineered Safety Feature Systems
2.5.2 - System Required for Safe Shutdown
2.5.3 - Diverse Actuation System
2.5.4 - Information System Important to Safety
2.5.5 - Control System Not Required for Safety
2.5.6 - Data Communication Systems

DCD Tier 2: As documented in Section 14.3.4.5 of DCD Tier 2, the ITAAC for I&C equipment address compliance with 10 CFR 50.55a(h) and applicable sections of Institute of Electrical and Electronics Engineers (IEEE) Standard (Std.) 603-1991 as they pertain to safety systems.

These ITAAC also address compliance with the following General Design Criteria (GDC) set forth in Appendix A of 10 CFR Part 50:

- GDC 1, "Quality Standards and Records," as it pertains to quality standards for design, fabrication, erection, and testing
- GDC 2, "Design Bases for Protection Against Natural Phenomena," as it pertains to protection against natural phenomenon
- GDC 4, "Environmental and Dynamic Effects Design Bases," as it pertains to environmental and dynamic effects
- GDC 13, "Instrumentation and Control," as it pertains to I&C requirements
- GDC 19, "Control Room," as it pertains to control room requirements
- GDC 20, "Protection System Functions," as it pertains to protection system design requirements
- GDC 21, "Protection System Reliability and Testability," as it pertains to protection system reliability and testability requirements
- GDC 22, "Protection System Independence," as it pertains to protection system independence requirements
- GDC 23, "Protection System Failure Modes," as it pertains to protection system failure modes requirements

- GDC 24, “Separation of Protection and Control Systems,” as it pertains to separation of protection systems from control systems

- GDC 25, “Protection System Requirements for Reactivity Control Malfunctions,” as it pertains to protection system requirements for reactivity control malfunctions

- GDC 29, “Protection Against Anticipated Operational Occurrences,” as it pertains to protection against anticipated operational occurrences (AOOs).

ITAAC are also provided for documentation of a high-quality software design process consistent with each of the management, implementation, and resource characteristics shown in NUREG-0800, branch technical position (BTP) 7-14, “Guidance on Software Reviews for Digital Computer-Based I&C Systems,” in SRP Chapter 7.

DCD Tier 2, Table 14.3-8 provides conformance with I&C systems design to criteria in IEEE Std. 603-1991, with cross references to applicable Tier 1 information including ITAAC.

ITAAC: The ITAAC associated with Tier 1, Section 2.5, are given in Tier 1, Sections 2.5.1.2, 2.5.2.2, 2.5.3.2, 2.5.4.2, 2.5.5.2, and 2.5.6.2.

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

COL information or action items: There are no COL information or action items for this area of review.

Technical Report(s): There are no technical reports associated with this area of review.

Topical Report(s): There are no topical reports associated with this area of review.

US-APWR Interface Issues identified in the DCD: There are no US-APWR interface issues associated with this area of review.

Site Interface Requirements Identified in the DCD: There are no site interface requirements associated with this area of review.

Cross-cutting Requirements (TMI, USI/GSI, Op Ex): None identified.

RTNSS: There are no RTNSS issues for this area of review.

10 CFR 20.1406: There are no issues related to 10 CFR 20.1406 for this area of review.

14.3.5.3 Regulatory Basis

The relevant requirements of the NRC regulations for this area of review, and the associated acceptance criteria are given in SRP Section 14.3.5. Review interfaces with other SRP sections are discussed in SRP Section 14.3 – Inspections, Tests, Analyses, and Acceptance Criteria, and SRP Section 14.3, Appendix C – Detailed Review Guidance.

10 CFR 52.47(b)(1) requires that a DC application contain the proposed ITAAC that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification has been constructed and will operate in accordance with the design certification, the provisions of the Atomic Energy Act, and the NRC's regulations.

14.3.5.4 Technical Evaluation

The staff has reviewed US-APWR DCD Tier 1, Section 2.5 in conjunction with the review of DCD Tier 2, Chapter 7, Instrumentation and Controls. Several ITAAC-related RAI questions have been issued to the applicant during the I&C review. These questions are to ensure that the US-APWR design meets the 10 CFR 52.47(b)(1) requirements. The required documentation for ITAAC is to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant will be operated in accordance with the DC. In response to the staff's RAI questions, the applicant addressed and documented appropriate ITAAC in DCD Tier 1, Sections 2.5.1 through 2.5.6.

Concurrent with evaluation of the US-APWR I&C design presented in DCD Tier 2, Chapter 7, the staff evaluated all ITAAC for the I&C systems listed under DCD Tier 1 Sections 2.5.1 through 2.5.6 for consistency with Tier 2 information, completeness, accuracy, and to determine their compliance with the NRC regulations. The staff evaluation of these ITAAC is documented in the relevant sections of the Chapter 7 SER, where the staff found the ITAAC to be in compliance with the relevant regulations, except for the Open Item related to **RAI 992-6999, Question 07.09-26** in Section 7.9. The following is a summary of the DCD Tier 1 information and the evaluation of the I&C systems ITAAC compliance with the applicable NRC regulations:

14.3.5.4.1 Design Descriptions and Figures

The design description should address I&C equipment that is involved in performing safety functions. The description would include the hardware architecture and software architecture descriptions for all Class 1E I&C systems. The figures are required to represent system configuration.

Section 2.5.1 of DCD Tier 1 describes the PSMS that consists of the reactor trip (RT) system and engineered safety features (ESF) system and the associated field instrumentation. The design description further describes functional arrangements, seismic and environmental equipment qualification, and the design features in conformance with IEEE Std. 603-1991 requirements. The software program manual (SPM) is implemented to manage the PSMS software development using a structured lifecycle process. Figure 2.5.1-1, "Configuration of the Reactor Trip System," provides configuration of the RT system. Figure 2.5.1-2, "Configuration of the Engineered Safety Feature System," provides configuration of the ESF system. Figure 2.5.1-3, "Configuration of the Safety Grade Component Control System," provides configuration of the safety grade component control system. Figure 2.5.1-4, "Configuration of the Reactor Trip Breakers," provides configuration of the reactor trip breakers.

DCD Tier 1 Section 2.5.2 describes the systems required for safe shutdown. Safe shutdown can be achieved from the Main Control Room (MCR) or the remote shutdown room (RSR) using redundant safety-related I&C systems of the PSMS, including the reactor protection system (RPS), engineered safety feature actuation system (ESFAS), safety logic system (SLS) and safety visual display units (VDUs). The non-safety operational VDUs may also be used for

monitoring safety-related instrumentation and manually controlling safety-related components. Figure 2.5.2-1, "Configuration of the SLS and HSIS for Safe Shutdown," provides configuration of the SLS and human system interface system (HSIS) for safe shutdown.

DCD Tier 1, Section 2.5.3 describes a non-safety diverse actuation system (DAS) that is diverse from the PSMS software and the digital platform of the PSMS. The DAS provides monitoring, control and actuation capability of safety and non-safety systems required to mitigate the AOOs and postulated accidents (PAs), concurrent with a common cause failure (CCF). Figure 2.5.3-1, "DAS Configuration," provides DAS configuration. In **RAI 275-2133, Question 14.03.05-22**, the staff requested that the applicant provide a figure of the DAS in DCD Tier 1, which shows the interface with the PSMS. In its response to **RAI 275-2133, Question 14.03.05-22**, dated April 28, 2009, the applicant proposed a revision to DCD Tier 1 to include a new figure that shows the DAS interface with the PSMS. The staff found that the response is acceptable and the **RAI 255-2133, Question 14.03.05-22 is closed**.

In **RAI 275-2133, Question 14.03.05-23**, the staff requested the applicant to address the possible use of digital components in the DAS. In its response to **RAI 275-2133, Question 14.03.05-23**, dated April 28, 2009, the applicant proposed a revision to DCD Tier 1 to clarify that the US-APWR DAS consists of conventional analog technologies only. The staff found that the response is acceptable and the **RAI 255-2133, Question 14.03.05-23 is closed**.

DCD Tier 1 Section 2.5.4 describes the PSMS and plant control and monitoring system (PCMS) that provide plant operators with the information systems important to safety for: (1) assessing plant conditions and safety system performance, and making decisions related to plant responses to abnormal events; and (2) preplanned manual operator actions related to accident mitigation. The information systems important to safety also provide the necessary information from which appropriate actions can be taken to mitigate the consequences of the AOOs. Figure 2.5.4-1, "Configuration of the PSMS and PCMS for Information Systems Important to Safety," provides configuration of the PSMS and PCMS for information systems important to safety.

DCD Tier 1, Section 2.5.5 describes the non-safety PCMS that provides for automatic and manual control of non safety-related plant components, and monitoring of non safety-related plant instrumentation. The PCMS automatically regulates conditions in the plant in response to changing plant processes and load demand to establish and maintain plant operating conditions within prescribed limits. The PCMS controls and monitors neutron flux, temperature, pressure, liquid level, flow and other process parameters throughout the plant.

DCD Tier 1, Section 2.5.6, describes the data communication systems (DCS) that consist of:

- Plant-wide unit bus
- Safety bus (for each PSMS division)
- Data links for point to point communication
- Input/Output (I/O) bus
- Maintenance network for each PSMS division and the PCMS

Figure 2.5.6-1, "DCS Configuration," provides DCS configuration.

During the Advisory Committee on Reactor Safeguards (ACRS) Subcommittee meeting on April 25-26, 2013 regarding the US-APWR DCD Tier 2 Chapter 7 SER with Open Items, the ACRS Subcommittee wanted confirmation that the data flow from the PSMS and PCMS to external networks is unidirectional, and all data is transmitted via a hardware device to ensure the unidirectional data flow. In response (MHI letter UAP-HF-13232, dated September 20, 2013 (ML13280A485), Item 13) the applicant provided proposed changes to the DCD that describe a clear commitment to use of a hardware device (e.g., data diode) to ensure unidirectional data flow from the PCMS to the station bus and external networks. This proposed DCD change also clarified that there is no communication interface between the PSMS and the station bus, and no communication interface between the PSMS with other external networks. As a part of their response to the ACRS question, the applicant provided proposed changes to impacted parts of DCD Tier 1 Subsection 2.5.6, Table 2.5.6-1, DCD Tier 2 Subsections 7.9.1.6, 7.9.1.7, 7.9.2.3.5, 7.9.2.5, 9.5.2.2.5.1, and Section 13.3. The staff finds the proposed change to the DCD Tier 1 design description and ITAAC Item 3 that clearly identifies the isolation device located between the unit management computer and the station bus to be hardware-based unidirectional device acceptable, because it provides the confirmation sought by the ACRS and does not change any of the staff's safety findings. The proposed changes to DCD Tier 1 Subsection 2.5.6 and the ITAAC Item 3 in Table 2.5.6-1 is being tracked as a **Confirmatory Item 14.03.05-20** pending verification of future DCD Revision.

Based on the review of DCD Tier 1 Sections 2.5.1 through 2.5.6, except for **Confirmatory Item 14.03.05-20** identified above, the staff concludes that the design description and figures in these sections appropriately describe the I&C design features and performance characteristics and finds the Tier 1 information acceptable.

14.3.5.4.2 ITAAC Entries Evaluation

As discussed in Chapter 1 of DCD Tier 1, Tier 1 provides Design Descriptions which are commitments that the design of the SSCs will meet the applicable regulations and standards. Where these commitments must be inspected or tested to verify that the performance or integrity of the as-built SSCs, an ITAAC is provided which states the Design Commitment, the Inspection, Test, or Analysis (ITA) to be performed, and the Acceptance Criteria (AC) which must be satisfactorily met to demonstrate that the commitment complies with regulations. The DCD Tier 2 provides further design details including some of the inspections, tests, and analysis which were performed to demonstrate that the design meets the applicable regulations. Tier 1 ITAACs verify that the as-built SSCs were built to the Tier 2 design and meet the regulations. Because there are multiple methods available to satisfy an ITAAC, it is incumbent on the applicant to provide the table of ITAACs which state the design commitment, the method (ITA), and the Acceptance Criteria. Some ITAAC may reference prescriptive tests, analyses, or report formats. Many ITAAC provide the intent or purpose of the ITA without being prescriptive. This allows the future licensee greater flexibility in executing the ITAAC without requiring a change to Tier 1.

When reviewing the ITAAC, staff verifies that all of the design commitments are included in the table and that appropriate ITA and AC are provided. The ITA is considered acceptable if the method(s) are consistent with the design commitment and format described in Tier 1 and with the Tier 2 documentation. The AC are considered acceptable if they are consistent with the ITA, the format described in Tier 1, and can be adequately verified by NRC inspection during construction. During the DCD review, the staff has held various rounds of ITAAC improvement

with the applicant in an effort to apply lessons learned from ongoing construction inspection. The applicant has incorporated many changes to the ITAAC at NRC's request via RAI's.

A. Compliance with 10 CFR 50.55a(h), "Protection and Safety Systems, IEEE Std. 603-1991."

As stated in Chapter 7, Section 7.1.4.1.1.2, "Conformance to Safety System Criteria (50.55a(h)(3))," of this report, the staff evaluated whether the applicant has adequately addressed all of the criteria listed in IEEE Std. 603-1991, as required by 10 CFR 50.55a(h). The staff issued several RAIs raising questions and concerns of the compliance with criteria of IEEE Std. 603-1991. The staff found that the responses for those RAIs are acceptable. The staff also verified in DCD Tier 2, Section 14.3, Table 14.3-8, "IEEE 603-1991 Compliance Matrix by DCD Tier 1 Sections," for appropriate ITAAC entries. The staff found that the ITAAC provided in the DCD are adequate for verification of the I&C design criteria provided in IEEE Std. 603-1991, and in conformance with 10 CFR 50.55a(h)(3).

B. Compliance with General Design Criteria in Appendix A to Part 50.

As stated in Chapter 7, Section 7.1.4.1.2, "Conformance to General Design Criteria (GDC)," of this report, the staff has reviewed DCD Tier 2, Table 7.1.2, "GDC Applicable to I&C Systems," and DCD Tier 2, Section 3.1 to ensure that the design of the I&C systems is in conformance with the applicable GDCs in Table 7-1 of the NUREG-0800 Chapter 7, Section 7.1-T. The following evaluation is to confirm that the ITAAC provided in the DCD Tier 1 are acceptable for verifying that the as-built design is in conformance with the GDCs applicable to the I&C Systems.

GDC 1 requires quality standards and maintenance of appropriate record for SSCs important to safety. As described in 10 CFR 50 Appendix B, every applicant for a design certification under part 52 is required by the provisions of 10 CFR 52.47 to include a description of the quality assurance program applied to the design of the SSCs of the facility. The applicant has provided the necessary information to fully comply with the Appendix B requirements as documented in Chapter 17 of the DCD and referenced Topical Report, PQD-HD-19005, "Quality Assurance Program Description for Design Certification of the US-APWR." This MHI QA program has been evaluated and found acceptable by the staff as documented in Supplemental Safety Evaluation Report for MHI US-APWR Topical Report Number PQD-HD-19005, Revision 4, "Quality Assurance Program (QAP) Description for Design Certification of the US-APWR" (ADAMS Accession No. ML112840193), and in Section 17.5.6 of this report. The staff concludes that QA program, as described above, complies with the GDC 1 requirements.

GDC 2 requires design bases for protection against natural phenomena. ITAAC Item 5 in Table 2.5.1-6, "RT System and ESF System Inspections, Tests, Analyses, and Acceptance Criteria," requires the inspection, type tests, analyses, or a combination of type tests and analyses of the as-built seismic Category I equipment to demonstrate that the seismic Category I equipment can withstand seismic design basis loads without loss of safety function. The applicant in US-APWR DCD Tier 1, Table 2.5.1-6 provided ITAAC Item 5 to verify that the I&C systems can withstand seismic design basis loads without loss of safety function. Since the applicant has provided the subject ITAAC to verify that the as-built I&C systems can withstand seismic design basis loads without loss of safety function, in conformance with GDC 2, the staff finds that the applicant has adequately addressed this item and the information submitted is acceptable.

GDC 4 requires that the SSCs important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associate with normal operation, maintenance, testing, and PAs. ITAAC Item 6 of Table 2.5.1-6, requires inspection, type tests, or a combination of type tests and analyses of the as-built Class 1E equipment for a harsh environmental qualification to demonstrate that Class 1E equipment can withstand the environmental conditions that would exist before, during, and following a design basis accident without loss of safety function for the time required to perform its safety function. ITAAC Item 7 in Table 2.5.1-6, requires performance of electromagnetic conditions type tests or a combination of type tests and analyses on the digital I&C equipment to demonstrate that the RPS, ESFAS, SLS, safety VDU processor, safety VDU are qualified to meet the electromagnetic conditions that may exist based on the location in the facility, without loss of safety function. The applicant in US-APWR DCD Tier 1, Table 2.5.1-6 provides ITAAC Item 6 to verify that the as-built Class 1E equipment is qualified for a harsh environment and conditions due to a design basis event without the loss of its safety function. The applicant in US-APWR DCD Tier 1, Table 2.5.1-6 provides ITAAC Item 7 to verify that the as-built digital I&C equipment associated with RPS, ESFAS, SLS, safety VDU processor, safety VDU can withstand the electromagnetic conditions without loss of its safety function. Since the applicant has provided the subject ITAACs to verify that the as-built I&C systems can withstand harsh environmental and electromagnetic conditions without loss of safety function in conformance with GDC 4, the staff finds that the applicant adequately addresses this item, and the information submitted is acceptable for I&C systems.

GDC 13 requires that instrumentation shall be provided to monitor variables and systems over their anticipated ranges for normal operation, for AOOs, and for PAs. ITAAC Item 14.a of Table 2.5.1-6, requires tests to verify that each as-built RTB opens upon receipt of the automatic reactor trip signal, and the as-built PSMS provides signals to initiate each automatic ESF function when simulated RT and ESF measurement instrumentation input signal exceed the predetermined limits. ITAAC Item 22 of Table 2.5.1-6, requires inspection of the ranges of the as-built RT and ESF actuation instrumentation that is required to function during normal operation, AOOs, and PAs met design requirements. The applicant in US-APWR DCD Tier 1, Table 2.5.1-6 provides ITAAC 14.a and 22 to verify that the as-built instrumentation monitor variables and systems over their anticipated ranges for normal operation, for AOOs, and for PAs by the use of the PSMS. Since the applicant has provided the subject ITAACs to verify that the as-built I&C systems can monitor variables and systems over their anticipated ranges for normal operation, for AOOs, and for PAs in conformance with GDC 13, the staff finds that the applicant adequately addresses this item and the information submitted is acceptable for I&C systems.

GDC 19 requires that a control room shall be provided from which actions can be taken to operate the nuclear power unit safely under normal conditions and to maintain it in a safe condition under accident conditions, including LOCA. Equipment at appropriate locations outside the control room shall provide capability for hot shutdown and subsequent cold shutdown of the reactor through the use of suitable procedures. ITAAC Item 4 of Table 2.5.1-6 requires performance of tests to verify that the as-built conventional PSMS manual switches in the MCR perform manual initiation for the RT and ESF manual actuations. The applicant in US-APWR DCD Tier 1, Table 2.5.1-6 provides ITAAC Item 4 to verify that the as-built conventional PSMS manual switches in the MCR perform manual initiation for the RT and ESF manual actuations for safe operation of the plant during normal and accident conditions. ITAAC Item 11 of Table 2.5.1-6 requires performance of tests to verify that the as-built equipment provides (1) automatic BISI for RT and ESF actuations and interlock important to safety, and (2) manual BISI for these protective actions. The applicant in US-APWR DCD Tier 1, Table 2.5.1-6 provides ITAAC Item 11 to verify that the as-built equipment related to the BISI, RT, and ESF provide

automatic indication of the bypassed and operable status of the safety systems. ITAAC Item 2 of Table 2.5.2-3, "Systems Required for Safe Shutdown Inspections, Tests, Analyses, and Acceptance Criteria," requires performance of tests to verify that the as-built MCR/RSR transfer controls between the MCR and the RSR and perform safe shutdown function. The applicant in US-APWR DCD Tier 1, Table 2.5.2-3 provides ITAAC Item 2 to verify that the as-built MCR and RSR are such that the operator can transfer control from the MCR to the RSR to perform safe shutdown. Since the applicant has provided the subject ITAACs to verify that the as-built I&C systems can operate the plant safely from the MCR and that the operator can transfer control from the MCR to the RSR to perform safe shutdown in conformance with GDC 19, the staff finds that the applicant adequately addresses this item, and the information submitted is acceptable for I&C systems.

GDC 20 requires that the protection system shall be designed to initiate automatically the operation of systems to assure that specified acceptable fuel design limits are not exceeded as a result of AOOs, and to sense accident conditions and to initiate the operation of systems and components important to safety. ITAAC Item 14 of Table 2.5.1-6 requires performance of tests to verify the as-built PSMS initiates automatic RT and ESF actuations when the plant process signals reach a predetermined limit. The applicant in US-APWR DCD Tier 1, Table 2.5.1-6 provide ITAAC Item 14 to verify that the as-built PSMS initiates automatic RT and ESF actuations when the plant process signals reach a predetermined limit. Since the applicant has provided the subject ITAAC to verify that the as-built I&C systems are designed to automatically initiate RT and ESF actuations when process signals reach a predetermined limit in conformance with GDC 20, the staff finds that the applicant adequately addresses this item, and the information submitted is acceptable for I&C systems.

GDC 21 requires that the protection system shall be designed for high functional reliability and in-service testability commensurate with the safety functions to be performed. ITAAC Item 17.b of Table 2.5.1-6 requires performance of tests to verify that a single division of the as-built PSMS can be bypassed to allow on-line testing, maintenance or repair, and this capability does not prevent the PSMS from performing its safety function. The applicant in US-APWR DCD Tier 1, Table 2.5.1-6 provide ITAAC Item 17.b to verify that a single division of the as-built PSMS can be bypassed to allow on-line testing, maintenance or repair without preventing the PSMS from performing its safety function. ITAAC Item 27 of Table 2.5.1-6 requires performance of tests to verify that the input sensors from each division of the as-built PSMS that are out-of-tolerance can be detected by the PCMS. The applicant in US-APWR DCD Tier 1, Table 2.5.1-6 provided ITAAC Item 27 to verify that the input sensors from each division of the as-built PSMS that are out-of-tolerance can be detected by the PCMS. Since the applicant has provided the subject ITAACs to verify that the as-built I&C systems are designed for high functional reliability and in-service testability commensurate with the safety functions to be performed in conformance with GDC 21, the staff finds that the applicant has adequately addressed this item, and the information submitted is acceptable for I&C systems.

GDC 22 requires that the protection system shall be designed to assure that the effects of natural phenomena, and normal operating, maintenance, testing, AOO and PA conditions on redundant channels do not result in loss of the protection function. Design techniques, such as functional diversity or diversity in component design and principle of operation, shall be used to the extent practical to prevent loss of the protection function. Tier 1 Section 2.5.3 provides a DAS. The DAS is a non-safety system that is diverse from the PSMS and PCMS digital platform and their software. ITAAC Items 1.b, 1.c, 1.d, 1.e, 2, 3, and 4 of Table 2.5.3-4, "Diverse Actuation System Inspections, Tests, Analyses, and Acceptance Criteria," require

inspection, tests, analyses, or combination of tests and analyses to verify that the as-built DAS automatic actuation signal for the as-built equipment, prevents spurious actuation due to single failures or due to an SSE, has capabilities for on-line testing, maintenance and repairs, and the equipment used for the ATWS mitigation is diverse from the hardware used for the RT function of the PSMS. The applicant in US-APWR DCD Tier 1, Table 2.5.3-4 provided ITAACs 1.b, 1.c, 1.d, 1.e, 2, 3, and 4 to verify that as-built DAS automatic actuation signal for the as-built equipment, (1) prevents spurious actuation due to single failures or due to an SSE, (2) has capabilities for on-line testing, maintenance and repairs (3) the equipment used for the ATWS mitigation is diverse from the hardware used for the reactor trip function of the PSMS. Since the applicant has provided the subject ITAACs to verify that the as-built I&C systems are designed to prevent spurious actuation, have capabilities for on-line testing, maintenance, and repairs, and have diverse hardware used for RT function and ATWS mitigation in conformance with GDC 22, the staff finds that the applicant has adequately addressed this item, and the information submitted is acceptable for I&C systems.

GDC 23 requires that the protection system shall be designed to fail into a safe state or into a state demonstrated to be acceptable on some other defined basis if conditions such as disconnection of the system, loss of energy, or postulated adverse environments are experienced. ITAAC Item 21 of Table 2.5.1-6 requires performance of tests to verify that each division of the as-built RT logic of the as-built PSMS fails to the safe state upon loss of electric power to the division, and loss of electric power to a division of the ESF logic does not result in ESF actuation. The applicant in US-APWR DCD Tier 1, Table 2.5.1-6 provides ITAAC Item 21 to verify that each division of the as-built RT logic of the as-built PSMS fails to the safe state or does not initiate an ESF actuation upon loss of electric power to the division. Since the applicant has provided the subject I&C ITAAC to verify that the as-built protection systems is designed to fail into a safe state in conformance with GDC 23, the staff finds that the applicant has adequately addressed this item, and the information submitted is acceptable for I&C systems.

GDC 24 requires that the protection system shall be separated from control systems to the extent that failure of any single control system component or channel, or failure or removal from service of any single protection system component, which is common to the control and protection systems leaves intact a system satisfying all reliability, redundancy, and independence requirements of the protection system. Inter-connection of the protection and control system shall be limited. ITAAC Item 10.a of Table 2.5.1-6 requires performance of inspection, tests, or a combination of tests and analyses to verify that as-built PSMS and field equipment redundant divisions' electrical independence is achieved by independent power sources and electrical circuits for each division, and by fiber optic cable interfaces, conventional isolators, or other proven isolation methods or devices at interfaces between redundant divisions, and at interfaces between safety and non-safety systems. The applicant in US-APWR DCD Tier 1, Table 2.5.1-6 provided ITAAC 10.a to verify that the as-built protection system is separate from control system such that any failure in each system will leave such system intact. As discussed in Chapter 7 of this report, in **RAI 992-6999, Question 07.09-26** the staff requested the applicant to include an ITAAC to adequately address testing for normal and abnormal data transmission conditions for the interfaces between non-safety and safety systems. **RAI 992-6999, Question 07.09-26** remains an **Open Item**, because the applicant has not provided a satisfactory ITAAC to verify that the as-built I&C systems protection and control systems are separate such that any component failure would not interfere with system performance to satisfy GDC 24 requirements.

GDC 25 requires that the protection system shall be designed to assure that specified acceptable fuel design limits are not exceeded for any single malfunction of the reactivity control systems, such as accidental withdrawal of control rods. As discussed in DCD Tier 2 Section 15.4, analyses have been performed for possible malfunction of the reactivity control systems. The analyses show that acceptable fuel damage limits are not exceeded even in the event of a single malfunction of the reactivity control systems. Automatic RT on high source range, high intermediate range, or high power range neutron flux provides protection from any single malfunction of the reactivity control system. ITAAC Item 14.a of Table 2.5.1-6 requires performance of tests to verify that the as-built PSMS initiates automatic RT when the source range, intermediate range, or power range neutron flux signal exceeds a predetermined limit. The applicant in US-APWR DCD Tier 1, Table 2.5.1-6 provided ITAAC Item 14.a to verify that the as-built PSMS initiates automatic RT when the source range, intermediate range, or power range neutron flux signal exceeds a predetermined limit to address any single malfunction of the reactivity control systems. Since the applicant provided the subject ITAAC to verify that the as-built PSMS initiates automatic RT when the source range, intermediate range, or power range neutron flux signal exceeds a predetermined limit in conformance with GDC 25, the staff finds that the applicant has adequately addressed this item, and the information submitted is acceptable for I&C systems.

GDC 29 requires that the protection system and the reactivity control systems shall be designed to assure extremely high probability of accomplishing their safety functions in the event of AOOs. No specific ITAAC is required for this GDC. Reliability of I&C systems is considered in the PRA and addressed by Design-Reliability Assurance Program ITAAC Item 1 in Tier 1, Table 2.13-1 “Design Reliability Assurance Program Inspections, Tests, Analyses, and Acceptance Criteria.”

ITAAC for software design process is documented in ITAAC Item 24 of Table 2.5.1-6. This ITAAC verifies the implementation of the SPM defined lifecycle process in each software lifecycle phase. Detailed evaluation of the software design process includes the ITAAC is addressed in Chapter 7, Section 7.1.4.3 of this report.

Based on the review of ITAAC Tables in DCD Tier 1, Sections 2.5.1 through 2.5.6, the staff identified that **RAI 992-6999, Question 07.09-26** is being tracked as an **Open Item** as part of the review of Section 7.9 of this report. Until this open item is satisfactorily resolved and applicable sections and chapters of the DCD are finalized to the staff’s satisfaction, the staff is unable to conclude that the ITAAC are sufficient for 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 and applicable regulations.

14.3.5.5 Combined License Information Items

There is no COL information items associated with this area of review.

14.3.5.6 Conclusions

The staff reviewed all ITAAC information that is applicable to the I&C systems and evaluated its compliance with 10 CFR 50.55a(h) and applicable sections of IEEE Std. 603-1991, I&C related GDC 1, 2, 4, 13, 19, 20, 21, 22, 23, 24, 25, and 29 set forth in Appendix A of 10 CFR Part 50, and 10 CFR 52.47(b)(1). Until the **Open Item** associated with **RAI 992-6999, Question 07.09-**

26 as part of the review of Section 7.9 of this report is satisfactorily resolved and the applicable sections and chapters are finalized to the staff's satisfaction, the staff is unable to conclude that the ITAAC associated with the scope of Section 14.3.5 of this report are necessary and sufficient for reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, then a facility referencing the certified US-APWR design can be constructed and operated in compliance with the design certification and applicable regulations.

14.3.6 ITAAC for Electrical Systems

14.3.6.1 Introduction

This section provides the selection criteria and processes used to review and evaluate the US-APWR, Tier 1 (Section 2.6) and Tier 2 (Section 14.3.4.6) ITAAC information for electrical systems. Section 14.3.4.6 includes definitions and general provisions, design descriptions, inspections, tests, analyses, and acceptance criteria, significant site parameters, and significant interface requirements. It addresses the inspections, tests, and analyses, that the applicant proposes to perform as well as the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the proposed inspections, tests, and analyses are performed and the acceptance criteria are met, the facility has been constructed and will operate in conformance with the DC, the provisions of the Atomic Energy Act, and NRC regulations. The applicant, MHI proposes ITAAC in US-APWR DCD as Tier 1 (Section 2.6) and Tier 2 (Section 14.3.4.6) that addresses the review guidance given in the SRP Section 14.3.6, "Electrical System," and guidance of RG 1.206 for electrical systems.

14.3.6.2 Summary of Application

DCD Tier 1: In the US-APWR DCD, Section 2.6 of Tier 1 and Section 14.3.4.6, of Tier 2, "Inspections, Tests, Analyses, and Acceptance Criteria," the applicant incorporated by reference Sections 14.3 and 14.3.6 of the SRP and RG 1.206 without any departures. The Section 2.6 of Tier 1, which addresses electrical systems, was prepared in accordance with the guidance given in RG 1.206, SRP Section 14.3, and SRP Section 14.3.6.

DCD Tier 2: Tier 2 Section 14.3 of the DCD provides general description and information on ITAAC for Electrical Systems. In Chapter 14 of the US-APWR DCD, an ITAAC template is provided for the plant's electrical system, including Class 1E portions of the system, major portions of the non-Class 1E system, equipment qualification and portions of the plant lighting, grounding, lightning protection systems, and containment electrical penetrations. Design descriptions for electrical systems follow NRC guidelines for electric systems ITAAC in Appendix C.II.1-A of RG 1.206.

These design descriptions address electrical equipment that is involved in performing safety functions. Such equipment includes the complete Class 1E electrical system, including power sources (which include offsite sources even though they are not Class 1E) and direct current (dc) and alternating current (ac) distribution equipment. Design descriptions also address additional relevant factors related to the electrical equipment that are not part of the Class 1E system, but are included to improve the reliability of the individual Class 1E divisions. Brief design descriptions are included for the non-Class 1E portions of the electrical system that

power the balance of plant loads although these descriptions generally focus on the aspects needed to support the Class 1E portion.

Consistent with Appendix C.II.1-A of RG 1.206, the applicant has provided ITAAC entries for verifying the electrical ITAAC for the following aspects of their design: (1) equipment qualification for seismic and harsh environment; (2) redundancy and independence; (3) capacity and capability; (4) equipment protective features; (5) controls, displays, and alarms; (6) offsite power; (7) containment electrical penetrations; (8) alternate ac power sources; (9) lighting; (10) electrical power for non-safety plant systems; and (11) other electrical systems and equipment.

Design descriptions in the US-APWR DCD also address electrical equipment that are not part of the Class 1E system, but are included to improve the reliability of the individual Class 1E divisions. Also, brief design descriptions are included for the non-Class 1E portions of the electrical system that power the balance of plant loads and these generally focus on the aspects needed to support the Class 1E portion. The electrical system design descriptions addressed in the US-APWR are: (1) The overall Class 1E electric distribution system; (2) Power sources; (3) Other electrical features, such as containment electrical penetrations and cable ampacity and de-rating criteria; (4) Lightning protection, which involves a general configuration type check; (5) Grounding, which also involves a configuration type check; (6) Lighting for the emergency control room and remote shutdown panel; (7) Requirements of GDC 17 and GDC 18; (8) SBO rule (10 CFR 50.63); (9) Safety-significant operating experience problems that have been identified, particularly through electrical distribution system functional inspections, generic letters, circulars, regulatory issue summaries, NRC bulletins, and in some cases, information notices (10) Policy issues raised for the standard designs; (11) New features in the design significant enough to warrant Tier 1 treatment; (12) Insights or key assumptions from the PRA; (13) Severe accident features added to the design; and (14) Post-TMI requirements such as the power to the power-operated relief valves, block valves, and pressurizer heaters. The applicant has identified electrical systems that are selected as Tier 1 in Table 14.3-5 of the US-APWR DCD.

ITAAC: The applicant has provided ITAAC tables for each of the systems listed in Tier 1 Section 2.6 for which Tier 1 design Descriptions were provided.

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

COL information or action items: See Section 14.3.4.6.5 below.

Technical Report(s): There are no technical reports associated with this area of review.

Topical Report(s): There are no topical reports associated with this area of review.

US-APWR Interface Issues identified in the DCD: There are no US-APWR interface issues associated with this area of review.

Site Interface Requirements Identified in the DCD: The site interface requirements associated with this area of review are provided in Tier 1, Section 3.2.4.

Cross-Cutting Requirements (TMI, USI/GSI, Op Ex): None identified.

RTNSS: There are no RTNSS issues for this area of review.

10 CFR 20.1406: There are no issues related to 10 CFR 20.1406 for this area of review.

Conceptual Design Information: This section of the DCD does not include CDI that is outside the scope of the US-APWR certification.

14.3.6.3 Regulatory Basis

The relevant requirements of the Commission's regulations for this area of review, and the associated acceptance criteria, are given in Section 14.3.6 of the SRP and are summarized below. Review interfaces with other SRP sections can be found in Section 14.3.6 of the SRP. Acceptance criteria are based on meeting the relevant requirements of the following Commission regulations:

1. 10 CFR 52.47(b)(1), which requires that a DC application include 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 DC has been constructed and will operate in accordance with the DC, the provisions of the Atomic Energy Act, and the NRC's regulations.

2. GDC 17, in part, requires that an onsite and an offsite electric power system be provided to permit functioning of SSCs important to safety. It 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.

3. 10 CFR 50.49, as it relates to the 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 requires that a nuclear power plant be able to withstand and recover from an SBO event.

Specific SRP acceptance criteria acceptable to meet the relevant requirements of the NRC's regulations identified above can be found in Part II of Section 14.3.6 of the SRP.

14.3.6.4 Technical Evaluation

The staff reviewed the following US-APWR DCD information on Tier 1 and Tier 2 including DCD Revision 3 and DCD Revision 3 Tier 1 Markup and Tracking Report Revision dated January 28, 2013 with ADAMS Accession No. ML13037A074. The Chapter on Tier 1, Section 2.6, "Electrical System," of the DCD provides top-level information on the plant design, including the principal performance characteristics and safety functions of the structures, systems, and components (SSCs). It provides ITAAC to be used to provide reasonable assurance that the as-built plant will operate in conformity with the COL, and applicable NRC regulations.

The staff reviewed the US-APWR DCD Tier 1 system design descriptions (DDs), Section 2.6 and Tier 2 Chapter 14, Section 14.3.4.6 to ensure, in part, that Tier 1 contains summary design, fabrication, testing, and performance requirements for SSCs important to safety. Also, the staff reviewed the information for conformance to the guidance given in RG 1.206, Section C.II.1.2.6 and C.II.1-A, and SRP Chapter 14.3, "Inspection, Test, Analysis, and Acceptance Criteria." The staff review documented in this section is limited to US-APWR DCD, Tier 1, Section 2.6 and Chapter 14, Section 14.3.4.6 that address ITAACs for electrical systems and selection methodology for SSCs to be included in the ITAACs. Design descriptions and ITAAC proposed by the applicant were reviewed to verify that these top level and Tier 2 requirements (or design commitments) are met when the plant is built. Since the DCD Revision 3 Tier 1 Markup and Tracking Report, dated January 28, 2013, as noted above, is not formally incorporated into the DCD, **Confirmatory Item 14.03.06-01** has been established to verify the draft documentation is incorporated into a future revision of the DCD

14.3.6.4.1 ITAAC for Class 1E Electrical Systems

The Class 1E electrical systems of the US-APWR design include: (1) the Class 1E electrical power distribution system, (2) the emergency gas turbine generators (GTGs), (3) the Class 1E direct current power supply, and (4) the Class 1E vital ac and Class 1E instrument and control power supplies. The staff reviewed the US-APWR design to establish whether the applicant established top-level design commitments for the Class 1E electrical systems and that they are verified by ITAAC. The top-level design commitments proposed by the applicant for the Class 1E electrical systems include design aspects related to:

1. Equipment qualification for seismic and harsh environment.

The SRP acceptance criteria for 14.3.6,"Electrical System-ITAAC" identify EQ for seismic and harsh environment to ensure that the seismic design requirement of GDC 2, and the EQ requirements of 10 CFR 50.49 are met. In section 14.3.4.6 of the DCD the applicant stated that ITAAC for electrical systems and equipment verify that equipment is qualified for seismic and harsh environments, that the Class 1E equipment is seismic category 1, and that equipment located in harsh environment is qualified accordingly. In US-APWR DCD Tier 1, Tables 2.6.1-1,"AC Electric Power Systems – Safety-related Equipment Characteristics" and 2.6.2-1, "DC Power System Equipment Characteristics" show electrical and seismic classification of major class 1E ac electrical power distribution equipment and dc power system equipment respectively. The applicant has identified in columns 2 and 3 of the Tables 2.6.1-1, and 2.6.2-1 the seismic and harsh environment classification of the major class 1E ac and dc electrical distribution equipment. There is no Class 1E equipment listed in these tables that are located in a harsh environment. The applicant in US-APWR DCD Tier 1, Table 2.6.1-3, "AC Electric Power Systems ITAAC," Table 2.6.2-2, "DC Power Systems ITAAC," and Table 2.6.3-3, I&C Power Supply Systems ITAAC" provide ITAACs to verify that the electrical systems and equipment is qualified for seismic and harsh environments. Since the applicant has provided the subject ITAAC that verifies that the seismic and environmental qualifications of the major class 1E ac and dc electrical distribution equipment electrical systems located in harsh environment in conformance with the requirements set forth in GDC 2 and 10 CFR 50.49, the staff finds that the applicant has adequately addressed this item and the information submitted is acceptable.

2. Redundancy and independence

In DCD Section 14.3.4.6, the applicant has included an ITAAC to verify that the Class 1E electrical divisional equipment and systems are independent by both inspections and tests. Tier 1 Table 2.6.1-3 of the US-APWR DCD describes the ITAAC for the onsite electric power system to assess the independence within class 1E electric power distribution equipment, and between class 1E electric power distribution equipment and non-safety-related electrical power distribution equipment (Table 2.6.1-3, Items 2 and 3). For Item 2, tests will be conducted on the as-built design by providing a test signal in only one Class 1E division at a time. For Item 3, type tests, analyses, or a combination of type test and analyses will be performed to verify the qualification of isolation devices. Also, Item 3 will verify independence between the as-built Class 1E electric power distribution equipment and non-Class 1E loads is provided by Class 1E qualified isolation devices.

The staff has verified that the applicant has included testing and appropriate acceptance criteria for Items 2 and 3 in Table 2.6.1-3, "AC Electric Power Systems Inspections, Tests, Analyses, and Acceptance Criteria." Since the applicant has provided the subject ITAAC that verifies the divisional assignments and independence of the Class 1E electric power system equipment by both inspection and testing in conformance with the requirements set forth in GDC 17 as it pertains to physical independence of the onsite power systems, the staff finds that the applicant has adequately addressed this item and the information submitted is acceptable.

3. Capacity and Capability

To ensure that the electrical systems have the capacity and capability to supply the safety-related electrical loads, ITAAC are required to verify the adequate sizing of the electrical system equipment and its ability to respond (e.g., automatically in the time needed to support the accident analyses) to postulated events. This includes the Class 1E portion and the non-Class 1E portion to the extent that it is involved in supporting the Class 1E system. ITAAC should be included to analyze the as-built electrical system and installed equipment (emergency ac generators (GTGs), transformers, switchgear, batteries, etc.) to verify its ability to power the loads. In addition, the ITAAC should also include tests to demonstrate the operation of the equipment. Testing should be included in ITAAC to verify gas turbine generator (GTG) capacity and capability based on the Technical Specifications. ITAAC should verify the capacity and capability of the Class 1E equipment necessary to mitigate postulated events for which the equipment is credited (e.g., loss of coolant accident (LOCA), loss of offsite power (LOOP), and degraded voltage conditions). ITAAC should be included to analyze the as-built electrical power system for its response to a LOCA, LOOP, combinations of LOCA and LOOP, and degraded voltage, including tests to demonstrate the actuation of the electrical equipment in response to postulated events. Analyses to demonstrate the acceptability of a voltage drop should be included in ITAAC to verify adequacy for supporting the accomplishment of a direct safety function. Testing should be included in ITAAC to verify the GTG voltage and frequency response to assure that it is acceptable, and is the same as that specified in the Technical Specifications.

The staff reviewed the Tier 1, Section 2.6 and Tier 2, Sections 1.8 and 14.3.4.6 information in the US-APWR DCD to ascertain whether the above stated requirements are met. The staff found that the applicant had not provided sufficient information for the transmission switchyard and onsite power system in accordance with 10 CFR 52.79(b) under Tier 2 interface requirements. Specifically, "Plant Interfaces with the Remainder of Plant," of Tier 2 requires the COL applicant to address offsite ac requirements for steady-state load, inrush kVA for motors, nominal voltage, allowable voltage regulation, nominal allowable frequency fluctuation,

maximum frequency decay rate, and limiting under-frequency value for the reactor coolant pump (RCP). It further requires the offsite transmission system analysis for loss of the unit or the largest unit, for voltage operating range, for maintaining transient stability, and for the RCP bus voltage to remain above the voltage required to maintain the flow assumed in Chapter 15 analyses following a turbine trip.

Therefore, the staff in **RAI 32-738, Question 14.03-2** dated July 17, 2008, requested additional information on the interface requirements with regard to capacity and capability of the offsite power and onsite power system and transmission switchyard. The applicant in response to **RAI 32-738, Question 14.03-2** dated August 29, 2008, stated that the applicant considers the items noted in the subject RAI are not significant interfaces; therefore the applicant stated that conformance and adjustment between the onsite power system and offsite power system would be addressed by the COL applicants through COL items provided in the DCD.

The staff held a teleconference with the applicant on March 23, 2009, to further discuss its concern on the ITAACs and interface requirements with respect to GDC 17 for offsite transmission system analysis for loss of the unit or the largest unit, for voltage operating range, for maintaining transient stability, and for the reactor coolant pump (RCP) bus voltage to remain above the voltage required to maintain the flow assumed in Chapter 15 analyses following a turbine trip. The applicant agreed to revise COL Items 8.2(3) and 8.2(11) in the DCD, Tier 2 Table 1.8.2 in the next revision of the DCD to include COL interface requirements for stability analysis in accordance with GDC 17 requirements for maintaining transient stability and for grounding and lightning protection. The staff indicated to the applicant that this commitment needed to be captured in the DCD.

In supplemental **RAI 424-3281, Question 14.03.06-16,** the staff requested that the applicant provide interface requirements in the US-APWR DCD for the transmission switchyard and onsite power system in accordance with 10 CFR 52.79(b) under Tier 2 interface requirements. Also, the staff requested the applicant to provide COL interface requirements related to the stability study analysis, voltage operating range, maintaining transient stability, the RCP bus voltage to remain above the voltage required to maintain the flow assumed in Chapter 15 analyses following a turbine trip, and grounding and lightning protection.

In its response to **RAI 424-3281, Question 14.03.06-16**, dated September 8, 2009, the applicant committed to revise COL Item 8.2(3) to include a COL interface requirement for grounding and lightning protection, and COL Item 8.2(11) to include COL interface requirements for stability study analysis in accordance with the GDC requirements to address loss of the unit, or loss of the largest unit, or largest load or loss of the most critical transmission line including operating range, for maintaining transient stability. The applicant also committed to revise COL Items 8.2(3) and 8.2(11) to include the interface requirement for lightning and grounding protection, and the interface requirement for stability study analysis in accordance with the GDC requirements respectively. The staff has reviewed and verified that these changes have been made as part of Revision 2 to the DCD. The subject ITAAC for verifying the capacity and capability of the as-built electrical power system, including the transmission switchyard, for its response to postulated events is acceptable based on the compliance with GDC 17 criteria. Therefore, the staff finds that **RAI 32-738, Question 14.03-2** and **RAI 424-3281, Question 14.03.06-16, are closed and the issue resolved**. Since the applicant has provided the subject ITAAC that verifies that the electrical systems have the capacity and capability to supply the safety-related electrical loads the divisional assignments and independence of the Class 1E electric power system equipment in conformance with the requirements set forth in GDC 17, the

staff finds that the applicant has adequately addressed this item and the information submitted is acceptable.

4. Electrical protection features

ITAAC are required to verify the adequacy of the electrical circuit protection design to ensure that the electrical power system is protected against potential electrical faults. Operating experience and NRC Electrical Distribution System Functional Inspections (EDSFIs) have found inadequacy of the short circuit rating of certain electrical equipment and breaker and protective device coordination. ITAAC are required to analyze the as-built electrical system equipment for its ability to withstand and clear electrical faults. Further, ITAAC are included to analyze the protection coordination to verify its ability to limit the loss of equipment due to postulated faults. Similarly, emergency power (i.e., GTGs) protective trips (and bypasses if applicable) are to be verified by ITAAC.

The staff reviewed the Tier 1 and Tier 2 information in the US-APWR DCD to verify that the applicant had included ITAAC for the above stated requirements. The applicant has provided ITAAC for the electrical protection features including attributes such as analyzing the ability of the as-built electrical system equipment to withstand and clear electrical faults and to possess protection feature coordination. These ITAAC items are identified as follows:

Table	ITAAC Item Numbers
2.6.1-3	7, 8, 11a, 12, 18, 21
2.6.2-2	13
2.6.3-3	11
2.6.4-1	16
2.6.7-1	2
2.6.8-1	5, 6

The staff finds the applicant has included ITAAC in the US-APWR electrical design for analyzing the as-built electrical system equipment to withstand and clear an electrical fault and to maintain protection coordination. Since the information in Section 2.6 of Tier 1 of the DCD, which addresses electrical protection features, has been prepared in accordance with the guidance in SRP Section 14.3, SRP Section 14.3.6, and RG 1.206, which states that the applicant should develop ITAAC to verify the adequacy of the electrical circuit protection included in the design, the staff finds that the applicant has adequately addressed this item and the information submitted is acceptable.

5. Displays/controls/alarms

To ensure that the electrical power system is available when required, ITAACs are required to verify the existence of monitoring and controls for the electrical equipment. The minimum set of

displays, alarms, and controls is based on the emergency procedure guidelines. In some cases, additional displays, alarms, and controls may be specified based on special considerations in the design and/or operating experience. The applicant has included ITAAC to inspect, to retrieve the information (displays and alarms), and to control the electrical power system in the main control room and/or at locations provided for remote shutdown. Detection of undervoltage conditions along with the starting and loading of GTGs are included in ITAAC. This is a direct safety function in response to loss of power to the safety buses; therefore the staff finds it acceptable. Since the applicant has provided the information in Section 2.6 of Tier 1 of the DCD, which addresses displays, controls, and alarms, has been prepared in accordance with the guidance in SRP Section 14.3, SRP Section 14.3.6, and RG 1.206, the staff finds that the applicant has adequately addressed this item and the information submitted is acceptable.

14.3.6.4.2 ITAAC for Other Electrical Systems/Components

In addition to the Class 1E systems addressed above, other aspects of the electrical design that are deemed to be important to safety and the top-level design commitments (Tier1) were reviewed by the staff for ITAAC compliance. These electrical systems are discussed as follows:

1. Offsite Power

To ensure that the requirements of GDC 17 for the adequacy and independence of the preferred offsite power sources within the standard design scope are met, an ITAAC should verify the capacity and capability of the offsite sources to feed the Class 1E divisions, and the independence of those sources. ITAAC should be included to inspect the direct connection of the offsite sources to at least one Class 1E division, and to inspect for the independence/separation of the offsite sources, and offsite sources and onsite power sources. ITAAC should include appropriate lightning protection and grounding features associated with the offsite power system. In addition, the design description should include COL interface requirements for the portions of the offsite power outside of the standard design scope.

The staff reviewed the Tier 1 Section 2.6 “Electrical system,” and Tier1 Section 3, “Interface Requirements,” and Tier 2, Section 14.3.4.6 information in the US-APWR DCD for ITAACs to verify the above requirements. The staff found that the applicant had not provided sufficient information on site-specific ITAAC for the transmission switchyard and offsite power system. RG 1.206, CIII.7.2, Site-Specific ITAAC, recommends that applicants develop ITAAC for the site-specific systems that are designed to meet the significant interface requirements of the standard certified design, that is, the site-specific systems that are needed for operation of the plant (e.g., offsite power). RG 1.206, C.II.1.2.6, ITAAC for Electrical Systems (SRP Section 14.3.6) states that applicants should develop ITAAC for the Offsite Power to verify by inspection and/or test the direct connection of offsite power sources to the Class 1E divisions including the adequacy of voltage, capacity, independence/separation and stability of frequency of the offsite sources. The staff in **RAI 32-738, Question 14.03-01** requested that the applicant develop a site-specific ITAAC for the switchyard and offsite power system to address the following:

a. A minimum of two independent offsite transmission circuits from the transmission network (TN) to the safety buses with no intervening non-safety buses (direct connection).

b. Voltage variations of the offsite TN during steady-state operation shall not cause voltage variations at the loads of more than plus or minus 10 percent of the loads’ nominal ratings.

c. The normal steady state frequency of the offsite TN shall be within plus or minus 2 Hz of 60 Hz during recoverable periods of system instability.

d. The capacity and capability of each circuit to power the required loads during steady state, transient, and postulated events and accident conditions. This should include proper operation and load carrying capability of breakers, switchgear buses, transformers, and cables.

e. The independence and separation of the offsite circuits and offsite circuits and onsite Class 1E electrical system and components.

f. The appropriate lightning protection and grounding features for the system and components of the offsite circuits from the TN to the safety buses.

g. Operation of instrumentation and control alarms used to monitor switchyard equipment status.

h. The proper operation of the automatic fast transfer capability of the preferred power supply to the non-preferred power supply, i.e., from the reserve auxiliary transformer (RAT) to the unit auxiliary transformer (UAT).

i. Switchyard interface agreement and protocols with the TN system operator/owner in accordance with the guidance given in GL 2006-2.

j. Interface requirements (such as transient stability analysis) for the offsite power system (switchyard) to assess minimizing the probability of losing electric power from any of the remaining supplies as a result of or coincident with, the loss of power generated by the nuclear unit, the loss of power from the TN, or the loss of the largest load.

In its response to **RAI 32-738, Question 14.03-01,** dated August 29, 2008, the applicant stated that they will add items a through f as an interface requirement in Tier 1, Section 3.0 for the verification of the as-built system by the COL applicant. Also, the applicant stated that it considers Items g, h and I not significant interfaces, therefore, need not be addressed. The staff held a teleconference on March 23, 2009, with the applicant to further elaborate on its position of why the staff considered these items to be important and significant, and also try to understand why the applicant considered them to be not significant interfaces. Based on the discussions held during the March 23, 2009, teleconference the applicant agreed with the staff's view that these items are important and should be included as COL interface requirements. The staff indicated to the applicant that this commitment needed to be captured in the DCD.

In supplemental **RAI 424-3281, Question 14.03.06-15,** dated July 27, 2009, the staff requested that the applicant docket its response confirming the provision for interface requirements in the upcoming revisions of the US-APWR DCD for the COL applicant to develop site-specific ITAACs for the switchyard and offsite power systems as listed in the response to **RAI 32-738, Question 14.03-1** to resolve this RAI question.

In its response to **RAI 424-3281, Question 14.03.06-15**, dated September 8, 2009, the applicant agreed that it would provide interface requirements in the upcoming revisions of the US-APWR DCD for the COL applicant to develop site-specific ITAACs for the switchyard and offsite power systems for the items a through j listed above as follows:

a. *A minimum of two independent offsite transmission circuits from the transmission network (TN) to the safety buses with no intervening non-safety buses (direct connection).* The

applicant will add an interface requirement to Section 3.2 for a minimum of two independent offsite transmission circuits from the transmission network (TN) to the safety buses with no intervening non-safety buses.

b. *Voltage variations of the offsite TN during steady-state operation shall not cause voltage variations at the loads of more than plus or minus 10 percent of the loads' nominal ratings.* The applicant will add an interface requirement to Section 3.2 to verify the voltage variations of the offsite TN during steady state operations do not cause voltage variations beyond an acceptable tolerance of the loads' nominal ratings.

c. *The normal steady state frequency of the offsite TN shall be within plus or minus 2 Hz of 60Hz during recoverable periods of system instability.* The applicant will add an interface requirement to Section 3.2 for the normal steady state frequency of the offsite TN to be within an acceptable tolerance of 60 Hz during recoverable periods of instability.

d. *The capacity and capability of each circuit to power the required loads during steady state, transient, and postulated events and accident conditions. This should include proper operation and load carrying capability of breakers, switchgear buses, transformers, and cables.* The applicant will add an interface requirement to Section 3.2 for the as-built system to have the capacity and capabilities to power the required loads during steady state, transient, and postulated events and accident conditions.

e. *The independence and separation of the offsite circuits and onsite class 1E electrical system and components.* The applicant will add an interface requirement to Section 3.2 for the as-built electrical system to verify the independence and separation of the offsite circuits and the onsite Class 1E electrical system and components.

f. *The appropriate lightning protection and grounding features for the system and components of the offsite circuits from the TN to the safety buses.* The applicant will add an interface requirement to Section 3.2 for the COL applicant to verify the appropriate as-built lightning protection and grounding features exist for the offsite circuits from the TN to the safety buses.

g. *Instrumentation, controls and alarms used for monitoring switchyard equipment status.* The applicant will add an interface requirement to Section 3.2 for the COL applicant to verify the as-built electrical system has alarms and displays for monitoring the switchyard 14.03.06-3 equipment status.

h. *The proper operation of the automatic fast transfer capability of the preferred power supply to the non-preferred power supply, i.e., from the reserve auxiliary transformer (RAT) to the unit auxiliary transformer (UAT).* The applicant will add an interface requirement to Section 3.2 for the COL applicant to verify that the as-built electrical system will automatically transfer power supply from the RAT to the UAT.

i. *Switchyard interface agreement and protocols with the TN system operator/owner in accordance with the guidance given in GL 2006-2.* The applicant will add an interface requirement to Section 3.2 for the COL applicant for switchyard agreements and protocols between the NPP and the TN operator in accordance with GL 2006-2.

j. *Because of its importance to safety, provide ITAAC or interface requirements (such as*

transient stability analysis) for the offsite power system (switchyard) to assess minimizing the probability of losing electric power from any of the remaining supplies as a result of or coincident with, the loss of power generated by the nuclear unit, the loss of power from the TN, or the loss of the largest load. The applicant will add an interface requirement to Section 3.2 for the COL applicant to assess the probability of losing electric power caused by the loss of power generated by the nuclear unit, the loss of power from the TN, or the loss of the largest load.

On the basis of its review, and in conformance with the guidance in SRP Sections 14.3, and 14.3.6, the staff finds that the applicant has adequately addressed the above issues and considers them resolved. Therefore, **RAI 32-738, Question 14.03-01** and **RAI 424-3281, Question 14.03.06-15 are resolved and closed**.

2. Containment Electrical Penetrations

The ITAAC for containment electrical penetrations (both Class 1E and non-Class 1E circuits) needs to verify that the containment electrical penetrations do not fail due to electrical faults and thereby potentially breach the containment. The ITAAC should verify that all electrical containment penetrations are protected against postulated fault currents, i.e., currents much greater than their continuous current rating. In addition, the ITAAC should demonstrate that the penetrations can withstand seismic design basis loads without loss of safety function and withstand the environmental conditions that would exist before, during and after a design basis event for the time required to perform the safety function. Separation of the electrical penetrations should also be verified by non-safety/safety divisions and by voltage class.

Tier 1 Table 2.6.8-1, “Containment Electrical Penetration Assemblies Inspections, Tests, Analyses and Acceptance Criteria” provides the necessary ITAAC described above. Since the information in Section 2.6 of Tier 1 has been prepared in accordance with the guidance in SRP Section 14.3, SRP Section 14.3.6, and RG 1.206, and addresses the above items, the staff finds that the applicant has adequately addressed ITAAC for the containment electrical penetrations and is acceptable.

3. Alternate AC Power Source

The ITAAC for alternate AC power source is required to verify through inspection and testing the availability of the alternate AC (AAC) power source for station blackout events, and the AAC power sources and their auxiliaries are independent from other AC sources. Tier 1 Table 2.6.5-1 includes an ITAAC to verify through inspection and testing that the combustion gas turbines as AAC power sources and their auxiliaries are available for SBO events, and have independence from other ac power sources.

Since the information in Section 2.6 of Tier 1, which addresses AAC power source, has been prepared in accordance with the guidance in SRP Section 14.3 , SRP Section 14.3.6 , and RG 1.206 , which states that the applicant should develop ITAAC to verify through inspection and testing the AAC power source and its auxiliaries to ensure the availability of the AAC power source for SBO events as well as its independence from other ac sources, staff finds that the applicant has adequately addressed this item and the information submitted is acceptable.

4. Lighting

The ITAAC for lighting are required for verifying the continuity of power sources for plant lighting

systems to ensure that portions of the plant lighting remain available during accident events, partial loss of power and SBO conditions. The applicant in Section 14.3.4.6 of the DCD has committed to have ITAAC to verify lighting including continuity of power sources for plant lighting systems to assure that portions of the plant lighting are available during accident and loss of power events:

> Lighting, including the continuity of power sources for plant lighting systems to assure that portions of the plant lighting remain available during accident scenarios and power failures

Tier 1 Table 2.6.6-1 captures the applicant's commitment. Since the information in Section 2.6 of Tier 1, which addresses lighting, has been prepared in accordance with the guidance in SRP Section 14.3 , SRP Section 14.3.6 , and RG 1.206 , which states that the applicant should develop ITAAC to verify the continuity of power sources for plant lighting systems to ensure that portions of the plant lighting remain available during accident scenarios and power failures, staff finds that the applicant has adequately addressed this item and is acceptable.

5. Electrical Power for Non-Safety Plant Systems

The ITAAC are required to ensure that electrical power is provided to support the non-safety plant systems, including the functional arrangement of electrical power systems to the extent that those systems perform a significant safety function. The applicant in Section 14.3.4.6 of the DCD has committed to have ITAAC to verify electrical power is provided to support the non-safety plant systems to the extent that those systems perform a significant safety function:

> Electrical power for non-safety plant systems, including the functional arrangement of electrical power systems provided to support non-safety systems to the extent that those systems perform a significant safety function

Tier 1 Table 2.6.5-1, **"**AAC Systems Inspections, Tests, Analyses, and Acceptance Criteria" includes an ITAAC regarding the inspection of the as-built non-safety disconnect switch and Class 1E circuit breaker between each AAC power source and the emergency Class 1E power supply systems. Since the information in Section 2.6 of Tier 1, which addresses alternate lighting, has been prepared in accordance with the guidance in SRP Section 14.3 , SRP Section 14.3.6 , and RG 1.206 , which states that the applicant should develop ITAAC to verify the functional arrangement of electrical power systems provided to support non-safety systems to the extent that those systems perform a significant safety function, staff finds that the applicant has adequately addressed this item and is acceptable.

6. Other Electrical systems and Equipment

Design descriptions in the US-APWR DCD also address electrical equipment that are not part of the Class 1E system, but are included to improve the reliability of the individual Class 1E systems. Also, brief design descriptions are included for the non-Class 1E portions of the electrical system that power the balance of plant loads and these generally focus on the aspects needed to support the Class 1E portion. The applicant has provided description of these non-Class 1E systems that power the balance of the plant loads and are included to improve the reliability of the individual Class 1E divisions. Appendix A to RG 1.206, (pages C.II.1-A-19 – C.II.1-A-22) lists ITAAC for ac distribution equipment in items A through P. Similarly, SRP Section 14.3, Appendix CII list electrical systems review checklist that should be included in the Tier 1 information. The equipment and systems identified in the ITAAC in the US-APWR DCD

did not include several of the ac distribution equipment that are identified by the RG 1.206 and SRP review checklists.

The staff in **RAI 32-738, Question 14.03.5** requested that the applicant address the ITAAC for the following ac distribution equipment and systems.

a. Emergency onsite power sources (GTGs), including load sequencing and GTG support systems.

b. Alternate ac (AAC) Power sources for SBO and recovery of ac power following an SBO event.

c. Lightning protection and grounding for lightning system, and power system grounding.

d. Safety-significant operating experience problems have been identified via NRC inspections and generic communications (e.g., Generic Letters, Circulars, Regulatory Information Summaries Bulletins and information Notices). Some examples of the ac distribution problems involve breaker coordination, short circuit protection and medium voltage cables susceptible to moisture (Generic Letter 2007-1, "Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients").

e. Design and operational features resulting from solutions identified to resolve Generic Safety Issues, which identified the need for interlocks and Limiting Condition for Operations (LCOs) of tie breakers and LCOs for Class 1E vital instrument buses (GL 91-11, Resolution of Generic Safety Issues 48, "LCOs For Class 1E Vital Instrument Buses," and 49, "Interlocks AND LCOs For Class 1E Tie Breakers."). Provide ITAACs for tie breakers in the 6.9 kV and 480 volt systems and vital instrument buses to verify operational features, LCOs and interlocks.

f. Post TMI requirements such as power to the power-operated relief valve, block valve, and pressurizer heaters.

g. Post-fire safe shutdown circuit analysis and supporting breaker coordination including a testing program to for the protective devices credited in the safe shutdown circuit analysis.

h. Sensing instrumentation and logic.

i. Connection of non-Class 1E loads on Class 1E buses because of the potential degradation of Class 1E sources and fire-induced cable damage. Provide ITAAC to verify independence between the Class 1E sources and non-Class 1E loads.

j. Harmonics introduced by non-linear loads (e.g., speed controllers) and their potential effects on Class 1E equipment.

The applicant in its response to **RAI 32-738, Question 14.03.5** dated August 29, 2008, regarding ITAACs for the distribution equipment and systems listed above, stated that ITAAC for these systems and components is encompassed within the ITAAC for Subsections 2.6.1 through 2.6.8. The staff held a teleconference on March 23, 2009, with the applicant to discuss the ac distribution equipment and systems that are not encompassed within the ITAAC for Subsections 2.6.1 through 2.6.8. During the teleconference held on March 23, 2009, the applicant agreed that it will include ITAACs for items those items not already covered in the Table 2.6.1-1 in future revisions of the US-APWR DCD.

Subsequent to the teleconference, the staff formalized this request in supplemental **RAI 424-3281 Question 14.03.06-18** dated July 27, 2009, identifying the below listed equipment that is

not within the ITAAC for Subsections 2.6.1 through 2.6.8 and asked the applicant to include it in Table 2.6.1-1 of the US-APWR DCD:

- Lightning protection to verify that lightning protection is provided, installed and tested to perform its intended function;

  In its response dated September 8, 2009, the applicant agreed to add ITAAC item for lightning protection Table 2.6.7-1.

- Breaker coordination and medium voltage cables susceptible to moisture and electrical issues that are identified via functional inspections, generic letters, circulars, regulatory information summaries (RIS), NRC bulletins and information notices (IN);

  In its response dated September 8, 2009, the applicant agreed to add ITAAC item for breaker coordination to Table 2.6.1-3. Regarding medium voltage cables susceptible to moisture, the applicant responded by saying that it considers the potential for medium voltage cable degradation as described in GL 2007-01 to be in the scope of maintenance rule implementation. The COL applicant is responsible to develop and implement the maintenance rule program per COL 17.6(1). The applicant will revise DCD Subsection 8.1.5.3.4 to include reference to GL 2007-01.

- Tiebreakers in the 480 volt systems and vital instrument buses to assure their design and operational features;

  In its response dated September 8, 2009, the applicant proposes to include ITAAC in DCD Tier 1, Revision 2 to verify the design features related to electrical division independence and separation, including:

  - ITAAC for independence of Class 1E electrical distribution system equipment;
  - ITAAC for independence of dc power system divisions;
  - ITAAC for independence of Class 1E I&C power supply system divisions; and
  - ITAAC for Class 1E I&C power supply transfer capability to provide uninterruptible power supply (UPS).

  The applicant's proposed actions listed above for vital instrument buses to assure their design and operational features are acceptable to the staff.

- Post fire safe shutdown circuit analysis and supporting breaker coordination and a testing program for the protective devices credited in the safe shutdown circuit analysis;

  In its response dated September 8, 2009, the applicant agreed to add ITAAC items for post fire safe shutdown circuit analyses, breaker coordination and testing program to Table 2.6.1-3.

- Harmonics introduced by non-linear loads and their potential effects on Class 1E equipment.

In its response dated September 8, 2009, the applicant agreed to add ITAAC item for harmonics introduced by non-linear loads and their potential effects on Class IE equipment will be added to Table 2.6.1-3.
The staff found that the applicant's response to **RAI 424-3281 Question 14.03.06-18** acceptable, and the information provided by the applicant has been prepared in accordance with the guidance in SRP Sections 14.3, and 14.3.6. Since, the staff has verified that this information has been incorporated into the DCD, **RAI 424-3281 Question 14.03.06-18** and **RAI 32-738, Question 14.03.5 are closed and the issue resolved.**.

Editorial Comment:
Delete extra period.

Since the information in Section 2.6 of Tier 1, which addresses other electrical systems and equipment, has been prepared in accordance with the guidance in SRP 14.3, SRP 14.3.6, and RG 1.206, which states that the applicant should develop ITAAC to verify the functional arrangement of other electrical systems and equipment that are not part of the Class 1E system, but are included to improve the reliability of the individual Class 1E systems, staff finds this that the applicant has adequately addressed this item and the information submitted is acceptable.

14.3.6.5 Combined License Information Items – Electrical systems

These items are listed in DCD, Tier 2, Section 1, Table 1.8-2, and are evaluated as part of the staff's SER for Section 8 of the DCD.

14.3.6.6 Conclusions

The staff has reviewed all the relevant ITAAC information that is applicable to the electrical power system design and evaluated its compliance with 10 CFR 50.49, 10 CFR 50.63, GDC 2 and GDC 17, and its conformance with relevant NRC guidance in SRP Sections 14.3 and 14.3.6. On the basis of the information provided in the DCD, the general description of ITAAC for electrical review areas found in Tier 1, Section 2.6 and Tier 2, Chapter 14, Section 14.3.4.6, the staff finds that the US-APWR DCD Tier 1 has provided sufficient information to satisfy Section 14.3.6 of this report for ITAAC design certification. Except for **Confirmatory Item 14.03.06-1** identified above, 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 and applicable regulations.

14.3.7 ITAAC for Plant Systems

14.3.7.1 Introduction

This SER section addresses ITAAC related to most of the fluid systems that are not part of the core reactor systems. The specific areas addressed in this section include:

- New and spent fuel handling systems, power generation systems, air systems, cooling water systems, radioactive waste systems and HVAC systems

- Issues, which affect multiple SSCs, such as equipment qualification and protection from fires, floods and tornado missiles.

The staff reviewed 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 DC is built and will operate in accordance with the DC, the Atomic Energy Act, and the NRC's regulations. In addition, the staff reviews the justification that compliance with the interface requirements is verifiable through ITAAC, and also reviews the method that is to be used for verification of the interface requirements.

14.3.7.2 Summary of Application

DCD Tier 1: The Tier 1 information associated with this section is found in Tier 1, Section 2.7, "Plant Systems," of the DCD.

DCD Tier 2: The applicant has provided a Tier 2 design description in DCD Section 14.3.4.7, summarized here in part, as follows:

ITAAC are specified for the plant systems identified in Section 14.3.4.7.1 above to provide for, as applicable:

- As-built plant reports for reconciliation with flood analyses to assure consistency with design requirements of SSCs for flood protection and mitigation.
- As-built plant reports for reconciliation with post-fire safe shutdown analyses to assure consistency with design requirements of SSCs for fire protection and mitigation.
- Verifying heat removal capabilities for design-basis accidents as well as tornado and missile protection.
- Verifying net positive suction head for key pumps.
- Verifying physical separation for appropriate systems.
- Verifying that the minimum inventory of alarms, controls, and indications – as derived from emergency procedure guidelines; RG 1.97; and probabilistic risk assessment (PRA) insights – is provided for the MCR and remote shutdown stations.
- Commensurate with the importance of the design attribute to safety, verifying various design attributes for plant systems.
- Verifying the performance of the liquid waste management system (as permanently installed systems or in combination with mobile processing equipment).
- Verifying the performance of the gaseous waste management system (as permanently installed systems or in combination with mobile processing equipment).
- Verifying the performance of the solid waste management system (as permanently installed systems or in combination with mobile processing equipment).

- Verifying the performance of the process and effluent radiological monitoring instrumentation and sampling systems (as permanently installed systems or in combination with portable skid-mounted equipment).

ITAAC: The ITAAC associated with Tier 1, Section 2.7 are given in Tier 1, Sections 2.7.1.1.2, 2.7.1.2.2, 2.7.1.3.2, 2.7.1.4.2, 2.7.1.5.2, 2.7.1.6.2, 2.7.1.7.2, 2.7.1.8.2, 2.7.1.9.2, 2.7.1.10.2, 2.7.1.11.2, 2.7.1.12.2, 2.7.1.13.2, 2.7.2.2., 2.7.3.1.2, 2.7.3.2.2., 2.7.3.3.2, 2.7.3.4.2, 2.7.3.5.2, 2.7.3.6.2, 2.7.4.1.2, 2.7.4.2.2., 2.7.4.3.2, 2.7.5.1.2, 2.7.5.2.2, 2.7.5.3.2, 2.7.5.4.2, 2.7.5.5.2, 2.7.6.1.2., 2.7.6.2.2., 2.7.6.3.2, 2.7.6.4.2, 2.7.6.5.2, 2.7.6.6.2, 2.7.6.7.2, 2.7.6.8.2, 2.7.6.9.2, 2.7.6.10.2, 2.7.6.11.2, 2.7.6.12.2, and 2.7.6.13.1.3.

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

COL information or action items: See Section 14.3.4.7.5 below.

Technical Report(s): There are no technical reports associated with this area of review.

Topical Report(s): There are no topical reports associated with this area of review.

US-APWR Interface Issues identified in the DCD: There are no US-APWR interface issues associated with this area of review.

Site Interface Requirements Identified in the DCD: There are no site interface requirements associated with this area of review.

Cross-cutting Requirements (TMI, USI/GSI, Op Ex): None identified.

RTNSS: There are no RTNSS issues for this area of review.

10 CFR 20.1406: There are no issues related to 10 CFR 20.1406 for this area of review.

Conceptual Design Information: This section of the DCD does not include CDI that is outside the scope of the US-APWR certification.

14.3.7.3 Regulatory Basis

The relevant requirements of the Commission's regulations for this area of review, and the associated acceptance criteria, are given in Section 14.3.7 of NUREG-0800 and are summarized below. Review interfaces with other SRP sections can be found in Section 14.3.7 of NUREG-0800. Acceptance criteria are based on meeting the relevant requirements of the following Commission regulation:

> 10 CFR 52.47(b)(1), which requires that a DC application include 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 DC has been constructed and will operate in accordance with the DC, the provisions of the Atomic Energy Act, and the NRC's regulations.

Specific SRP acceptance criteria acceptable to meet the relevant requirements of the NRC's regulation identified above can be found in Part II of Section 14.3.7 of NUREG-0800.

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 Tier 2 DCD Sections. The staff verified that key performance characteristics and safety functions of SSCs were based on its safety significance. ASME Code III related ITAAC and equipment qualification are discussed in Sections 14.3.3 and 14.3.6 of this report respectively.

Table 14.3.7-1 below provides the Tier 1 plant systems description, corresponding Tier 1 sections, and related Tier 2 sections. The staff's review of plant systems ITAAC are discussed in the specific sections of this report as listed in Table 14.3.7-1. Not all of the systems listed in Table 14.3.7-1 have an ITAAC and staff verified that no ITAAC was needed for those systems.

Table 14.3.7-1

Plant Systems Description	Tier 1 Section Number	Related Tier 2 Section Numbers
Turbine Generator (T/G)	2.7.1.1	10.2
Main Steam Supply System (MSS)	2.7.1.2	10.3
Main Condenser	2.7.1.3	10.4.1
Main Condenser Evacuation System (MCES)	2.7.1.4	10.4.2
Gland Seal System (GSS)	2.7.1.5	10.4.3
Turbine Bypass System (TBS)	2.7.1.6	10.4.4
Circulating Water System (CWS)	2.7.1.7	10.4.5
Condensate Polishing System (CPS)	2.7.1.8	10.4.6
Condensate and Feedwater System (CFS)	2.7.1.9	10.4.7
Steam Generator Blowdown System (SGBDS)	2.7.1.10	10.4.8
Emergency Feedwater System (EFWS)	2.7.1.11	10.4.9
Secondary Side Chemical Injection System (SCIS)	2.7.1.12	10.4.10
Auxiliary Steam Supply System (ASSS)	2.7.1.13	10.4.11
Compressed Air and Gas Systems (CAGS)	2.7.2	9.3.1
Essential Service Water System (ESWS)	2.7.3.1	9.2.1
Non-Essential Service Water System (Non-ESWS)	2.7.3.2	9.2.9
Component Cooling Water System (CCWS)	2.7.3.3	9.2.2

Plant Systems Description	Tier 1 Section Number	Related Tier 2 Section Numbers
Turbine Component Cooling Water System	2.7.3.4	9.2.8
Essential Chilled Water System (ECWS)	2.7.3.5	9.2.7
Non-Essential Chilled Water System (non-ECWS)	2.7.3.6	9.2.7
Liquid Waste Management System (LWMS)	2.7.4.1	11.2
Gaseous Waste Management System (GWMS)	2.7.4.2	11.3
Solid Waste Management System (SWMS)	2.7.4.3	11.4
Main Control Room HVAC System	2.7.5.1	9.4.1
Engineered Safety Features Ventilation Systems (ESFVS)	2.7.5.2	9.4.5
Containment Ventilation System (CVVS)	2.7.5.3	9.4.6
Auxiliary Building Ventilation System (ABVS)	2.7.5.4	9.4.3
Turbine Building Area Ventilation System	2.7.5.5	9.4.4
New Fuel Storage	2.7.6.1	9.1.2
Spent Fuel Storage	2.7.6.2	9.1.2
Spent Fuel Pit Cooling and Purification System	2.7.6.3	9.1.3
Light Load Handling System	2.7.6.4	9.1.4
Overhead Heavy Load Handling System	2.7.6.5	9.1.5
Process Effluent Radiation Monitoring and Sampling System	2.7.6.6	11.5
Process and Post-accident Sampling System (PSS)	2.7.6.7	9.3.2
Equipment and Floor Drainage Systems	2.7.6.8	9.3.3
Fire Protection System	2.7.6.9	9.5.1
Communications Systems	2.7.6.10	9.5.2
Condensate Storage Facilities	2.7.6.11	9.2.6
Potable and Sanitary Water Systems (PSWS)	2.7.6.12	9.2.4
Ultimate Heat Sink	3.2.1	9.2.5

HVAC Systems

The staff initially developed 69 questions during its SRP Section 14.3.7 evaluation of the five Tier 1 ventilation systems. The applicant sent their response by letter titled “MHI Responses to

US-APWR DCD RAI No. 54," dated September 19, 2008 (ADAMS Accession No. ML082680032). The staff developed and sent follow-up RAI questions. The applicant sent their response to the follow-up RAIs by letter titled, "MHI's Responses to US-APWR DCD RAI No. 381-2806 Revision 1," dated July 17, 2009 (ADAMS Accession No. ML092030410). Only the RAI questions that resulted in significant changes to the DCD Tier 1 technical content are discussed as part of this SER Technical Evaluation. The staff has condensed the RAI questions and answers where possible from the complete version in the response letters from MHI.

Other relevant staff/applicant correspondence as invoked in this SER includes:

- "MHI's Response to US-APWR DCD RAI No.30" dated September 3, 2008 (ADAMS Accession No. ML082520817)
- "MHI's Response to US-APWR DCD RAI No. 33" dated September 4, 2008 (ADAMS Accession No. ML082520230)
- "MHI's Responses to US-APWR DCD RAI No. 337-2398" dated May 18, 2009 (ADAMS Accession No. ML091410434)
- "MHI's Response to US-APWR DCD RAI No.582-4456 Revision 2" dated July 16, 2010 (ADAMS Accession No. ML102010040)
- "MHI's Responses to US-APWR DCD RAI No.675-5231 Revision 2" dated January 31, 2011 (ADAMS Accession No. ML110340019)
- "MHI's Response to US-APWR DCD RAI No.926-6448 Revision 3" dated June 7, 2012 (ADAMS Accession No. ML12163A010)

2.7.5.1 Main Control Room HVAC System

US-APWR DCD Tier 1 Section 2.7.5.1 provides the Tier 1 information associated with the MCR HVAC system. Subsection 2.7.5.1.1 provides a description of the MCR HVAC system, and states that the MCR HVAC system is a safety-related system except for the toilet/ kitchen exhaust and smoke purge fans. US-APWR DCD Tier 2 Section 9.4.1 provides the MCR HVAC system design. The MCRE consists of the following:

- MCR
- Operator area
- Shift supervisor office
- Clerk room
- Tagging room
- Toilet
- Kitchen

The MRC HVAC system, with exception of the toilet/kitchen exhaust and smoke purge subsystems, is classified as safety-related and seismic Category 1. The MCR HVAC system is designed to meet the following safety design bases:

- Exclude entry of airborne radioactivity into the MCRE and remove radioactive material from the MCRE environment such that radiation dose to MCR personnel is within the GDC 19 (10 CFR 50, Appendix A) design criteria.

- Support and maintain MCRE habitability and permit personnel occupancy and proper functioning of instrumentation during normal and design basis accidents, assuming a single active failure.

- Withstand the effects of adverse environmental conditions.

- Withstand the effects of tornadoes and tornado missiles.

- Withstand the effects of seismic events. The MCR HVAC system equipment and the associated ductwork are designed to seismic Category I requirements.

- Provide MCR personnel protection by detecting and preventing the introduction of smoke into the MCRE by automatically aligning the system to the isolation mode upon the detection of smoke in the outside air intake.

- Automatically switch from normal operating mode to emergency pressurization mode upon the MCR isolation signal (Chapter 7).

System Analyses

SRP Section 14.3.7 Acceptance Criterion 1 reads in part "… Tier 1 should be reviewed for consistency with the ITP described in DCD Tier 2 Chapter 14."

In **RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-15)**, the staff found that the maximum stroke times associated with the active safety function of the dampers listed in DCD Tier 1 Table 2.7.5.1-1, "Main Control Room HVAC System Equipment Characteristics," were not located in any of the DCD Tier 1 or Tier 2 documents. These stroke times are essential to the accident analyses for a toxic gas, smoke, or radioactive release's impact on habitability of the control room envelope (CRE). The staff requested that the applicant amend the DCD Tier 1 and Tier 2 documentation and testing requirements to include the stroke times and the stroke time testing associated with safety-related dampers of Table 2.7.5.1-1.

In its response to **RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-15)**, dated September 19, 2008, ADAMS Accession No. ML082680032, the applicant responded that the closure stroke time associated with the active safety function of the isolation dampers used to isolate the CRE has safety related significance. This value, less than or equal to 10 seconds, was already described in Tier 2 Section 6.4, Table 6.4-1, "Main Control Room Emergency Filtration System Equipment Specifications." The applicant agreed to revise DCD Tier 1 and Tier 2 to include closure time testing requirements for the isolation dampers in the MCR HVAC system. The staff confirmed that the applicant revised DCD Tier 1 Table 2.7.5.1-3, "Main Control Room HVAC System Inspections, Tests, Analyses, and Acceptance Criteria" (Item 5c) and the relevant section of Tier 2 to include closure time testing requirements. Since the resultant DCD Item 5c

is consistent with the direction provided in SRP Section 14.3.7 Acceptance Criterion 1 and SRP 14.3 Appendix I.A.xiii the staff found the response acceptable. Based on this, the staff **closed RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-15)**

In **RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-19)** the staff noted that Acceptance Criteria 4.b.ii of Table 2.7.5.1-3, "Main Control Room HVAC System Inspections, Tests, Analyses, and Acceptance Criteria," states that the as-built MCR HVAC system is capable of meeting the airflow identified in Subsection 2.7.5.1.1. The staff requested additional information for only requiring verification of the two flow parameters "Filtered air intake flow" (1,200 cfm) and "Filtered air recirculation flow" (2400 cfm). In **RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-19)**, and follow-up **RAIs 381-2806, Question 14.03.07-38** and **685-5359 Question 14.03.07-57**, the staff and applicant exchanged RAIs on the subject of system flow rates.

In its response to **RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-19)** dated September 19, 2008, **RAI 381-2806, Question 14.03.07-38** dated July 17, 2009 and **RAI 685-5359, Question 14.03.07-57** dated February 21, 2011, the applicant cumulatively resolved all staff concerns.

In closing the issue the staff confirmed that Revision 3 DCD Subsection 9.4.1.2 contains the following words: "*The ductwork delivers the conditioned air of 11.000 cfm to MCR and of 9,000 cfm to other rooms (i.e., file room, shift supervisor's room, conference room, break room kitchen, and restroom)*."

To the issues:

(1) of using SR 3.7.10.4 to verify that the design control room envelope in-leakage to be less than or equal to 120 scfm during the MCR HVAC system pressurization mode consistent with the regulatory guidance of TSTF-448 and RG 1.196;

(2) of verifying the essential MCR HVAC system flow balance values in DCD Subsections 6.4.2.3 and 9.4.1.2 with the use of preoperational test 14.2.12.1.101; and

(3) of verifying the MCR HVAC systems ability to provide conditioning air to maintain the proper design temperature for the CRE during all plant operating conditions, including normal plant operations, abnormal and accident conditions via ITAAC Table 2.7.5.1-3 Item 4.a;

Therefore, the staff found the applicant's amended DCD approach comprehensive in scope. Since these resultant Tier 1 and Tier 2 DCD sections and tables are consistent with the direction provided in SRP Section 14.3.7 Acceptance Criterion 1 and SRP 14.3 Appendix I.A.xiii, the staff found the applicant's resolution acceptable. Based on this, the staff closed **RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-19)**, **RAI 381-2806, Question 14.03.07-38** and **RAI 685-5359 Question 14.03.07-57.**

SRP 14.3 Appendix C ITAAC section II.B.ii pertains to "Critical Assumptions from Transient and Accident Analyses" and reads in part "The critical assumptions from transient and accident analyses should be verified by ITAAC."

In **RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-2)** the staff noted that DCD Tier 2 Subsections 6.4.5 and 9.4.1.4 and the surveillance requirements of TS 3.7.10 identify

requirements for in-service inspection and in-place testing. Tier 1 Table 2.7.5.1-3, ITAAC 1a, identified only a functional arrangement inspection. The staff noted that the issue of Revision 3 to TSTF-448 impacted NUREG-1431 (i.e., STS for Westinghouse plants) with the addition of Subsection 5.5.18, which provides the relationship between CRE habitability and operability of the control room emergency filtration system. The staff requested that the applicant amend DCD Subsections 9.4.1, 6.4, TS 3.7.10, and other relevant parts of DCD Chapter 16 to reflect the current status NUREG-1431 and TSTF-448, Revision 3. The staff also recommended that the applicant incorporate the outcome of these changes into the relevant ITAAC of Tier 1 Table 2.7.5.1-3.

In its response to **RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-2)**, dated September 19, 2008, ADAMS Accession No. ML082680032, the applicant responded that the DCD would reflect TSTF-448 in Tier 2 Chapter 16, TSs 3.7.10 and 5.5.20. Revision 1 of Tier 2 Sections 6.4.5 and 9.4.1.4 refer to technical specifications for in-service test program requirements, including in-leakage testing. Tier 1 Table 2.7.5.1-3, Item 4.c, requires testing and analyses to verify the as-built MCR HVAC system is capable of meeting the unfiltered in-leakage limit used in the safety analyses and specified in Tier 1 Section 2.7.5.1.1. Consistent with Section IV.4.B of Appendix A to NUREG-0800, operational programs such as technical specifications, ISI, and IST demonstrate that the facility will operate in accordance with the certified design and the license after completion of ITAAC.

The staff reviewed the adequacy of the applicant's revision to DCD Revision 3 Tier 2 Subsections 6.4.5, 9.4.1.4, and TSs 3.7.10 and 5.5.20. The staff found that the needed revisions for SR 3.7.10.4 and 5.5.20 are all contained in the DCD and parallel the prescribed changes in their entirety for SR 3.7.10.4 and 5.5.18 of TSTF-448, Revision 3. The staff concluded that these changes fulfill the intent of SRP Section 14.3.7 Acceptance Criterion 1 and SRP Section 14.3, Appendix C. Based on the above DCD changes, the staff found the applicant's response acceptable and **closed RAI 54-891, Question No. 14.03.07-2 (RAI 14.3.7.3.2-2)**.

SRP Section 14.3.7 Acceptance Criterion 1 reads in part "… Tier 1 should be reviewed for consistency with the ITP described in DCD Tier 2 Chapter 14. …"

In **RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-14)**, the staff noted that Design Commitment 5.a of Table 2.7.5.1-3 reads, *"Each as-built remotely operated dampers identified in Table 2.7.5.1-1 perform the active function identified in the table after receiving a signal*," and that Design Commitment 5.b of Table 2.7.5.1-3 reads, *"Upon loss of motive power, each as-built remotely operated damper identified in Table 2.7.5.1-1 assumes the indicated loss of motive power position."* The staff found that Tier 2 Subsection 14.2.12.1.101, "MCR HVAC System Preoperational Test (including MCR Habitability)" did not ensure verification of both of these functions. The staff requested that the applicant amend the test method and the acceptance criteria of Tier 2 Subsection 14.2.12.1.101 to ensure verification of both the safety-related function and the loss of motive power position function of the dampers during the preoperational test.

In its response to **RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-14)**, dated September 19, 2008, ADAMS Accession No. ML082680032, the applicant responded with a revision to preoperational test 14.2.12.1.101 in response to the staff's concerns. The staff verified that DCD Revision 3 preoperational test 14.2.12.1.101 contains a demonstration of the automatic switching to both the isolation mode and to the pressurization mode upon receipt of the requisite

initiation signals. This demonstration by default verifies that the remotely operated dampers identified in Table 2.7.5.1-1 perform their active safety function. The staff also verified that the preoperational test contains a requirement to verify the loss of motive power function position of the isolation dampers. The staff concluded for the subject ITAAC and preoperational test, that a consistency between the two has been demonstrated consistent with SRP Section 14.3.7 Acceptance Criterion 1. Based on this, the staff found the applicant's response as acceptable and **closed RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-14).**

In **RAI 381-2806, Question 14.03.07-36** (follow-up to **RAI 54-891, Question 14.03.07-2, RAI 14.3.7.3.2-13**), the staff noted that Item 4.b of ITAAC Table 2.7.5.1-3 did not accurately reflect the issue of CRE in-leakage testing. The staff noted that Item 4.b.iii referred to as-built unfiltered in-leakage of the HVAC system. Since significant portions of MCR HVAC system ductwork form only a part of the larger control room envelope the staff noted that this ITAAC item should refer to the unfiltered in-leakage of the control room envelope and not the unfiltered in-leakage of the HVAC system. The staff requested that the applicant amend Tier 1 Table 2.7.5.1-3 Item 4.b.iii to remove this point of confusion from the DCD.

In its response to **RAI 381-2806, Question 14.03.07-36**, dated July 17, 2009**,** ADAMS Accession No. ML092030410, the applicant agreed that unfiltered in-leakage applies to the CRE and agreed to revise the first line of Tier 1 Subsection 2.7.5.1.1 table "Numerical Performance Values" by changing "*Unfiltered in-leakage*" to "*Unfiltered CRE in-leakage*." The applicant also agreed to: (a) revise Tier 1 Table 2.7.5.1-3, Item 4.b.iii of the "Inspections, Tests, Analyses" to read "*Tests and analyses of as-built unfiltered CRE in-leakage will be performed*" and (b) revise Item 4.b.iii "Acceptance criteria" to read " *The as-built CRE is capable of meeting the unfiltered in-leakage identified in Subsection 2.7.5.1.1*." The staff confirmed that Revision 2 of DCD Subsection 2.7.5.1.1 and Table 2.7.5.1-3 contained all three changes. The staff notes that Item 4.b.iii in DCD Revision 2 became Item 4.c in DCD Revision 3. Since the relevant subsections of DCD Tier 1 and Tier 2 now preserve the integrity of the analyses of TSTF-448 and the regulatory guidance Regulatory Guide 1.197 the staff concluded that Table 2.7.5.1-3, Item 4.c satisfies the intent of SRP Section 14.3.7 Acceptance Criterion 5. Based on this the staff **closed RAI 381-2806, Question 14.03.07-36** and **RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-13)**.

SRP Section 14.3.7 Acceptance Criterion 5 reads in part that "*The design features in Tier 1 should be selected to ensure that the integrity of the analyses are preserved in an as-built facility. …".*

In **RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-7)**, the staff noted DCD Subsection 9.4.1.3 indicates that specially designed protective gratings protect the MCR HVAC system's outside air intakes from tornado-generated missiles. The staff found that the ITAAC of Tier 1 Subsection 2.7.5.1 does not verify the ability to perform this specific function. The staff requested additional information about this omission and requested clarification of the applicable Tier 1 and Tier 2 Subsections of the DCD.

In its response to **RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-7)**, dated September 19, 2008, ADAMS Accession No. ML082680032, the applicant stated the gratings that protect outside air intakes from tornado-generated missile damage are considered structural design elements as opposed to plant system design features. Tier 1 Section 2.2.1, "Building Structures Design Description," states that safety-related structures are designed and constructed to withstand design-basis loads including those associated with external events (e.g., tornado

generated missiles) without loss of structural integrity and the safety-related functions. The subject gratings support this statement. The staff reviewed Tier 1 Subsection 2.2.1 and the passage invoked in the applicant's response. The staff found ITAAC Table 2.2-4 lacking with respect to requiring an inspection of the subject gratings.

Therefore, in follow-up **RAI 675-5231, Question 14.03.07-54** and **RAI 926-6448, Question 14.03.07-59**, the staff requested that the applicant address the issue pertaining to requiring an inspection of the subject gratings: In its response to **RAI 926-6448, Question 14.03.07-59**, dated June 7, 2012, the applicant agreed to amend Tier 1, Table 2.2-4 "Structural and Systems Engineering Inspections, Tests, Analyses, and Acceptance Criteria" with three new Design Commitments 25, 26 and 27 pertaining to the inspections of the exterior protective barriers that shield the outside air intakes and exhaust outlets for the MCR HVAC system, the Class 1E electrical room HVAC system and the emergency feedwater pump area HVAC system. The applicant also provided other related DCD changes to both Tier 1 and Tier 2 documents in their response to **Question 14.03.07-59**. In totality and once finally incorporated in the DCD, these amendments fully address and fully resolve the staff's original RAI concern of **RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-7)** and follow-up **RAI 675-5231, Question 14.03.07-54** and satisfy the intent of SRP Section 14.3.7, Acceptance Criterion 5. Based on this, the staff lists **RAI 926-6448, Question 14.03.07-59 as Confirmatory Item 14.03.07-2.**

In **RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-8)** the staff noted that DCD Tier 2 Subsection 14.2.12.1.101 identifies as an acceptance criterion for the system "that the MCR tornado depressurization protection dampers operate as designed." The staff found that the ITAAC of Tier 1 Subsection 2.7.5.1 did not verify the ability to perform the specified function. The staff requested additional information about this and clarification of the applicable Tier 1 and Tier 2 Subsections of the DC.

In its response to **RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-8)**, dated September 19, 2008, ADAMS Accession No. ML082680032, the applicant stated that, based on NUREG-0800 Section 14.3.7, "Plant Systems - Inspections, Tests, Analyses, and Acceptance Criteria," and RG 1.206 Section C.I1.1.2.7, "ITAAC for Plant Systems (SRP Section 14.3.7)," the ITAAC for tornado protection dampers will be included in DCD Tier 1 Section 2.7.5.1. The applicant provided a revision to Tier 1 Tables 2.7.5.1-1 and 2.7.5.1-3, and Figure 2.7.5.1-1, "Main Control room HVAC System," to include the tornado protection dampers. The staff confirmed that Revision 3 of the Tier 1 DCD Tables 2.7.5.1-1 and 2.7.5.1-3 and Figure 2.7.5.1-1 included the tornado protection dampers. In particular, the staff notes that Item 5.f of Table 2.7.5.1-3 resolves the staff's identified concern of **RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-8)** and satisfies the intent of SRP Section 14.3.7, Acceptance Criterion 5**.** Based on this the staff found the applicant's response as acceptable and **closed RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-8)**.

SRP Section 14.3.7 Acceptance Criterion 6 reads in part "*Other specific issues that should be addressed include heat removal capabilities for design-basis accidents and …"*

In **RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-16)**, the staff noted that acceptance criteria for Item 4.a of Table 2.7.5.1-3 reads that the as-built MCR HVAC system provides conditioned air to maintain the proper environmental condition of the CRE during all plant conditions. The staff found the acceptance criteria as non-definitive. The staff requested additional information as to how the COL Applicant would demonstrate and satisfy the acceptance criteria of 4.a.

In its response to **RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-16)**, dated September 19, 2008, ADAMS Accession No. ML082680032, the applicant responded that *"proper environmental condition"* of the CRE is meant to denote the MCR design conditions (i.e., temperature and humidity levels). The applicant agreed to revise ITAAC Item 4.a of Table 2.7.5.1-3 to clarify that a COL Applicant will employ a combination of tests and analyses to verify the MCR HVAC system is capable of maintaining acceptable temperatures under design basis conditions in the various modes of MCR HVAC operation. The staff confirmed that Table 2.7.5.1-3 ITAAC Item 4.a contains the requisite changes. The staff confirmed that the applicant made conforming changes to other subsections of the DCD as necessary for consistency. Since the response precisely defines the Acceptance Criteria of Item 4.a the staff concluded that the ITAAC now satisfies the intent of SRP 14.3.7, Acceptance Criterion 6. Based on this the staff **closed RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-16).**

SRP Section 14.3.7 Acceptance Criterion 9 reads in part that "Tier 1 should address and verify at least the minimum inventory of alarms, controls, and indications as derived from the Emergency Procedure Guidelines, the requirements of RG 1.97, and probabilistic risk assessment insights."

In **RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-3)** and **RAI 381-2806, Question 14.03.07-35** the staff noted that DCD Subsections 6.4.6 and 9.4.1.5 identify instrumentation requirements for the MCR HVAC system. The staff found that these instrumentation requirements do not appear to be consistent with Tier 1 Table 2.7.5.1-3.

In its responses to **RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-3)** dated September 19, 2008, ADAMS Accession No. ML082680032 and **RAI 381-2806, Question 14.03.07-35** dated July 17, 2009, ADAMS Accession No. ML092030410, the resultant changes to Tier 2 DCD Subsection 9.4.1.5 and Figures 9.4.1-1, 6.4-2, 6.4-3 and 6.4-4 still failed to resolve the staff's concerns. Therefore, in **RAI 675- 5231, Question 14.3.07-53** the staff invoked the guidance of RG 1.52, Design Criterion 3.8 and IEEE Standard 603-1991 to elicit an applicant justification for not listing the ESF filter train monitoring instrumentation as safety related with Class 1E power supply. In its response to **RAI 675-5231, Question 14.03.07-53**, dated January 31, 2011, ADAMS Accession No. ML110340019, the applicant responded in part:

> "…The MCR HVAC emergency filtration units are designed to operate for their entire mission time without the need to monitor filtration unit flowrate or filter differential pressure. The MCR HVAC system is designed in accordance with IEEE 603-199..."

Upon further review, the staff observed that SRP 6.5.1 ESF "Atmosphere Cleanup Systems" provides Table 6.5.1-1 "Minimum instrumentation, readout, recording and alarm provisions for ESF atmosphere cleanup systems" but does not require Class 1E power supplies for the instrumentation listed and that Subsection 5.8.2 "System Status Indication" (page 19 of IEEE Std. 603-1991) reads:

> "Display instrumentation shall provide accurate, complete, and timely information pertinent to safety system status. This information shall include indication and identification of protective actions of the sense and command features and execute features. The design shall minimize the possibility of ambiguous indications that could be confusing to the operator. The display instrumentation provided for safety system status indication need not be part of the safety systems."

Based on this guidance from SRP 6.5.1and IEEE Std. 603-1991, "Criteria for Safety Systems for Nuclear Power Generating Stations," the staff concluded that for the MCR ESF filter trains the system design instrumentation satisfied SRP Section 14.3.7, Acceptance Criterion 9. Based on this conclusion the staff found the applicant's response acceptable and **closed** the following RAIs**: RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-3); RAI 381-2806, Question 14.03.07-35; and RAI 675-5231, Question 14.03.07-53.**

The staff reviewed the US-APWR main control room HVAC system ITAAC in accordance with SRP Section 14.3.7 to ensure that the relevant requirements of 10 CFR 52.47(b)(1) are met. Pending the verification of **Confirmatory Item 14.03.07-2**, the staff finds that sufficient information has been provided to satisfy SRP Section 14.3 and SRP Section 14.3.7 and therefore the US-APWR main control room HVAC system ITAAC meet the relevant requirements of 10 CFR 52.47(b)(1).

2.7.5.2 Engineered Safety Features Ventilation Systems

US-APWR DCD Tier 1 Section 2.7.5.2 provides the Tier 1 information associated with the ESF ventilation system. Section 2.7.5.2.1 of the DCD provides the Design Description of the ESF ventilation system and states that the ESF ventilation system is a safety-related system. US-APWR DCD Tier 2 Section 9.4.5 provides the ESF ventilation system design. The ESF ventilation system includes:

- Annulus emergency exhaust system
- Class 1E electrical room HVAC system
- Safeguard component area HVAC system
- Emergency feed water pump area HVAC system
- Safety-related component area HVAC system

The ESF ventilation system is designed to satisfy the following design bases:

- Classified as a safety-related and seismic Category I system;
- Redundant ventilation systems powered by separate safety-related buses so that a failure of a single active component cannot result in loss of cooling for the served areas;
- Capable of performing the intended design functions assuming a single active component failure coincident with a loss of offsite power (LOOP);
- Withstand the effects of adverse environmental conditions; and
- Withstand the effects of tornado depressurization and tornado-generated missiles

System Analyses

SRP Section 14.3.7 Acceptance Criterion 1 reads in part "…Tier 1 should be reviewed for consistency with the ITP described in DCD Tier 2 Chapter 14. …"

In **RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-6)**, the staff noted that Tier 1 Subsection 2.7.5.2.1.1 and DCD Subsection 6.5.1 define the penetration and safeguard area negative pressure arrival time as 240 seconds and that DCD Subsection 14.2.12.1.70 defines the negative pressure arrival time as 180 seconds. The staff requested that the applicant clarify which is the correct acceptance criterion. The staff also noted that DCD Surveillance Requirement 3.7.11.4 does not specify the arrival time. The staff requested the applicant provide justification for not specifying the arrival time of 240 seconds (or 180 seconds) as part of this surveillance requirement.

In its response to **RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-6)**, dated September 19, 2008, ADAMS Accession No. ML082680032, the applicant responded with an amendment to Tier 1 Subsection 2.7.5.2.1.1 and to Tier 2 Subsection 14.2.12.1.70 that: (a) reflects the correct negative pressure arrival time; and (b) clarifies the reference pressure for determining the negative pressure value (i.e., surrounding areas vs. atmospheric). The applicant noted that DCD Chapter 16 Surveillance Requirement Bases 3.7.11.4 states that the annulus emergency exhaust system is designed to maintain ≤-0.25 inches water gauge relative to atmospheric pressure. The negative pressure arrival time is an input parameter to safety analyses for postulated LOCA accidents. Therefore, the applicant agreed to revise SR 3.7.11.4 to demonstrate annulus emergency exhaust system performance consistent with 10 CFR 50.36(d)(3)." The applicant also agreed to address conforming changes to other subsections of the DCD as necessary to maintain consistency throughout the DCD. The staff verified that DCD Revision 2 DCD Subsection 14.2.12.1.70 have been revised consistent with the applicant's RAI response. The staff noted that SR 3.7.11.4 was revised; however the revision lacked technical consistency with the Acceptance Criteria of Tier 2 preoperational test 14.2.12.1.70 and Tier 1 Item 4.a.ii of ITAAC Table 2.7.5.2-3. Therefore, in **RAI 675-5231, Question 14.03.07-55**, the staff requested that the applicant establish a technical consistency between the surveillance (i.e., SR 3.7.11.4), the ITAAC (i.e., Item 4.a.ii of Table 2.7.5.2-3) and the preoperational test (i.e., 14.2.12.1.70). In its response to **RAI 675-5231, Question 14.03.07-55**, dated January 31, 2011, ADAMS Accession No. ML110340019, the applicant indicated that Technical Specification 3.7.11, Surveillance Requirement 3.7.11.4, would be revised to indicate that the associated room pressure is relative to surrounding areas instead of atmospheric pressure and that preoperational test 14.2.12.1.70 would be revised to clarify that Annulus Emergency Exhaust System can establish a pressure < -0.25 inch water gauge pressure in the penetration areas and safeguard component areas with respect to the surrounding areas within 240 sec. The staff found the response to **Question 14.03.07-55** acceptable since once implemented the changes would remove the conflicting information from the DCD. The staff concluded that once implemented a consistency between the Tier 1 and Tier 2 testing requirements would be created consistent with SRP Section 14.3.7, Acceptance Criterion 1. Accordingly, the staff lists **RAI 675-5231, Question 14.03.07-55 as Confirmatory Item 14.03.07-1**.

SRP Section 14.3.7 Acceptance Criterion 1 references the check lists of SRP 14.3, Appendix C. Appendix C section II.B.vii "Initiation Logic" reads in part "*If a system/component has a direct safety function it typically receives automatic signals to perform some action. This includes start, isolation, etc…*"

In **RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-7)**, the staff noted that Tier 1 Table 2.7.5.2-3 defines the ITAAC for the ESF ventilation system and that Tier 1 Table 2.7.5.4-2

defines the ITAAC for the Auxiliary Building (A/B) ventilation system. The staff went on to note that DCD Subsections 6.5.1.2, 9.4.3, and 9.4.5 identify that the isolation dampers in the A/B ventilation system must function simultaneously to meet the performance requirements for the ESF ventilation system. The staff found that the ITAAC for these systems do not address the simultaneous testing of these systems. The staff requested that the applicant include a requirement in the appropriate ITAAC for testing the appropriate A/B ventilation system and ESF ventilation system components simultaneously. In its response to **RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-7)**, dated September 19, 2008, ADAMS Accession No. ML082680032, the applicant provided a revision to Table 2.7.5.2-3 to resolve the DCD deficiency. The staff verified that DCD Revision 3 Item 6.b of Tier 1 Table 2.7.5.2-3 will test the safety-related isolation dampers and annulus emergency exhaust system fans simultaneously. In particular, that the dampers close and the fans start upon receipt of an ECCS initiation signal. The staff found that the applicant's resolution satisfies the intent of SRP Section 14.3.7 Acceptance Criterion I. Based on this, the staff **closed RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-7).**

In **RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-8)**, the staff noted that Tier 1 Subsection 2.7.5.2 defines the ESF ventilation system. The staff found that the system description for the isolation dampers VRS-MOD-301 (A, B, C, D) and VRS-MOD-302(A, B, C, D), and did not clearly identify the normal status of these dampers (open/closed). The staff noted that Table 2.7.5.2-1 identifies the active safety function as "transfer open/closed" and only identifies the position for "loss of motive power." The staff requested clarification of the normal position and active safety function position for these dampers.

In its response to **RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-8)**, dated September 19, 2008, ADAMS Accession No. ML082680032, the applicant stated that the active safety function position for the isolation dampers is "OPEN." The applicant provided a revision to Table 2.7.5.2-1 that clarified the active safety function position. The damper alignment during normal operations is not intended to require operators to take any particular action. These operational matters are governed by the plant operating and emergency procedures to ensure the safe operation of a facility. The applicant concluded that no ITAAC are required in Tier 1 Subsection 2.7.5.2 for the normal status of these dampers.

The staff verified that DCD Revision 3 Tier 1 Table 2.7.5.2-1 now reads "Transfer Open" for the active safety function position of the subject isolation dampers. This resolved the staff's original concern. The staff notes that the Tier 2 Figures 9.4.5-1 and 9.4.5-3 display the non-safety related positioning of these dampers as normally closed "NC". The staff concurred with the applicant that the normal positioning of these dampers need not be included in the Tier 1 table. The staff found that the applicant's resolution satisfies the intent of SRP Section 14.3.7, Acceptance Criterion I. Based on this, the staff found the response acceptable and **closed RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-8).**

In **RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-16)**, the staff noted that Tier 1 Table 2.7.5.2-3 identifies ITAAC for the ESF ventilation system. This table identifies closure verification of the isolation dampers after receiving a signal." The staff requested additional information concerning the:

a) Signal source (i.e., a local or remote signal)

b) Verification of the safety actuation signal/connection (ECCS signal, high or low temperature signals, etc.)

c) Acceptance criterion for the isolation dampers to close and/or open

d) Performance requirements of the isolation dampers for leak tightness after closure.

Editorial Comment:
This should be Tier "1", not "I".

In its response to **RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-16)**, dated September 19, 2008, ADAMS Accession No. ML082680032, the applicant agreed to clarify Tier I Subsection 2.7.5.2 to identify the signal associated with the dampers in Table 2.7.5.2-1.

The staff verified that DCD Revision 3 Tier 1 Table 2.7.5.2-3 (Criterion 5.a) tests the "PSMS Control" signal associated with each damper. The staff concurred with the applicant in that information about timing of these dampers to transfer open or leak tightness of the dampers need not be included in the Tier 1 tables. For the annulus emergency exhaust system, the adequacy of these dampers response times and leak tightness are tested as part of the testing of the annulus emergency exhaust system (i.e., ITAAC Item 4.a of Table 2.7.5.2-3). For the case of the Table 2.7.5.2-1 dampers associated with the Class 1E Electrical Rooms and Class 1E Battery Rooms, the dampers will transfer open (as necessary – the dampers are likely to already be open) only if the Class 1E ventilation system is not already running to support normal plant power operations. Therefore, leak tightness and transfer time is not inherently essential to plant safety. For the dampers associated with the Safeguard Component AHUs, the dampers are actuated by temperature to transfer to the open position and neither leak tightness nor transfer time is essential to plant safety.

The staff found that the applicant's resolution satisfies the intent of SRP Section 14.3.7, Acceptance Criterion I and therefore acceptable. Based on this, the staff **closed RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-16)**.

In **RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-19)**, the staff requested that the applicant capture verification of both the safety-related function and the loss of motive power position of the dampers. This included the following DCD preoperational tests.

- 14.2.12.1.70. "Annulus Emergency Exhaust System Preoperational Test"
- 14.2.12.1.96, "Safeguard Component Area HVAC System Preoperational Test"
- 14.2.12.1.97, "Emergency Feed water Pump Area HVAC System Preoperational Test"
- 14.2.12.1.98, "Class 1E Electrical Room HVAC System Preoperational Test"
- 14.2.12.1.106, "Safety-Related Component Area HVAC System Preoperational Test"

In follow-up **RAI 381-2806, Question 14.03.07-44** (follow-up to RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-19)), the staff stated that they did not agree with the applicant's position on verifying the completion of the loss of motive power testing. After review of the subject preoperational tests (i.e., 14.2.12.1.70, 14.2.12.1.96, 14.2.12.1.97, 14.2.12.1.98 and 14.2.12.1.106) cited by the staff in the original RAI, the staff cannot conclude that the loss of motive power test will be captured with the preoperational test's completion. Satisfying a generically worded prerequisite contained in each of the preoperational tests which reads

"Required construction testing is completed" does not guarantee the completion of the loss of motive power testing. The staff also requested that the applicant revise the DCD to the staff's concern discussed in **Question 14.03.07-5 (RAI 14.3.7.3.6-19)**.

In its response to **RAI 381-2806, Question 14.03.07-44,** dated July 17, 2009, ADAMS Accession No. ML092030410, the applicant responded by agreeing to revise the DCD Tier 2 preoperational test abstracts to ensure the test prerequisites include verification of the dampers' loss of motive power position. The staff verified that the DCD Revision 3 test prerequisites for Subsections 14.2.12.1.70, 14.2.12.1.96 14.2.12.1.97, 14.2.12.1.98 and 14.2.12.1.106 include verification of the dampers' loss of motive power position. The staff found that the applicant's resolution satisfies the intent of SRP Section 14.3.7 Acceptance Criterion I and therefore acceptable and **closed RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-19) and RAI 381-2806, Question 14.03.07-44.**

SRP Section 14.3.7 Acceptance Criterion 2 identifies "Class 1E electrical power sources and divisions" as an attribute the helps define the attributes significance to Tier 1.

In **RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-4)**, the staff noted that DCD Subsections 9.4.5 and 2.7.5.2 identify the ESF ventilation system as provided with 100 percent redundancy. The design basis identifies that the system *"is capable of performing the intended design functions assuming a single active component failure coincident with LOOP."* The staff noted however, that the ITAAC in Table 2.7.5.2-3 did not clearly identify that each train will be individually tested to meet the defined acceptance criteria. The staff requested that the applicant include a requirement in the appropriate ITAAC for testing each divisional train individually. This would include the annulus emergency exhaust system, Class-1E electrical room HVAC system, safeguard component area HVAC system, emergency feed water pump area HVAC system, and safety-related component area HVAC system.

In its response to **RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-4)**, dated September 19, 2008, ADAMS Accession No. ML082680032, the applicant agreed to revise Items 4.a and 4.b of Tier 1 Table 2.7.5.2-3. The staff notes that the scope of ITACC Table 2.7.5.2-3 Item 4 was expanded. DCD Revision 3 now includes separate ITAAC criteria (i.e., 4.a through 4.f) to clearly identify the unique acceptance criteria for the five different ESFVS subsystems. The staff verified that the "Inspection, Tests, Analyses" attributes for Items 4.a through 4.f of ITAAC Table 2.7.5.2-3 will test and analyze each divisional train HVAC system or each safety-related component area HVAC system individually.

Since the applicant's resolution provided ITAAC that satisfies the intent of SRP Section 14.3.7 Acceptance Criterion 2, the staff found the resolution acceptable. The ultimate resolve as described in DCD Revision 3 completely resolved all staff concerns. Based on this, the staff **closed RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-4).**

SRP Section 14.3.7 Acceptance Criterion 5 reads in part that "*The design features in Tier 1 should be selected to ensure that the integrity of the analyses are preserved in an as-built facility…".*

In **RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-22)**, the staff noted that Tier 2 Subsection 9.4.5.1.1 contains the following safety-related design requirement for the ESF ventilation system: "*The system can withstand the effects of tornado depressurization and tornado-generated missiles."* The staff also noted that Tier 2 Figures 9.4.5-1, 9.4.5-2, and 9.4.5-4 all

display tornado dampers as part of the respective system configuration. The staff found that Tier 1 Subsection 2.7.5.2 did not include a discussion of these dampers. The corresponding Tier 1 figures (i.e., 2.7.5.2-1, 2.7.5.2-2, and 2.7.5.2-4) did not display these dampers. The staff requested that the applicant revise Subsection 2.7.5.2 to include a discussion of the dampers; revise Figures 2.7.5.2-1, 2.7.5.2-2, and 2.7.5.2-4 to display the dampers; and revise Table 2.7.5.2-3 to include an ITAAC line item (i.e., "Design Commitment," "Inspection, Tests, Analyses," and "Acceptance Criteria") for these tornado dampers.

In its response to **RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-22)**, dated September 19, 2008, ADAMS Accession No. ML082680032, the applicant responded that based on the guidance of NUREG-0800 Section 14.3.7 and RG 1.206 Section C.11.1.2.7, the ITAAC for tornado protection dampers (OTDs) would be included in DCD Tier 1 Section 2.7.5.2. The applicant agreed to revise Tier 1 Tables 2.7.5.2-1 and 2.7.5.2-3 to include testing of the tornado protection dampers and to revise Tier 1 Figures 2.7.5.2-1, 2.7.5.2-2, and 2.7.5.2-4 to display the tornado protection dampers.

The staff verified that DCD Revision 3 Tier 1 Table 2.7.5.2-3 Item 5.e includes testing of the OTDs listed in Table 2.7.5.2-1. The staff confirmed that the tornado protection dampers are now displayed on Figures 2.7.5.2-1, 2.7.5.2-2 and 2.7.5.2-4 and that all the displayed OTDs are listed in Table 2.7.5.2-1.

The staff concluded that the applicant's comprehensive resolution satisfies the intent of SRP Section 14.3.7, Acceptance Criterion 5 and is therefore acceptable. Based on this, the staff **closed RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-22).**

SRP Section 14.3.7, Acceptance Criterion 6 reads in part "*Other specific issues that should be addressed include heat removal capabilities for design-basis accidents and …"* and Acceptance Criterion 5 reads in part "The design features in Tier 1 should be selected to ensure the integrity of the analyses are preserved in an as-built facility."

In **RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-14)**, the staff noted that US-APWR Subsection 9.4.5.1.1.2 defines the design requirements for the Class 1E electrical room HVAC system for both environmental conditions and hydrogen concentration. Table 9.5.4-1 defines the equipment design data. The staff went on to note that DCD Tier 1 Table 2.7.5.2-3, ITAAC 4.a, defines a global verification of the "as-built ESFVS" to maintain proper environmental conditions "within respective areas." The staff requested separate ITAAC for the different ESFVS subsystems to clearly identify the specific acceptance criteria. This would include the annulus emergency exhaust system, Class 1E electrical room HVAC system, safeguard component area HVAC system, emergency feed water pump area HVAC system, and safety-related component area HVAC system.

In its response to **RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-14)**, dated September 19, 2008, ADAMS Accession No. ML082680032, the applicant responded with a revision to the DCD that clarified Table 2.7.5.2-3, ITAAC Item 4, to address the subsystems of ESFVS. This included the annulus emergency exhaust system which interfaces with the safety related component area as stated in DCD Revision 1, Table 9.4-1.

The staff verified that DCD Revision 3 Tier 1 Table 2.7.5.2-3 includes separate ITAAC criteria (i.e., 4.a through 4.f) to clearly identify the unique acceptance criteria for the five different ESFVS subsystems. The staff notes that Item 4.c will require testing and analysis that

demonstrates that the hydrogen concentrations within the Class 1E battery rooms are maintained well below the lower explosive limit. The staff found the response acceptable since, ITAAC Items 4.a, 4.b, 4.d, 4.e and 4.f verify adequate heat removal capability and satisfy the intent of SRP Section 14.3.7, Acceptance Criterion 5; while ITAAC Item 4.c ensures hydrogen concentrations in the Class 1E battery rooms remain below the gas's lower explosive limit and satisfies the intent of SRP Section 14.3.7 Acceptance Criterion 6. Based on this, the staff **closed RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-14).**

SRP Section 14.3.7 Acceptance Criterion 9 reads in part that "Tier 1 should address and verify at least the minimum inventory of alarms, controls, and indications as derived from the Emergency Procedure Guidelines, the requirements of RG 1.97, and probabilistic risk assessment insights."

In **RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-3)**, the staff noted that DCD Chapter 16 Section 3.7.11, DCD Subsections 6.5.1.6 and 9.4.5.5 identify instrumentation requirements for the ESFVS. This included instrumentation requirements for the annulus emergency exhaust system, Class-1E electrical room HVAC system, safeguard component area HVAC system, emergency feed water pump area HVAC system, and safety-related component area HVAC system. The staff found that the instrument listing in these Tier 2 subsections is not consistent with Tier 1 Table 2.7.5.2-2. More specifically, differential pressure across the filter banks, emergency filtration unit flow rate, pressure and differential pressure in the penetration and safeguard areas, and combined exhaust flow are not included in Table 2.7.5.2-2. This included associated transmitters, recorders, and indicators. The staff requested that the applicant amend Table 2.7.5.2-2 as appropriate. The staff noted that DCD Subsection 9.4.5.5 reads "Instrumentation for controlling and monitoring the ESF ventilation system meets the requirements of ANSI/ANS 51.1 (Reference 9.4.8-11), IEEE Std. 603 (Reference 9.4.8-12), and are qualified in accordance with IEEE Std. 323 (Reference 9.4.8-13) and IEEE Std. 344 (Reference 9.4.8-14)."

In its response to **RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-3)**, dated September 19, 2008, ADAMS Accession No. ML082680032, the applicant responded that the instruments identified in **RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-3)** are neither safety-related nor required for post-accident monitoring as required by RG 1.97. These instruments render no safety-related function with respect to their role as instrumentation. Therefore, the staff initiated **RAI 675-5231, Question 14.03.07-56**, for the applicant to justify that instrumentation used by the Control Room operators to monitor the status and manipulate the annulus emergency exhaust system annulus during an accident need not be safety related.

In its response to **RAI 675-5231, Question 14.03.07-56**, dated January 31, 2011, ADAMS Accession No. ML110340019 the applicant responded to the staff's concerns. After further review, the staff concurred with the applicant's response as the staff noted that SRP 6.5.1 ESF "Atmosphere Cleanup Systems" provides Table 6.5.1-1 "Minimum instrumentation, readout, recording and alarm provisions for ESF atmosphere cleanup systems" but does not require Class 1E power supplies for the instrumentation listed and that Subsection 5.8.2 "System Status Indication" (page 19 of IEEE Std. 603-1991) reads:

> "Display instrumentation shall provide accurate, complete, and timely information pertinent to safety system status. This information shall include indication and identification of protective actions of the sense and command features and execute features. The design shall minimize the possibility of ambiguous indications that could be confusing to the

operator. The display instrumentation provided for safety system status indication need not be part of the safety systems."

Based on this guidance from SRP 6.5.1and IEEE Std. 603-1991 the staff concluded that for the ESF filter trains the system design instrumentation satisfied SRP Section 14.3.7 Acceptance Criterion 9. The staff **closed** the following RAIs**: RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-3) and RAI 675-5231, Question 14.03.07-56.**

In **RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-20)**, the staff noted that Tier 1 Table 2.7.5.2-2 lists "Yes" for RSC display for the AHU fans, filtration unit fans, dampers, and exhaust fans of the ESF ventilation system. From the Tier 1 and 2 information it was not clear to the staff that "RSC display" means component status indication only (i.e., no controls at the RSC) for these components of the ESF ventilation system. The staff went on to note that the "Alarms, Displays, and Controls" Tier 1 Subsection 2.7.5.2 for each of the subsystems of the ESF ventilation system did not contain any information about the RSC display for the subject components. The staff found that information about the RSC status/control indication is not contained in either in US-APWR Subsection 9.4.5 or in the ESF ventilation system preoperational tests of US-APWR Section 14.2 (i.e., 14.2.12.1.70, 14.2.12.1.96, 14.2.12.1.97, 14.2.12.1.98, or 14.2.12.1.106). The staff requested that the applicant clarify Tier 1 Subsection 2.7.5.2 and Tier 1 Table 2.7.5.2-2, and add information to the subsections to ensure the adequate testing of the RSC display information during the preoperational tests for Tier 2 Subsection 9.4.5.

Editorial Comment:
This should be Tier "1", not "I".

In its response to **RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-20)**, dated September 19, 2008, ADAMS Accession No. ML082680032, the applicant responded that Tier 1 Section 2.7.5.2 and Table 2.7.5.2-2 will be clarified accordingly. The applicant agreed to revise Tier I Subsection 2.7.5.2 and Table 2.7.5.2-2 to remove the ambiguity with respect to "Display" and "Control" functions. The staff verified that applicant removed the ambiguity with respect to "Display" and "Control" functions in DCD Revision 3 Subsection 2.7.5.2 and Table 2.7.5.2-2. Since preoperational testing and startup testing of the RSC are performed per DCD Sections 14.2.12.1.76 and 14.2.12.2.4.6 there was no need to update the ESF ventilation system preoperational tests. The staff concluded the applicant's resolution satisfied the intent of SRP Section 14.3.7 Acceptance Criterion 9 and therefore found it acceptable. Based on this, the staff closed **RAI 54-891, Question 14.03.07-5 (RAI 14.3.7.3.6-20).**

The staff reviewed the US-APWR engineered safety features ventilation system ITAAC in accordance with SRP Section 14.3.7 to ensure that the relevant requirements of 10 CFR 52.47(b)(1) are met. Pending the verification of **Confirmatory Item 14.03.07-1**, the staff finds that sufficient information has been provided to satisfy SRP Section 14.3 and SRP Section 14.3.7 and therefore the US-APWR engineered safety features ventilation system ITAAC meet the relevant requirements of 10 CFR 52.47(b)(1).

2.7.5.3 Containment Ventilation System

US-APWR DCD Tier 1 Section 2.7.5.3.1 of the DCD provides a Design Description of the containment ventilation system and states that the containment ventilation system includes safety related and non-safety related systems. US-APWR DCD Tier 2 Section 9.4.6 provides the containment ventilation system design. The safety-related system serving the containment ventilation system consists of the containment penetration isolation assemblies. The containment ventilation system includes:

- Containment fan cooler system
- Control rod drive mechanism cooling system
- Reactor cavity cooling system
- Containment purge system

The containment ventilation system is classified as a non-safety related, non-seismic Category I system. However, ductwork is supported as required to prevent adverse interaction with safety-related systems during a seismic event. The containment ventilation system is designed to satisfy the following safety-related design bases:

- The containment purge system has the capability to close the safety-related, seismic Category I, containment isolation valves during a design-basis accident.
- The safety-related containment isolation valves isolating the containment are connected to separate electrical safety buses that satisfy the single active failure criterion.
- The containment isolation valves assemblies are design to withstand the effect of adverse environment conditions.

The staff reviewed the US-APWR containment ventilation system ITAAC in accordance with SRP Section 14.3.7 to ensure that the relevant requirements of 10 CFR 52.47(b)(1) are met. The staff finds that sufficient information has been provided to satisfy SRP Section 14.3 and SRP Section 14.3.7 and concludes that the US-APWR containment ventilation system ITAAC meet the relevant requirements of 10 CFR 52.47(b)(1).

2.7.5.4 Auxiliary Building Ventilation System

US-APWR DCD Tier 1 Section 2.7.5.4 provides the Tier 1 information associated with the Auxiliary Building (A/B) ventilation system. Section 2.7.5.4.1 of the DCD provides the design description of the A/B ventilation system US-APWR DCD Tier 2 Section 9.4.3 provides the A/B ventilation system design. The A/B ventilation system includes the following:

- A/B HVAC system
- Non-Class 1E electrical room HVAC system
- Main steam/feed water piping area HVAC system
- Technical support center (TSC) HVAC system

The A/B ventilation system is classified as a non-safety-related, non-seismic Category I system, with the exception of isolation damper assemblies. The safety-related, seismic Category I isolation dampers close during a design basis accident. Also, required ductwork will be supported to prevent adverse interaction with safety-related systems during seismic events.

System Analyses

SRP Section 14.3.7 Acceptance Criterion 1 references the check lists of SRP 14.3 Appendix C. Appendix C Section II.B.vii "Initiation Logic" reads in part "*If a system/component has a direct safety function it typically receives automatic signals to perform some action. This includes start, isolation, etc. …*"

In **RAI 54-891, Question 14.03.07-3 (RAI 14.3.7.3.4-6),** the staff noted that Tier 1 Table 2.7.5.4-3 identifies ITAAC for the A/B ventilation system. The staff went on note that Table 2.7.5.4-3 identifies that isolation dampers will be verified to close using a simulated local signal. The staff requested that the applicant clarify how the ECCS signal/connection will be verified.

In its response to **RAI 54-891, Question 14.03.07-3 (RAI 14.3.7.3.4-6),** dated September 19, 2008, ADAMS Accession No. ML082680032, the applicant stated that, consistent with other safety-related isolation dampers of US-APWR, the A/B ventilation system safety-related isolation dampers are also tested for function and operation when an ECCS signal is generated. To ensure consistency and provide the requested clarity, applicant agreed to revise Tier 1 Table 2.7.5.4-3 Criteria 4.a and subsection 2.7.5.4.1.

The staff confirmed that DCD Revision 3 Tier 1 verifies that the each as-built isolation damper identified in Table 2.7.5.4-1 performs the active function after receiving the ECCS active safety function signal. The staff found that the applicant's resolution satisfies the intent of SRP 14.3.7 Acceptance Criterion I. Based on this, the staff found the applicant's response acceptable and **closed RAI 54-891, Question 14.03.07-3 (RAI 14.3.7.3.4-6).**

SRP Section 14.3.7 Acceptance Criterion 2 identifies "Class 1E electrical power sources and divisions" as an attribute the helps define an attribute's significance to Tier 1.

In **RAI 54-891, Question 14.03.07-3 (RAI 14.3.7.3.4-9)**, the staff noted DCD Subsection 9.2.7 reads that the function of the non-essential chilled water system is to provide, during plant normal operation and LOOP, chilled water for the plant air cooling and ventilation systems serving the nonsafety-related areas. The staff requested additional information as to the availability of AC power to the A/B HVAC system during a LOOP. In its response to **RAI 54-891, Question 14.03.07-3 (RAI 14.3.7.3.4-9),** dated September 19, 2008, ADAMS Accession No. ML082680032, the applicant responded that the non-Class 1E electrical room and TSC HVAC systems, subsystems of the A/B ventilation system, operate during a LOOP. The applicant agreed to revise the Tier 1 Subsections 2.7.5.4.1.2 and 2.7.5.4.1.4, accordingly. The staff confirmed that DCD Revision 3 Tier 1 Subsections 2.7.5.4.1.2 and 2.7.5.4.1.4 include discussion of the capability of the respective non-Class 1E electrical room and TSC HVAC systems to function during a LOOP. The staff notes that DCD Subsections 9.4.3.2.2 and 9.4.3.2.4 identify that the non-Class 1E electrical room and TSC HVAC systems are serviced by the alternate ac power source during LOOP. Since the applicant's resolution provided ITAAC that satisfies the intent of SRP Section 14.3.7 Acceptance Criterion 2, the staff found the resolution acceptable. The staff **closed RAI 54-891, Question 14.03.07-3 (RAI 14.3.7.3.4-9).**

SRP Section 14.3.7 Acceptance Criterion 5 reads in part that "The design features in Tier 1 should be selected to ensure that the integrity of the analyses is preserved in an as-built facility. …".

In **RAI 54-891, Question 14.03.07-3 (RAI 14.3.7.3.4-14)**, the staff noted DCD Tier 2 Subsection 9.5.1.2.7 highlights an important system interface between the plant's fire protection system and the four HVAC systems that comprise the A/B ventilation system.

The staff requested the applicant amend Tier 1 Subsections: 2.7.5.4.1.1, 2.7.5.4.1.2, 2.7.5.4.1.3, and 2.7.5.4.1.4 to reflect the fire protection attributes of Subsection 9.5.1.2.7.

In its response to **RAI 54-891, Question 14.03.07-3 (RAI 14.3.7.3.4-14),** the applicant referred to **RAI 54-891, Question 14.03.07-2 (RAI 14.3.7.3.2-1)** for definition of the US-APWR interface requirements.

In follow-up **RAI 381-2806, Question 14.03.07-41 (**follow-up to **RAI 54-891, Question 14.03.07-3 (RAI 14.3.7.3.4-14),** the staff stated that the response was insufficient and that issues that pertain to fire protection and 10 CFR 50.48 are in the arena of special regulated events (i.e. Fire Protection, EQ, PTS, ATWS & SBO) and warrant elevated attention as opposed NSR systems. Therefore, the staff believes that Tier 1 should capture these issues against the relevant subsystems of the Auxiliary Building Ventilation System. The staff recommends that the applicant include (as applicable) in the following Tier 1 sections:

- 2.7.5.4.1.1 Auxiliary Building HVAC System
- 2.7.5.4.1.2 Non-Class 1E Electrical Room HVAC System
- 2.7.5.4.1.3 Main Steam /Feedwater Piping Area HVAC System
- 2.7.5.4.1.4 Technical Support Center HVAC System

In its response to **RAI 381-2806, Question 14.03.07-41,** dated July 17, 2009**,** ADAMS Accession No. ML092030410**,** the applicant referred to **RAI 30-635, Question 09.05.01-11**, ADAMS Accession No. ML082520817, where the applicant had already agreed to add ITAAC to Tier 1 Table 2.7.5.4-3 for testing the ability of A/B ventilation system fire dampers to close when called upon to do so under design air flow conditions. This ITAAC line item applies to each of the applicable A/B ventilation system subsystems (i.e., A/B HVAC System, Non-Class 1E electrical room HVAC system and the TSC HVAC system). The applicant continued that Tier 1 Subsection 2.7.6.9 addresses fire detectors, including ITAAC Item 2 in Table 2.7.6.9-2, to verify the fire detectors' capability to initiate fire alarms. The applicant agreed to enhance of Tier 1 Subsection 2.7.5.4.1 to reflect the fire protection attributes of the applicant's response. The staff verified that DCD Revision 3 Tier 1 Table 2.7.5.4-3 (Item 4.c) will test the ability of A/B ventilation system fire dampers to close when called upon to do so under design air flow conditions. The staff confirmed that DCD Revision 3 Tier 1 Subsection 2.7.5.4.1 includes a discussion of the fire dampers capability of closing against full flow.

The staff concluded that the changes to Tier 1 Subsection 2.7.5.4.1 and Table 2.7.5.4-3 (Item 4.c) satisfied the intent of SRP 14.3.7 Acceptance Criterion 5. Based on this, the staff found the applicant's response acceptable and **closed** the following RAIs**: RAI 54-891, Question 14.03.07-3 (RAI 14.3.7.3.4-14)** and **RAI 381-2806, Question 14.03.07-41.**

SRP Section 14.3.7 Acceptance Criterion 9 reads in part that "Tier 1 should address and verify at least the minimum inventory of alarms, controls, and indications as derived from the

Emergency Procedure Guidelines, the requirements of RG 1.97, and probabilistic risk assessment insights."

In **RAI 54-891, Question 14.03.07-3 (RAI 14.3.7.3.4-11)** the staff found that Chapter 14.2 Preoperational Tests 14.2.12.1.99, 14.2.12.1.100, 14.2.12.1.102, and 14.2.12.1.103 are not consistent with the ITAAC identified in Tier 1 Table 2.7.5.4-3 or with the system descriptions provided in Tier 1 Subsection 2.7.5.4. The staff requested that the applicant amend the applicable Tier 1 and Tier 2 subsections to identify and describe the important alarms, displays, and controls with associated with the safety-related isolation dampers of the A/B ventilation system.

In its response to **RAI 54-891, Question 14.03.07-3 (RAI 14.3.7.3.4-11),** dated September 19, 2008, ADAMS Accession No. ML082680032, the applicant responded , that Tier 1 Table 2.7.5.4-3, ITAAC Items 4.a and 4.b require testing of the A/B ventilation system isolation dampers to demonstrate closure in response to an ECCS closure signal and loss of motive power. The applicant concluded that no revision to 14.2.12.1.99 was required since DCD Section 14.2.12.1.99 tests alarms, indications and controls, and verifies isolation dampers on ECCS signal. The applicant agreed to revise the Tier 1 A/B ventilation system information to assure the alarms, displays and controls necessary to support the A/B ventilation system isolation dampers' safety-related functions are identified and tested via ITAAC. The applicant agreed to make conforming changes to other DCD subsections to ensure DCD consistency.

The staff verified that DCD Revision 2 Tier 1 Subsection 2.7.5.4 and Table 2.7.4.5-2 and 2.7.5.4-3 (Criteria 4.a, 5, 6 and 7) contained the identification and testing of alarms, displays and controls necessary to support the A/B ventilation system isolation dampers' safety-related functions. The staff also verified that DCD Revision 3 Tier 2 Subsection 9.4.3.5 "Instrumentation Requirements" contained sufficient detail with respect to alarms and indications.

In follow-up **RAI 381-2806, Question 14.03.07-39 (**follow-up to **RAI 54-891, Question 14.03.07-3 (RAI 14.3.7.3.4-11)),** the staff stated that they disagreed with the applicant's conclusion that Preoperational Test 14.2.12.1.99 "Auxiliary Building HVAC System Preoperational Test" does not need revising. SRP 14.3.7 Section II, SRP Acceptance Criteria 1 reads "Tier *1 should be reviewed for consistency with the initial test program described in* ***DCD*** *Tier 2 Chapter 14.2.* ". Preoperational Test 14.2.12.1.99 does not currently include testing of the loss of motive power position as identified in Tier 1 Table 2.7.5.4-1

In its response to **RAI 381-2806, Question 14.03.07-39,** dated July 17, 2009, ADAMS Accession No. ML092030410, the applicant also responded that the A/B ventilation system isolation dampers listed in DCD Tier 1 Table 2.7.5.4-1 are air-operated and fail closed on loss of motive power. The applicant agreed to revise the DCD Tier 2 Subsection 14.2.12.1.91 **"**Instrument Air System Preoperational Test" to include a test method step and acceptance criteria to verify the fail-safe position of safety-related air-operated components in response to a loss of instrument air.

The staff verified that DCD Revision 3 Tier 2 Subsection 14.2.12.1.91 contains loss-of-motive-power testing (i.e. Test Method 6, Acceptance Criteria 7) for the system isolation dampers of the Auxiliary Building ventilation system. In summary, the staff concluded that the applicant's response resolutions had satisfied the intent of SRP 14.3.7 Acceptance Criteria 1 and 9. Based on this, the staff found the applicant's composite response acceptable and **closed** the

following RAIs: **RAI 54-891, Question 14.03.07-3 (RAI 14.3.7.3.4-11), and RAI 381-2806, Question 14.03.07-39**.

In **RAI 54-891, Question 14.03.07-3 (RAI 14.3.7.3.4-10)**, the staff noted that Acceptance Criteria 3.a of Table 2.7.5.4-2, "Auxiliary Building Ventilation System Inspections, Tests, Analyses, and Acceptance Criteria" read that the simulated test signal exists only at the as-built Class 1E isolation dampers identified in Table 2.7.5.4-1 under test in the as-built A/B HVAC system. The staff asked whether it was possible to verify this negative. The staff requested that the applicant reword the acceptance criteria to make it verifiable.

In its response to **RAI 54-891, Question 14.03.07-3 (RAI 14.3.7.3.4-10),** dated September 19, 2008, ADAMS Accession No. ML082680032, the applicant revised ITAAC Acceptance Criteria Item 3.a of Table 2.7.5 4-2 to state that the simulated test signal exists at the as-built Class 1E equipment identified in Table 2.7.5.4-1 under test in the as-built MCR HVAC system.

In follow-up **RAI 381-2806, Question 14.03.07-47 (**follow-up to **RAI 54-891, Question 14.03.07-3 (RAI 14.3.7.3.4-10)),** the staff stated that the applicant's response was incomplete and that the change to DCD Tier 1 Table 2.7.5.4-2 somewhat addresses the staff's concern, but there appears to be an error in the ITAAC Acceptance Criteria Item 3.a of Table 2.7.5 4-2.

In its response to **RAI 381-2806, Question 14.03.07-47,** dated July 17, 2009, ADAMS Accession No. ML092030410,, the applicant agreed to revise ITAAC Acceptance Criteria Item 3.a of Table 2.7.5 4-3 to read, "*The simulated test signal exists at the as-built Class 1E isolation dampers, identified in Table 2.7.5.4-1, under test*." The staff confirmed that DCD Revision 3 Tier 1 Table 2.7.5.4-3 (Criteria 3.a) contained this change. Since the applicant's changes to Table 2.7.5.4-3 Item 3.a removed the point of confusion from the Acceptance Criteria, the staff found the applicant's response acceptable and **closed** the following RAIs: **RAI 54-891, Question 14.03.07-3 (RAI 14.3.7.3.4-10)** and **RAI 381-2806, Question 14.03.07-47**

In **RAI 54-891, Question 14.03.07-3 (RAI 14.3.7.3.4-12)**, the staff noted that DCD Subsection 9.4.3.3.2 indicates there are air flow requirements in the non-Class 1E electrical room HVAC system to limit the buildup of hydrogen in the non-Class 1E battery rooms. The staff also noted that Subsection 9.4.3.5.2 indicates there is an alarm for smoke detection in the supply and return ducts of the non-Class 1E electrical room HVAC system. The staff requested that the applicant modify DCD Subsection 9.4.3.4 to ensure that the preoperational testing includes verification of these two key design features and include testing for this system attribute in Tier 2 DCD Subsection 14.2.12.1.102 "Non-Class 1E Electrical Room HVAC System Preoperational Test. "

In its response to **RAI 54-891, Question 14.03.07-3 (RAI 14.3.7.3.4-12),** dated September 19, 2008, ADAMS Accession No. ML082680032, the applicant agreed to revise Subsection 14.2.12.1.102 to demonstrate smoke purge operation mode of operation. The staff notes that the applicant's response to **RAI 33-651, Question 14.02-80**, dated September 4, 2008, ADAMS Accession No. ML082520230 added acceptance criteria to the Auxiliary Building HVAC preoperational test 14.2.12.1.102 "Non-Class 1E Electrical Room HVAC System Preoperational Test" which reads "*Battery Room Exhaust Fan operation maintains the hydrogen concentration below 1 percent by volume in the battery room per Subsection 9.4.3.1.2.2."* This appears in Revision 3 of the DCD. The staff found the inclusion in Tier 2, only, of these two not-safety-related key design features appropriate since this is consistent with the applicant's graded

approach with respect to the scope of the ITAAC. Based on this, the staff found the applicants response acceptable and **closed RAI 54-891, Question 14.03.07-3 (RAI 14.3.7.3.4-12).**

The staff reviewed the US-APWR auxiliary building ventilation system ITAAC in accordance with SRP Section 14.3.7 to ensure that the relevant requirements of 10 CFR 52.47(b)(1) are met. The staff finds that sufficient information has been provided to satisfy SRP Section 14.3 and SRP Section 14.3.7 and concludes that the US-APWR auxiliary building ventilation system ITAAC meet the relevant requirements of 10 CFR 52.47(b)(1).

2.7.5.5 Turbine Building Area Ventilation System

US-APWR DCD Tier 1 Section 2.7.5.5 provides the Tier 1 information associated with the turbine building area ventilation system. Section 2.7.5.5.1 of the DCD provides a brief description of the turbine building area ventilation system and states that the turbine building area ventilation system is a nonsafety-related system. US-APWR DCD Tier 2 Section 9.4.4 provides the turbine building area ventilation system design. The turbine building area ventilation system includes the following:

- General mechanical areas ventilation system
- Electrical equipment areas HVAC system

The turbine building area is not expected to include airborne radioactive contamination. Safety-related equipment is not located in this area. Therefore, the turbine building area ventilation system does not serve any safety-related function, and thus has no safety design bases.

The staff reviewed the turbine building ventilation system ITAAC for the US-APWR in accordance with SRP Section 14.3.7 and to ensure that the relevant requirements of 10 CFR 52.47(b)(1) are met. The staff finds that sufficient information has been provided to satisfy SRP Section 14.3 and SRP Section 14.3.7 and concludes that the turbine building ventilation system meet ITAAC the relevant requirements of 10 CFR 52.47(b)(1).

HVAC Summary

The staff finds that all RAI questions associated with:

- "MHI Responses to US-APWR DCD RAI No. 54," dated September 19, 2008 (ML082680032).
- "MHI's Responses to US-APWR DCD RAI No. 381-2806 Revision 1," dated July 17, 2009 (ML092030410).

can be closed except for **Confirmatory Item 14.03.07-1** and **Confirmatory Item 14.03.07-2** associated with **Question 14.03.07-55** and **Question 14.03.07-59** identified above.

14.3.7.5 Combined License Information Items

The following is a list of item numbers and descriptions from Table 1.8-2 of the DCD:

	Table 14.3.7-2 Combine License Information Items	
Item No.	**Description**	**Section**
14.3(1)	The COL applicant provides the ITAAC for the site-specific portion of the plant systems specified in DCD Section 14.3.5, Interface Requirements.	14.3.4.7

14.3.7.6 Conclusions

The staff reviewed plant systems ITAAC which includes 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. Except for the Confirmatory Items, the staff concludes that the requirements of 10 CFR 52.47(b)(1) have been met and that the proposed ITAAC provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in accordance with the design certification, the provisions of the Atomic Energy Act, and NRC regulations.

14.3.8 ITAAC for Radiation Protection

14.3.8.1 Introduction

This SER section addresses ITAAC related to the radiation protection aspects of the design. The specific areas addressed in this section include:

- Area radiation monitoring systems and airborne radioactivity monitoring systems.
- Radiation shielding provided by structures and components for normal and emergency conditions.
- Design processes for radiation protection and their related design acceptance criteria.
- Other Tier 1 and ITAAC, which address the plant radiation protection design. These ITAAC include buildings, ventilation and filtration systems, and the post-accident sampling system.

The staff reviewed 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 (DC) is built and will operate in accordance with the DC, the Atomic Energy Act, and the NRC's regulations. In addition, the staff reviews the justification that compliance with the interface requirements is verifiable through ITAAC, and also reviews the method that is to be used for verification of the interface requirements.

14.3.8.2 Summary of Application

DCD Tier 1: The Tier 1 information associated with this section is found in Tier 1, Section 2.8, "Radiation Protection," of the Design Control Document (DCD).

DCD Tier 2: The applicant has provided a Tier 2 design description in DCD Section 14.3.4.8, summarized here in part, as follows:

> ITAAC related to radiation protection are provided for those systems, structures, and components (SSCs) that provide radiation shielding, confinement or containment of radioactivity, ventilation of airborne contamination, or monitoring of radiation (or radioactivity concentration) for normal operations and during accidents.

ITAAC: The ITAAC associated with Tier 1, Section 2.8 is given in Tier 1, Section 2.8.2.

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

COL information or action items: See Section 14.3.4.8.5 below.

Technical Report(s): There are no technical reports associated with this area of review.

Topical Report(s): There are no topical reports associated with this area of review.

US-APWR Interface Issues identified in the DCD: There are no US-APWR interface issues associated with this area of review.

Site Interface Requirements Identified in the DCD: There are no site interface requirements associated with this area of review

Cross-cutting Requirements (TMI, USI/GSI, Op Ex): None identified.

RTNSS: There are no RTNSS issues for this area of review.

10 CFR 20.1406: there are no issues related to 10 CFR 20.1406 for this area of review.

14.3.8.3 Regulatory Basis

The relevant requirements of the Commission's regulations for this area of review, and the associated acceptance criteria, are given in Section 14.3.8 of NUREG-0800 and are summarized below. Review interfaces with other SRP sections can be found in Section 14.3.8 of NUREG-0800. Acceptance criteria are based on meeting the relevant requirements of the following Commission regulation:

> 10 CFR 52.47(b)(1), which requires that a DC application include 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 DC has been constructed and will operate in accordance with the DC, the provisions of the Atomic Energy Act, and the NRC's regulations.

Specific SRP acceptance criteria acceptable to meet the relevant requirements of the NRC's regulation identified above can be found in Part II of Section 14.3.8 of NUREG-0800.

14.3.8.4 Technical Evaluation

The applicant provided design basis information, including associated tables and figures, in accordance with the selection methodology for US-APWR Design Control Document (DCD) "Tier 1," as described in US-APWR DCD Tier 2, Section 14.3 "Inspections, Tests, Analyses, and Acceptance Criteria" (ITAAC), to support ITAAC for US-APWR structures, systems, and components. The applicant organized their DCD Tier 1 information in the systems, structures, and topical areas format as shown in the US-APWR DCD Tier 1," Table of Contents. The staff reviewed the US-APWR DCD Tier 1 information provided by the applicant in accordance with the review matrix as provided in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants – LWR Edition" (SRP) Section 14.3.8, "Radiation Protection" and Appendix 14.3A "Information on Evolutionary Design Certification Reviews." For the radiation protection aspects of the design, the supporting information is contained in DCD Tier 2, Section 14.3 and DCD Tier 1.

The Radiation Protection and Accident Consequences (RPAC) Branch has primary review responsibility of ITAAC for area radiation monitoring systems and airborne radioactivity monitoring systems; radiation shielding provided by structures and components for normal and emergency conditions and for design processes for radiation protection and their related design acceptance criteria. The review ensures that the US-APWR DCD Tier 1 identifies and describes, commensurate with their safety significance, those SSCs that provide radiation shielding, confinement or containment of radioactivity, ventilation of airborne contamination, or radiation (or radioactivity concentration) monitoring for normal operations and during accidents, such as:

- Tier 1, Section 2.7.6.6 for Process Effluent Radiation Monitoring and Sampling System (PERMS)
- Tier 1, Section 2.7.6.13 for Area Radiation and Airborne Radioactivity Monitoring Systems (ARMS)
- Tier 1, Section 2.8 for Radiation Protection.

The RPAC Branch performs secondary reviews for other US-APWR DCD Tier 1 ITAACs which address the plant radiation protection design. These ITAACs include buildings, ventilation and filtration systems, and the post-accident sampling system, such as:

- Tier 1, Section 2.7.6.7 for Process and Post-accident Sampling System (PSS)
- Tier 1, Section 2.7.5.2 for Engineered Safety Features Ventilation Systems (ESFVS)
- Tier 1, Section 2.7.5.4 for Auxiliary Building Ventilation Systems (ABVS)
- Tier 1, Section 2.7.6.2 for Spent Fuel Storage
- Tier 1, Section 2.7.6.4 for Light Load Handling System

The ESFVS includes a discussion of the equipment provided to maintain the required environment in plant areas that contain engineered safety features (ESF) equipment. The

ABVS includes a discussion of the equipment provided to maintain environmental conditions in areas of the plant, such as the Reactor Building, the Auxiliary Building and the Access Building. The PERMS includes a description of the system used to monitor radioactivity levels in various areas within the plant and effluent streams. The ARMS continuously monitors the gamma radiation and airborne radioactivity levels within the various areas of the plant and provides an early warning to operating personnel when high radiation levels are detected, so the appropriate action can be taken to minimize occupational exposure. The ITAAC on radiation protection contains a description of how the plant is designed to maintain radiation exposures ALARA through the use of ventilation flow and the containment of airborne radioactive materials, the use of area radiation monitoring to measure radiation levels throughout the plant, and the incorporation of radiation shielding to obtain radiation dose rates in each plant area commensurate with that area's occupancy requirements.

The staff evaluated the applicant's submittal of the US-APWR DCD Tier 2, Section 12 "Radiation Protection." Areas considered during the US-APWR DCD Tier 2 Section 12 review, included the area radiation monitoring systems, airborne radioactivity monitoring systems, and radiation shielding provided by structures and components for normal and emergency conditions. In addition, the review included an evaluation of the process radiation monitoring system (PRMS) with respect to the airborne radioactivity monitors used to measure airborne radioactivity levels within the plant. The staff did not identify the need for RAIs related to the completeness or adequacy of the Tier 1 ITAAC provided by the applicant.

The radiation protection ITAAC are for portions of systems that are not safety-related, but used to demonstrate compliance with the requirements of 10 Part 20, "Standards for Protection Against Radiation," 10 CFR 20.1101 "Radiation Protection Programs," 10 CFR 20.1201 "Occupational dose limits for adults," 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," 10 CFR 50.34(f) "Additional TMI-related requirements," and 10 CFR Part 50, Appendix A, General Design Criterion (GDC) 19 "Control Room." In demonstrating compliance with the above regulatory requirements, the operation of these systems is governed by operational programs that are mandated under license conditions. The 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 the public are ALARA. The milestones for the development and implementation of the radiation protection operational program are addressed as COL commitments in US-APWR DCD Tier 2 Sections 13.4 "Operational Program Implementation," 12.1 "Ensuring that Occupational Radiation Exposures are As Low As Reasonably Achievable" and 12.5 "Operational Radiation Protection Program." The proposed ITAACs, once performed by a COL applicant and meeting their respective acceptance criteria, provide reasonable assurance that a plant incorporating the requirements of the US-APWR DC will operate in accordance with the DC and meet the provisions of the Atomic Energy Act of 1954, as Amended in NUREG-0980 and NRC regulations.

10 CFR 52.47(b)(1), requires that a DC application contain the proposed ITAAC that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification has been constructed and should operate in accordance with the design certification. This SRP section also states that NRC generic communications and operating experience should be used as part of the bases for establishing ITAAC. The guidance contained in SRP Section 14.3.8 states that the DC should address instrumentation and control (I&C) equipment that is involved in performing safety functions, including operating experience

problems that have been identified (particularly through generic letters or bulletins, and in some cases information notices). Information Notice (IN) 85-66, "Discrepancies Between As-Built Construction Drawings And Equipment Installations," dated August 7, 1985, describes how potentially significant generic problems regarding as-built construction drawings were not correctly or completely reflecting equipment installations, which, if left uncorrected, could have resulted in the loss or incorrect function of a safety-related component or system. Examples of these discrepancies identified in IN 85-66 include wiring errors, unidentified jumpers, wrong tubing connections, and wrong installed components. NRC Bulletin 74-11, "Improper Wiring of Safety Injection Logic at Zion 1 & 2," dated October 21, 1974, identified wiring errors which had existed from the time of plant construction, and had gone undetected during functional testing by the supplier and preoperational testing by the licensee. The bulletin states that the preoperational testing procedures were inadequate to detect the miss-wiring because the logic testing was done in parts similar to the component test done at the factory. NUREG/CR-6819, Volume 1, "Common-Cause Failure Event Insights, Emergency Diesel Generators," and NUREG-1275 Volume 14, "Causes and Significance of Design-Basis Issues at U.S. Nuclear Power Plants," provide examples of wiring errors that impact the ability of equipment to operate as expected.

The US-APWR Tier 1 DCD does not appear to describe the ITAAC provided for identifying wiring errors between components, such as described in NRC Bulletin No. 74-11. Therefore, in **RAI 1010-7039 Question 14.03.08-1**, dated March 4, 2013, the staff asked the applicant to describe the proposed ITAAC provided in the US-APWR DCD to detect and correct wiring errors, such as those identified in IN 85-66 and Bulletin 74-11. The applicant's response to **RAI 1010-7039, Question 14.03.08-1** dated April 25, 2013, described examples of ITAAC used to provide assurance that connections between safety related components associated with radiation protection equipment and the plant computer systems would be tested. Based on the applicant's response, **RAI 1010-7039, Question 14.03.08-1** is **resolved and closed**.

The staff concludes that the top-level design features and performance characteristics of the SSCs are appropriately described in Tier 1 and that the Tier 1 information associated with the scope of SRP 14.3.8 is acceptable.

14.3.8.5 Combined License Information Items

There are none for Section 14.3.4.8.

COL information items not identified in Table 1.8-2 of the DCD: None

14.3.8.6 Conclusions

Based on the staff's review performed in accordance with the guidance contained in SRP 14.3.8, the staff's review of the applicant's application of the selection methodology and criteria for the development of the Tier 1 information in Section 14.3 of DCD Tier 2, and on the above discussions, the staff concludes that the top-level design features and performance characteristics of the SSCs are appropriately described in Tier 1 and that the Tier 1 information associated with the scope of SRP 14.3.8 is acceptable.

Further, the staff concludes that the Tier 1 design descriptions associated with the scope of SRP 14.3.8 can be verified adequately by ITAAC. Therefore, the staff concludes that the ITAAC associated with the scope of SRP 14.3.8 are necessary and sufficient for reasonable assurance

that, if the inspections, tests, and analyses are performed and the acceptance criteria met, then a facility referencing the certified US-APWR design can be constructed and operated in compliance with the design certification and applicable regulations.

14.3.9 ITAAC for Human Factors Engineering

14.3.9.1 Introduction

14.3.9.2 Summary of Application

14.3.9.3 Regulatory Basis

14.3.9.4 Technical Evaluation

14.3.9.5 Combined License Information

14.3.9.6 Conclusions

14.3.10 ITAAC for Emergency Planning

14.3.10.1 Introduction

This section addresses ITAAC in the following US-APWR DCD, Revision 4, Tier 1 sections, which are related to emergency planning design features, facilities, functions, and equipment.

- Section 2.5.4, “Information Systems Important to Safety”
- Section 2.7.5.4, “Auxiliary Building Ventilation System (ABVS)”
- Section 2.7.6.10, “Communication Systems”
- Section 2.10, “Emergency Planning”

14.3.10.2 Summary of Application

DCD Tier 1: Tier 1 Section 2.10 addresses certain features of the US-APWR plant design that support emergency planning and the capability of the licensee to cope with plant emergencies. Tier 1 Section 2.7.5.4.1.4, “Technical Support Center HVAC System,” describes technical support center (TSC) habitability in support of personnel occupancy during plant accident conditions. Tier 1 Sections 2.7.6.10 and 2.5.4 describe communication and information systems, including the emergency response data system (ERDS) and safety parameter displays system (SPDS), which are available in the main control room (MCR) and TSC. Table 2.10-1, “Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria,” describes ITAAC for emergency planning. Additional ITAAC that are associated with emergency planning are included in Table 2.5.4-2, “Information Systems Important to Safety Inspections, Tests, Analyses, and Acceptance Criteria,” Table 2.7.5.4-3, “Auxiliary Building Ventilation System

Inspections, Tests, Analyses, and Acceptance Criteria," and Table 2.7.6.10-1, "Communication Systems Inspections, Tests, Analyses and Acceptance Criteria." (See 10 CFR 52.47(b)(1).)

DCD Tier 2: Tier 2 Section 14.3.4.10, "ITAAC for Emergency Planning," describes various design-related aspects of emergency planning ITAAC, and states that the ITAAC for emergency planning are provided in accordance with the requirements of 10 CFR 52.47(b), and consistent with the applicable generic ITAAC in Table C.II.1-B1 of Appendix C.II.1-B to RG 1.206. In addition, the COL applicant will provide proposed ITAAC for the facility's emergency planning not addressed in the DCD, in accordance with RG 1.206, as appropriate (see COL Information Item 14.3(2), addressed below in Section 14.3.10.5). These ITAAC provide for verifying the following:

- Means of communications among the main control room (MCR), the TSC, and the emergency operations facility (EOF); and

- The emergency response data system (ERDS).

Additional Tier 2 DCD information relating to emergency planning is provided in Section 1.8, "Interfaces for Standard Design," Section 1.9.5.2, "Conformance with SECY-12-0025" (including Table 1.9.5-7, "Conformance with SECY-12-0025 – Recommendation 9.3 Provisions for Enhancing Emergency Preparedness"), Section 7.5, "Information Systems Important to Safety," Section 9.4.3.2.4, "Technical Support Center (TSC) HVAC System," Section 9.5.2, "Communication Systems," and Section 13.3, "Emergency Planning."

ITAAC: DCD Tier 2 Section 14.3.4.10 references Tier 1 Section 2.10, which includes the emergency planning ITAAC in Table 2.10-1. Additional ITAAC that are associated with emergency planning are provided in other DCD Tier 1 sections. The total DCD ITAAC associated with emergency planning consists of the following Tier 1 tables:

- Table 2.5.4-2, Design Commitment (DC) #1, Re: TSC information system displays
- Table 2.7.5.4-3, DC #8, Re: TSC heating, ventilation, and air conditioning (HVAC) system
- Table 2.7.6.10-1, DCs #1, #2, and #3, Re: communication systems
- Table 2.10-1, DC #1, Re: TSC floor space

Technical Specifications: There are no technical specifications for this area of review. (See 10 CFR 52.47(a)(11).)

COL information or action items: See Section 14.3.10.5, below.

Technical Reports: There are no technical reports for this area of review.

Topical Reports: There are no topical reports for this area of review.

US-APWR Interface Issues identified in the DCD: There are no US-APWR interface issues associated with this area of review. (See 10 CFR 52.47(a)(25) and (a)(26).)

Site Interface Requirements Identified in the DCD: There are no site interface requirements associated with this area of review. (See 10 CFR 52.47(a)(1) and Tier 2 Table 1.8-1.)

Cross-cutting Requirements (TMI, USI/GSI, Op Ex): None identified.
(See 10 CFR 52.47(a)(8), (a)(21), and (a)(22).)

Regulatory Treatment of Non-safety Systems (RTNSS): There are no RTNSS issues for this area of review. (See 10 CFR 52.47(c)(2), 10 CFR 50.69, and Section 19.3 of NUREG-0800.)

10 CFR 20.1406: There are no issues related to 10 CFR 20.1406 for this area of review.
(See 10 CFR 52.47(a)(6), (a)(10), and (a)(12).)

14.3.10.3 Regulatory Basis

The relevant requirements of the Commission's regulations for this area of review, and the associated acceptance criteria, are given in Section 14.3.10, "Emergency Planning – Inspections, Tests, Analyses, and Acceptance Criteria," of NUREG-0800 and are summarized below. Review interfaces with other SRP sections can be found in Section 14.3.10 of NUREG-0800. Acceptance criteria are based on meeting the relevant requirements of the following Commission regulation:

> 10 CFR 52.47(b)(1) requires that an application for standard design certification contain the proposed ITAAC that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the [Atomic Energy] Act, and the Commission's rules and regulations.

Additional guidance is provided in Section 13.3, "Emergency Planning," of NUREG-0800. Specific SRP acceptance criteria acceptable to meet the relevant requirements of the NRC's regulation identified above can be found in Part II of Section 14.3.10 of NUREG-0800.

14.3.10.4 Technical Evaluation

The staff reviewed the ITAAC relating to emergency planning, which are provided in DCD Tier 1 Sections 2.5.4, 2.7.5.4, 2.7.6.10, and 2.10, against the applicable requirements and guidance identified above in Section 14.3.10.3. These ITAAC consist of six individual Design Commitments included in the respective DCD section ITAAC tables identified above in Section 14.3.10.2. In addition, the staff reviewed various design-related aspects of emergency planning included in DCD Tier 2 Sections 1.8, 1.9.5.2, 7.5, 9.4.3.2.4, 9.5.2, 13.3, and 14.3.4.10.

Section 13.3 of NUREG-0800, states in part that for a design certification application, the review only addresses those design features, facilities, functions, and equipment that are technically relevant to the design and are not site-specific, and which affect some aspect of emergency planning or the capability of a licensee to cope with plant emergencies. There is no minimum amount of design-related emergency planning for the proposed reactor that must be addressed in the application. The applicant may choose the extent to which emergency planning features are included in the application to be reviewed as part of the certified design. In Section 14.3.10

of NUREG-0800, Table 14.3.10-1, "Emergency Planning – Generic Inspections, Tests, Analyses, & Acceptance Criteria (EP ITAAC)," provides examples of acceptable generic EP ITAAC that may be used, to the extent they are relevant to a specific application.

The staff reviewed the six DCD ITAAC against the EP ITAAC in Table 14.3.10-1, and determined that they are consistent with the content and intent of the respective generic ITAAC. The correlation between the DCD EP ITAAC and generic EP ITAAC are as follows:

Table 14.3.10-1
Emergency Planning EP ITAAC

US-APWR DCD Tier 1 EP ITAAC	NUREG-0800 Section 14.3.10 Table 14.3.10-1, Generic EP ITAAC
Table 2.5.4-2, Design Commitment (DC) #1	Acceptance Criterion (AC) 8.1.5
Table 2.7.5.4-3, DC #8	AC 8.1.3
Table 2.7.6.10-1, DC #1	AC 6.1
Table 2.7.6.10-1, DC #2	AC 6.1
Table 2.7.6.10-1, DC #3	AC 6.2
Table 2.10-1, DC #1	AC 8.1.1

In addition, the staff determined that the proposed six ITAAC are technically relevant to the design and are not site-specific. Pursuant to 10 CFR 52.80(a)(2), at the COL application stage, these DCD ITAAC (contained in the certified design) must apply to those portions of the facility design which are approved in the design certification.

The staff finds that the DCD Tier 1 emergency planning ITAAC identified above are acceptable because they are technically relevant to the design and not site-specific, and are consistent with the generic EP ITAAC in Table 14.3.10-1 in Section 14.3.10 of NUREG-0800.

14.3.10.5 Combined License Information Items

Table 14.3.10-2

US-APWR Combined License Information Items

Item No.	Description	Section
14.3(2)	The COL Applicant provides ITAAC for the facility's emergency planning not addressed in the DCD in accordance with RG 1.206 as appropriate.	14.3.4.10

The applicant identified additional COL information items in Table 1.8-2, which are associated with various features of the US-APWR plant design that support emergency planning. These include COL Item Nos. 1.9(6), 1.9(7), 7.5(2), 9.5(4), 9.5(5), 9.5(6), 9.5(8), and 13.3(1) through 13.3(7); which are described in their respective Tier 2 DCD sections, and addressed in the corresponding sections of this report. (See 10 CFR 52.47(a)(1) and Section C.III.4, "Combined License Action or Information Items," of RG 1.206.)

14.3.10.6 Conclusions

The staff concludes that the emergency planning ITAAC information addressed above for the US-APWR, Revision 4, is consistent with the guidance in Sections 13.3 and 14.3.10 of NUREG-0800, and is therefore acceptable and meets the relevant requirements of 10 CFR 52.47(b)(1).

14.3.11 ITAAC for Containment Systems

14.3.11.1 Introduction

This SER section addresses the ITAAC related to the containment and associated systems. Issues regarding containment design include containment pipe break accidents, containment heat removal and fission product removal and control systems, containment isolation provisions, containment leakage testing, hydrogen generation and control, and subcompartment analysis.

The staff reviewed 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 is built referencing the design certification (DC) will operate in accordance with the DC, the Atomic Energy Act, and the NRC's regulations. In addition, the staff reviewed the applicant's justification that compliance with the interface requirements is verifiable through ITAAC, as well as the applicant's method that is to be used for verification of any interface requirements.

14.3.11.2 Summary of Application

DCD Tier 1: The Tier 1 information associated with this section is primarily found in Tier 1, Section 2.11, "Containment Systems," of the DCD.

US-APWR DCD (Revision 3) Tier 1, Section 2.11, "Containment Systems," presents containment systems which include the Containment Vessel along with three related systems: Containment Isolation System (CIS), Containment Spray System (CSS), and Containment Hydrogen Monitoring and Control System (CHS). For each, system descriptions and figures are provided. ITAAC are presented in the following tables:

- Table 2.11.1-2 Containment Vessel ITAAC,
- Table 2.11.2-2 Containment Isolation System ITAAC,
- Table 2.11.3-5 Containment Spray System ITAAC,
- Table 2.11.4-1 Containment Hydrogen Monitoring and Control System ITAAC.

ITAAC for containment structures, heat removal and fission product removal and control systems are documented in DCD Tier 1, Section 2.2, "Structural and Systems Engineering," with Table 2.2-4 (Structural and Systems Engineering ITAAC); Section 2.3, "Piping Systems and Components," with Table 2.3-2 (Piping Systems and Components ITAAC); Section 2.4.4, "Emergency Core Cooling Systems," with Table 2.4.4-5 (Emergency Core Cooling System ITAAC); Section 2.7.5.2.1.1, "Annulus Emergency Exhaust System," with Table 2.7.5.2-3 (Engineered Safety Features Ventilation Systems ITAAC); Section 2.11.1, "Containment Vessel," with Table 2.11.1-1 (Key Containment Design and Performance Characteristics). In

addition, there are also ITAAC requirements for shared equipment and support systems listed in several other Tier 1 sections.

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, and controls, logic for system actuation, interlocks, 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 Design Commitment column of the ITAAC.

The applicant organized its Tier 1 information in a manner similar to that used for the evolutionary designs as described in SRP Section 14.3. The ITAAC for the containment systems follow the format recommended in RG 1.206, Table C.II.1-1, "Sample ITAAC Format." The ITAAC are presented in a three-column table. The first column identifies the proposed design requirement and/or commitment to be verified. The second column identifies the proposed method (inspection, testing, analysis, or some combinations of the three) by which the license will verify the design requirement/commitment described in column 1. The third column of the ITAAC identifies the proposed specific acceptance criteria for the inspections, tests, analyses described in column 2 that, if met, demonstrate the licensee has met the design requirements/commitment in column 1.

Tier 1 ITAAC for Systems that contain Containment Isolation System Functions

As indicated in Section 2.11 of the Tier 1, Figure 2.11.2-1, the following systems contain components that function as part of the Containment Isolation System, and have containment isolation system characteristics that are listed in CIS ITAAC Table 2.11.2-1:

- Reactor Coolant System (RCS)
- Waste Management System (WMS)
- Refueling Water Storage System (RWS)
- Primary Makeup Water System (PMWS)
- Instrument Air System (IAS)
- Fire Protection Water Supply System (FSS)
- Station Service Air System (SSAS)
- Containment Ventilation System-Containment Purge (CVVS)
- HVAC System (Non-essential Chilled Water System) (VWS)
- Radiation Monitoring Systems (RMS)
- In-Core Instrument Gas Purge System (ICIGS)
- Leak Rate Testing System (LRTS)

As indicated in Section 2.11 of the Tier 1, Figure 2.11.2-1, the following systems contain components that function as part of the Containment Isolation System. These systems have containment isolation system characteristics not listed in CIS ITAAC Table 2.11.2-1, but listed in a system-specific table in their respective Tier 1 section:

- Emergency Core Cooling System (ECCS)-Safety Injection System (SIS)
- Chemical and Volume Control System (CVCS)

- Residual Heat Removal System (RHRS)
- Main Steam System (MSS)
- Condensate and Feedwater System (FWS)
- Steam Generator Blowdown System (SGBDS)
- Emergency Feedwater System (EFWS)
- Component Cooling Water System (CCWS)
- Process and Post-accident Sampling System (PSS)
- Containment Spray System (CSS)

DCD Tier 2: The applicant has provided a Tier 2 design description (bases, processes, and selection criteria) in US-APWR DCD (Revision 3), Section 14.3.4.11, "ITAAC for Containment Systems," was used to develop the containment systems ITAAC information contained in Tier 1, Section 2.11, summarized here in part, as follows:

ITAAC for containment systems focus mainly on containment design and associated issues, such as containment isolation provisions, containment leakage testing, hydrogen generation and control, subcompartment analysis, containment heat removal, and fission product removal systems including the CSS and the annulus emergency exhaust filter system. These ITAAC provide for verifying the following:

- Key parameters and insights from containment safety analyses, such as LOCA, main steam line break, main feed line break, and subcompartment analyses.
- The existence of severe accident prevention and mitigation design features.
- The functional arrangements of containment isolation provisions.
- The design qualification of containment isolation valves.
- The containment isolation functions of motor-operated valves and check valves by in-situ testing.
- Containment isolation signal generation.
- Containment isolation valve closure times.
- Containment isolation valve leakage.
- The minimum inventory of alarms, displays, and controls.

The applicant stated that the ITAAC for containment systems were prepared in accordance with the guidance in RG 1.206, Section C.II.1, "Inspections, Tests, Analyses, and Acceptance Criteria"; NUREG-0800 SRP Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria"; and NUREG-0800 SRP Section 14.3.11 "Containment Systems – Inspections, Tests Analyses, and Acceptance Criteria."

ITAAC: The ITAAC associated with Tier 1, Section 2.11 are given in Tier 1, Sections 2.11.1.2, 2.11.2.2, 2.11.3.2, and 2.11.4.2.

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

COL information or action items: See Section 14.3.4.11.5 below.

Technical Report(s): There are no technical reports associated with this area of review.

Topical Report(s): There are no topical reports associated with this area of review.

US-APWR Interface Issues identified in the DCD: There are no US-APWR interface issues associated with this area of review.

Site Interface Requirements Identified in the DCD: There are no site interface requirements associated with this area of review.

Cross-cutting Requirements (TMI, USI/GSI, Op Ex): None identified.

RTNSS: There are no RTNSS issues for this area of review.

10 CFR 20.1406: there are no issues related to 10 CFR 20.1406 for this area of review.

14.3.11.3 Regulatory Basis

The relevant requirements of the Commission's regulations for this area of review, and the associated acceptance criteria, are given in Section 14.3.11, “Containment Systems – Inspections, Tests, Analyses, and Acceptance Criteria,” of NUREG-0800 and are summarized below. SRP Section 14.3.11 has been employed as the guidance for this SER in conjunction with SRP Section 14.3. Review interfaces with other SRP sections can be found in Section 14.3.11 of NUREG-0800. The acceptance criteria that apply to ITAAC review for design certification applications are based on meeting the relevant requirements of the following Commission regulation:

1. 10 CFR 52.47(a)(25), which requires that a DC application contain interface requirements to be met by those portions of the plant from which the application does not seek certification. This requirement must be sufficiently detailed to allow completion of the FSAR.

2. 10 CFR 52.47(a)(26), which requires that a DC 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.

3. 10 CFR 52.47(b)(1), which requires that a DC application include 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 DC has been constructed and will operate in accordance with the DC, the provisions of the Atomic Energy Act, and the NRC's regulations.

Specific SRP acceptance criteria acceptable to meet the relevant requirements of the NRC’s regulation identified above can be found in Part II of Section 14.3.11 of NUREG-0800. This review interfaces with other SRP sections on ITAAC; Sections 14.3, 14.3.2, 14.3.3, 14.3.5 and 14.3.6.

14.3.11.4 Technical Evaluation

14.3.11.4.1 Introduction

The staff reviewed conformance of the ITAAC in US-APWR DCD (Revision 3) Tier 1, Section 2.11, "Containment Systems," and the ITAAC of related systems that contain components with CIS functions to the guidance provided in RG 1.206, Section C.II.1, "Inspections, Tests, Analyses, and Acceptance Criteria." The review also followed the review procedures and acceptance criteria in SRP Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria." The Tier 1 information was derived from Tier 2 information based on a graded approach considering the safety significance of the SSCs for the design. Tier 1 information includes high-level design descriptions, performance characteristics, and safety functions to be verified by ITAAC for the plant systems. The applicant followed the guidance presented in SRP Sections 14.3.1 through 14.3.12 in their organization of the Tier 1 information.

The staff also reviewed Tier 2, Section 14.3.4.11, "ITAAC for Containment Systems," to the guidance provided in RG 1.206, Section C.II.1, and SRP Section 14.3. ITAAC described in the DCD Tier 1 for containment heat removal and fission product removal and control functions were reviewed following the guidance contained in SRP Chapter 14.3.11. The staff review of Tier 2, Chapter 14.3, Inspection, Tests, Analysis, and Acceptance Criteria, covers the bases, processes, and selection criteria used to develop the Tier 1 information. The following sections were reviewed from Chapter 14.3: 14.3.3.5, Safety Analyses and Probabilistic Risk Assessment Insights and Assumptions (with Table 14.3-1 a-f), 14.3.4.2, Structural and Systems Engineering, 14.3.4.4, Reactor Systems, 14.3.4.7, Plant Systems, and 14.3.4.11, Containment Systems. Of particular interest are Table 14.3-1a, "Design Basis Accident Analysis Key Design Features," Table 14.3-1d "PRA and Severe Accident Analyses Key Design Features," and Table 14.3.1f, "Radiological Analysis Key Design Features."

The purpose of the review was to ensure that the proposed ITAAC are necessary and sufficient to provide reasonable assurance that, if met, these systems will perform as required and the NRC regulations will be met.

14.3.11.4.2 ITAAC Development Criteria

The staff reviewed the US-APWR Tier 2 information on ITAAC to the guidance for containment systems ITAAC development. RG 1.206 Section C.II.1.2.11, "ITAAC for Containment Systems" defines the ITAAC development for containment systems and specifies the aspects to be verified through ITAAC. They relate to containment design along with containment isolation provisions, containment leakage testing, hydrogen generation and control, containment heat removal, and subcompartment analysis. It states that the ITAAC should be developed to verify the following aspects:

- Key parameters and insights from containment safety analyses, such as LOCA, main steam line break, main feedline break, and subcompartment analysis,
- The existence of severe accident prevention and mitigation design features,
- The functional arrangements of containment isolation provisions,
- The design qualification of containment isolation valves,
- The containment isolation functions of MOVs and check valves by in-situ testing,
- Containment isolation signal generation,

- Containment valve closure times,
- Containment isolation valve leakage.

ITAAC for the containment vessel as a leak-tight barrier to accommodate pipe breaks and fission products is provided in Section 2.11, Containment Systems, Table 2.11.1-2, Items 1-7 (all items of the table). Key containment design features for the containment internal design pressure of 570 Kilopascal (kPa) (68 psig), containment external design pressure differential of 26.9 kPad (3.9 psid), containment design temperature of 149°C (300°F), containment free volume of 79,287 m^3 (2,800,000 ft^3) and containment leakage rates are noted in Tier 1 Table 2.11.1-1. The leakage rates are 0.1 percent per day – normal design value and 0.15 percent per day - leak rate during a LOCA (0-24 hours).

The staff found that the US-APWR DCD Section 14.3.4.11, "ITAAC for Containment Systems," of the US-APWR DCD states that the ITAAC are developed to verify the above aspects. It also includes one additional item:

- The minimum inventory of alarms, displays, and controls.

Because the aspects for ITAAC development listed in DCD Tier 2 Section 14.3.4.11 include those listed in RG 1.206 Section C.II.1.2.11, the staff concludes that the applicant adequately identified the general aspects to be verified through ITAAC in DCD Tier 2 Section 14.3.4.11.

14.3.11.4.3 Design Descriptions and Figures

The staff reviewed the US-APWR DCD (Revision 3) Tier 1 ITAAC Design Descriptions and Figures in Section 2.11 and the design descriptions in other containment related systems in Tier 1 using the guidance provided in SRP Section 14.3 and the design description checklist provided in Appendix C to the section.

In **RAI 51-916, Questions 14.03.11-1**, and **14.03.11-6**, **RAI 222-1933, Questions 14.03.11-18** and, **14.03.11-22** the staff requested the applicant add additional Tier 2 design description information into Tier 1, in order to conform to SRP 14.3 guidance. In response to these questions, the applicant revised the US-APWR Tier 1 design description information. The staff has confirmed that the US-APWR DCD Tier 1, Revision 2, dated October 27, 2009 was revised as committed in the RAI responses. Accordingly, the staff finds that the applicant has addressed the issue and therefore considers **RAI 51-916, Questions 14.03.11-1, and 14.03.11-6, RAI 222-1933, Questions 14.03.11-18** and, **14.03.11-22 resolved and closed**.

Based on review of information provided in the US-APWR DCD (Revision 3) the staff found that the US-APWR Tier 1 containment systems and containment related systems descriptions and figures are acceptable because they conform to SRP Section 14.3 and the design description checklist provided in Appendix C of that section of the SRP.

14.3.11.4.4 Standard and System Specific ITAAC Entries

The staff reviewed the US-APWR DCD (Revision 3) Tier 1 ITAAC entries in Section 2.11 and the ITAAC in other containment related systems in Tier 1 using the guidance provided for standard and system specific ITAAC entries contained in SRP Section 14.3 Appendices C and D including the ITAAC checklist provided in Appendix C.

In request for additional information (RAI) **51-916, Question 14.03.11-8** and in follow-up **RAI 222-1933, Question 14.03.11-34** (RAI 14.3.4.11-24) the staff requested that the applicant provide necessary ITAAC to verify the minimum inventory of alarms, displays and controls associated with the containment instrumentation shown on Figure 2.11.2-1, but not listed in Table 2.11.2-1, and to amend Table 2.11.2-1 as needed. The staff also requested the applicant to provide containment isolation system ITAAC for those systems that have containment isolation functions (e.g., CVCS, SGBDS, and PSS). Specifically, the staff requested the applicant provide ITAAC to verify the display of position indication of the containment isolation valves in the MCR, to include the displays of the CIV positions in the respective system Tier 1 tables. The staff also requested the applicant provide ITAAC necessary to verify the minimum inventory of alarms, displays and controls for the CHS system.

In its response to **RAI 51-916, Question 14.03.11-8**, dated September 18, 2008, the applicant responded that ITAAC to verify the display of position indication of the containment isolation valves in the MCR will be added in the respective system tables. Based on review of the RAI response, the staff issued **RAI 222-1933, Question 14.03.11-34**, which requested DCD markups of all proposed new ITAAC for staff review.

In its response to **RAI 222-1933, Question 14.03.11-34**, dated April 23, 2009, the applicant responded that Tier 1 Table 2.11.2-1 will be revised to consolidate all valves with containment isolation function to make them subject to CIS ITAAC in Tier 1 table 2.11.2-2. The applicant also indicated that DCD Tier 1 will be revised as needed to ensure each of the CIVs in the revised table 2.11.2-1 is included in its appropriate table of alarms, displays and controls. The applicant submitted DCD markups reflecting the changes to Table 2.11.2-1 and indicated the other conforming changes will be submitted with a forthcoming DCD revision 2. Based on review of the RAI response and the proposed DCD markup, the staff issued follow up **RAI 488-3745, Question 14.03.11-42** (RAI 14.3.4.11-30), wherein the staff requested that the applicant add ITAAC to verify the CHS alarm function. The staff also stated that the staff would review all revised ITAAC tables upon receipt of DCD Revision 2. In its response to **RAI 488-3745, Question 14.03.11-42** dated January 13, 2010, the applicant responded stating that CCW containment isolation valves NCS-VLV-403 A, B have been added to Tier 1 Table 2.7.3.3- 2 in DCD Revision 2 and that ITAAC #4 has been added to ITAAC Table 2.11.4-1, which verifies the existence of the CHS alarm function in the MCR. The applicant submitted DCD markups reflecting these changes. The staff reviewed the RAI responses and finds them acceptable because the revised ITAAC verify that containment isolation valve position indication, and other important alarms, displays and controls needed to accomplish containment isolation and combustible gas control system functions are available to control room operators. Additional staff findings on the minimum inventory of alarms in the main control room are in Chapters 7 and 18 of this report.

The staff has confirmed that the US-APWR DCD (Tier 1, Revision 2), dated October 27, 2009 was revised as committed in the RAI responses. Accordingly, the staff finds that the applicant has addressed the issue, and therefore considers **RAI 51-916, Question 14.03.11-8, RAI 222-1933, Question 14.03.11-34**, and **RAI 488-3745, Question 14.3.11-42 resolved and closed**.

In **RAI 550-4359 Question 14.03.11-43**, the staff requested that the applicant clearly identify by valve ID number, those valves listed in Tier 1 Table 2.7.3.3-4, “Component Cooling Water System Equipment Alarms, Displays, and Control Functions” such that ITAAC Item 11 in Tier 1 Table 2.7.3.3-5, “Component Cooling Water System Inspections, Tests, Analyses, and Acceptance Criteria” is clear regarding which valves it applies. In its response to **RAI 550-4359**

Question 14.03.11-43, dated March 25, 2010, the applicant proposed changes to DCD Tier 1 Table 2.7.3.3-4 that adds valve ID numbers to the valve names on the table. The staff has reviewed the response and the proposed DCD changes and has found them acceptable because the revised table clearly defines the applicability of the ITAAC to specific components. The staff has confirmed that DCD, Tier 1, Revision 3, dated March 31, 2011 was revised as committed in the RAI response. Accordingly, the staff finds that the applicant has addressed the issue and therefore considers **RAI 550-4359, Question 14.03.11-43 resolved and closed**. Based on review of information provided in the US-APWR DCD (Revision 3) the staff found that the US-APWR Tier 1 containment systems and containment related systems standard and system specific ITAAC entries are acceptable, because they conform to the guidance of SRP Section 14.3 Appendices C and D as it relates to the format and content for these ITAAC. The staff finds these ITAAC sufficient to provide 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 and applicable regulations.

14.3.11.4.5 Containment Systems

The staff reviewed the US-APWR Tier 1 ITAAC entries in Section 2.11 and the ITAAC in other containment related systems in Tier 1 using the guidance provided for containment systems ITAAC entries contained in RG 1,206 Section C.II.1.2.11, "ITAAC for Containment Systems."

The staff performed a review to ensure that ITAAC exist to verify key parameters and insights from containment safety analyses, such as LOCA, main steamline break, main feedline break, and subcompartment analysis. The review of Tables 14.3-1 a-f shows that insights from containment safety analyses and subcompartment analysis have been addressed. Furthermore, the requirements to satisfy severe accidents have been specified.

In **RAI 51-916, Question 14.03.11-2**, and follow-up **RAI 222-1933, Question 14.03.11-29** (RAI 14.3.4.11-19) the staff requested, that the applicant provide additional information on how critical assumptions from transient and accident analyses are verified by ITAAC. The staff asked the applicant to indicate in the DCD, the cross references from containment safety analyses that are used to define specific ITAAC. The staff asked the applicant to discuss how the cross references have been used in developing the ITAAC, and for each ITAAC item identified, a discussion on how the ITAAC acceptance criteria will provide verification of the critical assumption from containment safety analyses.

In its response to **RAI 51-916, Question 14.03.11-2**, dated September 18, 2008, the applicant responded that they will expand DCD Tier 2 Table 14.3-1 and directly extract the design commitments from Section 6.2.1 of Tier 2 regarding the containment transient and accident analyses. The comparison with the assumptions in the containment transient and accident analyses are to be resolved with the enhancement of Table 14.3-1. Based on review of the proposed DCD changes cited in the RAI response, the staff determined that the table should be further clarified to indicate what particular analysis relates to each assumption listed in the table. Therefore staff issued follow-up **RAI 222-1933, Question 14.03.11-29** for the applicant to clarify information provided in Table 14.3-1

In **RAI 222-1933, Question 14.03.11-29**, the staff requested that the applicant further clarify DCD Tier 2 Table 14.3-1 to indicate what particular analysis relates to each assumption listed in the table. In its response to **RAI 222-1933, Question 14.03.11-29**, dated April 23, 2009, the

applicant responded with a revised DCD Tier 2 Table 14.3-1 which identifies which particular analysis (DBA, Severe Accident, Flooding, etc.) was used to create each assumption. In addition, several assumptions were added. Based on the review of the RAI response, the staff determined that the revised table did not indicate the corresponding ITAAC that verifies each assumption identified in the table. Therefore the staff issued follow-up **RAI 488-3745, Question 14.03.11-40** for the applicant to address missing ITAAC to verify information in Table 14.3-1.

In **RAI 488-3745, Question 14.03.11-40**, the staff requested that the applicant clearly link the specific ITAAC item number(s) that verify the listed design feature or assumption in Table 14.3-1. In its response to **RAI 488-3745, Question 14.03.11-40**, dated January 13, 2010, the applicant responded with a revised DCD Tier 2 Table 14.3-1 which identifies the specific ITAAC item number(s) that verify the design feature or assumption.

The staff has reviewed the applicant's response to the above questions and finds it acceptable because the applicant clarified the DCD to show how the ITAAC that verify key parameters and assumptions in transient and accident analyses are derived. DCD Tier 2, Table 14.3-1 clearly links each design feature or assumption listed in tier 2 with an ITAAC item in Tier 1. The staff has confirmed that DCD, Tier 1, Revision 3, dated March 31, 2011 was revised as committed in the RAI responses. Therefore, the staff considers **RAI 51-916, Question 14.03.11-2**, **RAI 222-1933, Question 14.03.11-29**, and **RAI 488-3745, Question 14.03.11-40 resolved and closed**.

Similarly, the staff performed a review to ensure that ITAAC exist to verify the severe accident prevention and mitigation design features. In **RAI 51-916, Question 14.03.11-3**, the staff requested that the applicant provide cross-references or roadmaps from severe accident analyses that are used to define specific ITAAC addressing severe accident prevention and mitigation features. Also, for each ITAAC item identified, the staff requested a discussion on how the ITAAC acceptance criteria provide verification of the critical assumptions or requirements in severe accident analyses. In its response to **RAI 51-916, Question 14.03.11-3**, dated September 18, 2008, the applicant responded stating that the applicant found that some of the design features were not specified in Table 14.3-1 and the existence of the SSCs used as the severe accident prevention and mitigation features were not clearly described in Tier 1. The applicant stated that it will add these unspecified design features in each design description in Tier 1 and provide the corresponding cross-reference in Table 14.3-1 of Tier 2, respectively. Based on review of **RAI 51-916, Question 14.03.11-3** response, the staff determined that all significant design features should be identified in the table. Therefore, the staff issued follow-up **RAI 222-1933, Question 14.03.11-30** (RAI 14.3.4.11-20) which requested that either Table 14.3-1 or the accompanying discussion be revised to identify the specific design feature(s), which should be verified for each of the item and the ITAAC defined to address them.

In its response to **RAI 222-1933, Question 14.03.11-30,** dated April 23, 2009, the applicant responded with a revised DCD Tier 2 Table 14.3-1 which identifies which particular analysis (DBA, Severe Accident, Flooding, etc.) was used to create each assumption. In addition, several assumptions were added.

Based on the review of **RAI 222-1933, Question 14.03.11-30**, the staff determined that Tier 2 Table 14.3-1 needs to be revised further to identify the specific ITAAC item number(s) that verify the design feature or assumption. Therefore, the staff issued follow-up **RAI 488-3745, Question 14.03.11-41** (RAI 14.3.4.11-29) wherein the staff requested that the applicant provide a roadmap, that directly addresses all the key design features and assumptions for which ITAAC should be developed. The applicant was requested to justify if any of the key design features

Technical Comment:
This is not latest submittal. A revised response was submitted on June 21, 2013.

and assumptions is not addressed in the ITAAC. In its response to **RAI 488-3745, Question 14.03.11-41** dated January 13, 2010, the applicant responded with a revised DCD Tier 2 Table 14.3-1 which identifies the specific ITAAC item number(s) that verify the design feature or assumption.

The staff has reviewed the applicant's responses to the above questions and finds them acceptable because the applicant clarified the DCD to show how the ITAAC that exist to verify severe accident prevention and mitigation design features are derived. DCD Tier 2, Table 14.3-1 clearly links each design feature or assumption listed in Tier 2 with an ITAAC item in Tier 1. The staff has confirmed that DCD, Tier 1, Revision 3, dated March 31, 2011 was revised as committed in the RAI responses. Therefore, the staff considers **RAI 51-916, Question 14.03.11-3**, **RAI 222-1933, Question 14.03.11-30**, and **RAI 488-3745, Question 14.03.11-41 resolved and closed**.

The ITAAC addressing the RWSP, strainer, coatings, insulation materials in containment, and the sodium tetraborate decahydrate (NaTB) baskets are provided in Tier 1 Chapter 2.4, "Reactor Systems, "Section 2.4.4, "Emergency Core Cooling System (ECCS)." The ITAAC for these items is described in Table 2.4.4.5, Items 7b and 7c. The RWSP provides the source of water to the CSS. The debris interceptors support long-term cooling by intercepting debris that could impede the operation of the CSS. The NaTB baskets provide the chemicals to increase the pH of the water from 4 to 7, needed for fission product removal by sprays.

In letter, UAP-HF-11449, "Updated Closure Plan for Issues Associated with GSI-191 for the US-APWR Design Certification," dated December 21, 2011, (ADAMS Accession Number ML11362A464), the applicant communicated their plan to change the recirculation flowpath design. The recirculation flow path design ensures the RCS break flow and containment spray water are systematically returned to the RWSP. In the revised design, the debris laden water is directed into the reactor cavity, the containment recirculation air distribution chamber and the containment volume (CV) drain pump room, which are dry during normal operation. Overflow pipes have been installed in the reactor cavity and the containment recirculation air distribution chamber to direct the reactor coolant system break water and containment spray water into the RWSP. The second floor area outside the SG compartment no longer has a direct RCS recirculation flow path to the RWSP (the 10 transfer pipes, arranged vertically in the second floor outside the SG compartment in the original design, have been removed). The portion of the containment spray water that falls outside the SG compartment now flows into the steam generator compartment and mixes with the break flow from the RCS. Additionally, the nominal water level of the RWSP will be raised slightly to increase the initial water inventory. In letter, UAP-HF-12239, "Transmittal of US-APWR DCD GSI-191 Tracking Report," dated August 30, 2012 (ADAMS Accession Number ML122490125), the applicant submitted changes to DCD Tier 1 Sections 2.4 and 2.11 to reflect the recirculation flow path changes. As part of this report, the applicant updated Tier 1 Sections 2.4.4 and 2.11.1 to modify piping and equipment (e.g., remove transfer piping, add overflow piping, add debris interceptors, and add drain paths). In addition, the report made adjustments to the RWSP inventory and reflects a correction to the strainer area. The staff finds these Tier 1 markups to be consistent with ITAAC guidance and Tier 2 information. Therefore, the staff finds the changes to Sections 2.4 and 2.11 provided in the GSI-191 Tracking Report are acceptable. The changes to DCD Sections 2.4 and 2.11 provided by the applicant in the letter (UAP-HF-12239) are being tracked as a **Confirmatory Item 14.03.11-1.**

ITAAC for the CSS are provided in Section 2.11.3, Containment Spray System (CSS), Table 2.11.3-5, Items 1-12 (all items). They include the ITAAC for the interlock required to preclude the simultaneous opening of both the RHR discharge line containment isolation valves, and the corresponding containment spray header containment isolation valves. The staff found that the Table 2.11.3-5 ITAAC, if met and accepted, are adequate to ensure proper performance of these systems to meet the design requirements.

The staff reviewed the ITAAC for the following content:

- The functional arrangements of containment isolation provisions,
- The design qualification of containment isolation valves,
- The containment isolation functions of MOVs and check valves by in-situ testing,
- Containment isolation signal generation,
- Containment valve closure times,
- Containment isolation valve leakage.
- The minimum inventory of alarms, displays, and controls.

Based on review of information provided in the US-APWR DCD (Revision 3) the staff found that the US-APWR Tier 1 ITAAC entries in Section 2.11 and the ITAAC in other containment related systems in Tier 1 are acceptable because they adhere to the guidance provided for containment systems ITAAC entries contained in RG 1,206 Section C.II.1.2.11. The staff finds these ITAAC sufficient to provide 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 and applicable regulations.

14.3.11.4.6 Fluid Systems

Because the containment systems contain various fluid systems and components, the staff reviewed the US-APWR Tier 1 ITAAC entries in Section 2.11 and the ITAAC in other containment related systems in Tier 1 using the guidance provided for fluid system ITAAC entries contained in SRP Section 14.3 Appendices C and D including the applicable portions of the Fluid System Review checklist provided in Appendix C. The staff also used guidance from RG 1.206 Section C.II.1.2.6, “Fluid Systems.”

The staff has reviewed the ITAAC for piping systems. The ITAAC for Piping Systems are addressed in Section 2.3, “Piping systems and Components” with the LBB piping evaluation. ITAAC Table 2.3-2, “Piping Systems and Components Inspections, Tests, Analyses, and Acceptance Criteria,” Item 2 is for the LBB piping.

14.3.11.4.7 Electrical Systems

Because the containment systems contain various electrical components such as MOVs, the staff reviewed the US-APWR Tier 1 ITAAC entries in Section 2.11 and the ITAAC in other containment related systems in Tier 1 using the guidance provided for electrical system ITAAC entries contained in SRP Section 14.3 Appendices C and D including the applicable portions of the Electrical System Review checklist provided in Appendix C. The staff also used guidance from RG 1.206 Section C.II.1.2.6, Electrical Systems.

In **RAI 51-916, Questions 14.03.11-13**, **14.03.11-14**, and **14.03.11-15** and **RAI 222-1933, Question 14.03.11-36** (RAI 14.3.4.11-26), the staff requested the applicant to add additional Tier 1 ITAAC to verify several design functions of electrical components of containment systems. In its response to these RAIs, the applicant revised the US-APWR Tier 1 design description information. The staff has confirmed that the US-APWR DCD Tier 1, Revision 2, dated October 27, 2009 was revised as committed in the RAI responses. Accordingly, the staff finds that the applicant has addressed the issues and therefore considers **RAI 51-916, Questions 14.03.11-13**, **14.03.11-14**, and **14.03.11-15** and **RAI 222-1933, Question 14.03.11-36 resolved and closed**.

Based on review of information provided in the US-APWR DCD (Revision 3) the staff found that the US-APWR Tier 1 ITAAC entries in Section 2.11 and the ITAAC in other containment related systems in Tier 1 are acceptable, because they conform to SRP guidance provided for electrical system ITAAC entries contained in SRP Section 14.3 Appendices C and D including the applicable portions of the Electrical System Review checklist provided in Appendix C. The US-APWR Tier 1 ITAAC entries in Section 2.11 and the ITAAC in other containment related systems in Tier 1 also follow the guidance from RG 1.206 Section C.II.1.2.6, Electrical Systems.

14.3.11.4.8 Building Structures

The containment systems contain a structure, the Containment Vessel. Therefore, the staff reviewed the US-APWR Tier 1 ITAAC entries in Section 2.11 in Tier 1 using the guidance provided for building structures ITAAC entries contained in SRP Section 14.3 Appendix C including the applicable portions of the Building Structures Review checklist provided in Appendix C. The staff also used guidance from RG 1.206 Section C.II.1.2.2, "ITAAC for Structures and Systems," and RG 1.206 Appendix C.II.1.A, "General ITAAC Development Guidance." Pertinent ITAAC for the containment structure, are provided in Tier 1, Section 2.2, "Structures and Systems Engineering," with ITAAC Table 2.2-4, Items 3-5.

In **RAI 51-916, Question 14.03.11-11**, the staff requested that the applicant explain why verification of the embedment depth is not identified as an ITAAC item in Table 2.11.1-2 or indicate where the item is addressed within the supplied ITAAC. In **RAI 51-916, Question 14.03.11-12**, the staff requested that the applicant clarify if the ITAAC defined for the inspections of the as built PCCV should also refer to Table 2.2-2, which contains additional relevant parameters for verification. In its response to **RAI 51-916, Question 14.03.11-11** dated September 18, 2008, the applicant responded that DCD Table 2.11.2-2 of Tier 1 of DCD Revision 1 will be revised to ensure verification of embedment depth. In its response to **RAI 51-916, Question 14.03.11-12** dated September 18, 2008, the applicant responded that the associated tables will be revised to ensure verification of dimensions of wall thicknesses, floor slabs and foundation mat as they were defined for the building structure design for safety-related structures. The applicant subsequently reorganized Tier 1 ITAAC. The staff confirmed that DCD, Tier 1, Revision 3, dated March 31, 2011 includes ITAAC Items 1a and 1b of Table 2.2-4, "Structural and Systems Engineering Inspections, Tests, Analyses and Acceptance Criteria." These ITAAC verify the physical arrangement, dimensions of wall thicknesses, floor slabs and foundation mat of the Reactor Building, which contains the Pre-stressed Concrete Containment Vessel. Therefore, the staff considers **RAI 51-916, Questions 14.03.11-11** and **14.03.11-12 resolved and closed**.

Based on review of information provided in the DCD and the applicant's response to **RAI 51-916, Questions 14.03.11-11** and **14.03.11-12**, the staff found that the US-APWR Tier 1 containment systems and containment related systems building structures specific ITAAC entries are acceptable because they follow the guidance provided for building structures ITAAC entries contained in SRP Section 14.3 Appendix C including the applicable portions of the Building Structures Review Checklist provided in Appendix C. They also follow the guidance in RG 1.206 Section C.II.1.2.2, ITAAC for Structures and Systems, and Appendix C.II.1.A, "General ITAAC Development Guidance."

14.3.11.4.9 Protection Against Hazards

The containment systems contain a structure, the Containment Vessel. Therefore, the staff reviewed the US-APWR Tier 1 ITAAC entries in Section 2.11 in Tier 1 using the guidance provided for protection against hazards ITAAC entries contained in SRP Section 14.3 Appendix C. The staff also used guidance from RG 1.206, Appendix C.II.1.A.

The staff found that the US-APWR Tier 1 containment systems and containment related systems protection against hazards specific ITAAC entries are acceptable because they conform to the above guidance.

14.3.11.4.10 Assumptions from Transient and Accident Analyses

The staff reviewed the US-APWR Tier 1 ITAAC entries in Section 2.11 in Tier 1 using the guidance provided for incorporation of key design features that arise from safety analyses, contained in SRP Section 14.3 and the ITAAC checklist provided in Appendix C to the section. The staff also used guidance contained in RG 1,206 Section C.II.1.2.11, "ITAAC for Containment Systems."

RG 1.206 guidance and SRP Chapter 14.3 review procedure state that PRA and severe accident insights should be addressed by ITAAC. PRA insights should be identified and DCD Section 14.3 should include roadmaps for PRA, including shutdown safety analyses and severe accidents, with references to the system ITAAC where key parameters from those analyses are verified. Per DCD chapter 19.1.3.2, the PRA identified the following design/operational features for mitigating consequences of core damage and preventing release from containment:

- Containment isolation,
- Containment spray,
- Hydrogen ignition system,
- Firewater injection into reactor cavity,
- Reactor cavity flood area,
- Reactor coolant system depressurization,
- Core debris trap,
- Alternative containment cooling,
- Firewater injection to spray header.

Also, the key design features to minimize offsite dose/consequences are as follows:

- Containment spray,

- Firewater injection to spray header.

The PRA results show the safety significance of these design features. The ITAAC developed for the containment systems address some of the design features and the key parameters are included in the design commitment and in the acceptance criteria. Section 14.3.11 of the DCD discusses how PRA and severe accident insights were considered and addressed in the ITAAC provided.

In **RAI 51-916, Questions 14.03.11-10**, and **14.03.11-16**, the staff requested the applicant to clarify DCD Tier 2 Table 14.3.-1 to include PRA insights, and to justify why the hydrogen igniter design features need not be verified through ITAAC. In its response to these RAIs, the applicant revised the US-APWR Tier 2 table 14.3-1 to include insights from PRA analyses. The staff confirmed that the US-APWR DCD Tier 1, Revision 2 dated October 27, 2009 was revised as committed in the RAI responses. Accordingly, the staff finds that the applicant has addressed the issue and therefore considers **RAI 51-916, Questions 14.03.11-10**, and **Question 14.03.11-16 resolved and closed**.

Based on review of information provided in the DCD and the applicant's response to **RAI 51-916, Questions 14.03.11-10** and **14.03.11-16**, the staff found that the ITAAC related to verification of assumptions for transient and accident analysis specific to containment systems and containment related systems are acceptable because they use the guidance provided for incorporation of key design features that arise from safety analyses, contained in SRP Section 14.3 and the ITAAC checklist provided in Appendix C to the section. They also follow the guidance contained in RG 1,206 Section C.II.1.2.11, "ITAAC for Containment Systems."

14.3.11.5 Combined License Information Items

There are no Combined License Information (COL) items for Tier 2 Section 14.3.4.11. Therefore, the staff finds that there are no interface requirements for portions of the plant related to containment systems for which the application does not seek certification. Consequently, the staff finds that the requirements of 10 CFR 52.47 (a)(25), 10 CFR 52.47 (a)(26) do not apply to the containment systems ITAAC of the US-APWR design.

14.3.11.6 Conclusions

The staff has reviewed the containment systems ITAAC in the US-APWR DCD to the requirements of 10 CFR 52.47 (a)(25), 10 CFR 52.47 (a)(26) and 10 CFR 52.47 (b)(1). The staff used the acceptance criteria defined in SRP Sections 14.3 and 14.3.11, and the ITAAC related guidance in RG 1.206 Sections C.1.14.3 and C.II.1.2.11. The staff finds that the requirements of 10 CFR 52.47 (a)(25), 10 CFR 52.47 (a)(26) do not apply to the containment systems ITAAC of the US-APWR design.

Based on this review and a review of the selection methodology and criteria for the development of the Tier 1 information in Tier 2, Section 14.3 of the DCD, the staff concludes that the top-level design features and performance characteristics of the containment SSCs are appropriately described in Tier 1 (pending the confirmation of the applicant's changes to DCD Sections 2.4 and 2.11, discussed above), and the Tier 1 information is acceptable. Further, the staff finds that the Tier 1 design descriptions can be verified adequately by ITAAC. Therefore, the staff concludes that the ITAAC are necessary and sufficient for 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 and applicable regulations. Consequently the staff finds that the US- APWR containment systems design meets the requirements of 10 CFR 52.47 (b)(1).

14.3.12 ITAAC for Physical Security Hardware

14.3.12.1 Introduction

DCD Tier 2, Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria [ITAAC]," describes the methods for verifying design commitments for physical security incorporated into the US-APWR standard design. The DCD describes the engineered physical security systems, hardware, and features (referred to herein as PSS) within the scope of the US-APWR DC to establish a design standard for multiple security functions. That standard will provide, in part, the detection, assessment, communications, delay, and response functions of a physical protection system and physical protection programs that will protect against potential acts of radiological sabotage and theft of special nuclear material (SNM).

Specifically, the applicant provided the design description for physical security systems and credited design features (e.g., structural walls, floors, and ceilings, configuration of nuclear island and structures), descriptions of intended security functions and performance requirements, assumptions for detailed design, and supporting technical bases that a COL applicant referencing the US-APWR DC will incorporate by reference as part of the design and licensing bases. The US-APWR standard design, along with site-specific design of a physical protection system, 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 Title 10 of the *Code of Federal Regulations* (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 US-APWR design, are described in MHI TR UAP-SGI-08002, "US-APWR High Assurance Evaluation Assessment." MHI TR UAP-SGI-08001, "US-APWR Design Certification Physical Security Element Review," evaluates and identifies vital equipment and areas for the US-APWR standard design. The scope of the PSS described in the US-APWR standard design is limited to those related to the nuclear islands and structures. DCD Tier 2, Chapter 13, "Conduct of Operations," Section 13.6, "Security," identifies COL information items and requires the COL applicant to provide descriptions addressing the design of PSS that are outside the scope of the US-APWR standard design and descriptions of the COL applicant's physical protection programs, respectively.

The US-APWR design certification, Tier 1, Section 2.12, "Physical Security Hardware," describes the generic standard physical security ITAAC for the verification of design commitments for vital equipment, vital areas, and PSS. The COL applicant addresses the PSS that are not within the scope of the certified design—beyond the nuclear island and structures—that reference the US-APWR DC. The COL applicant will address COL Information Items 14.3(1) and 14.3(3) by describing ITAAC required for site-specific PSS credited for performing physical protection functions based on the proposed design of a physical protection system and program.

14.3.12.2 Summary of Application

DCD Tier 1: DCD Tier 1, Section 2.12, "Physical Security Hardware," Subsection 2.12.1, "Design Description," describes key elements of a physical protection system for the US-APWR standard design that provide detection, delay, and response to protect against the design-basis threat (DBT) for radiological sabotage. Table 2.12.1, "Physical Security Hardware Inspections, Tests, Analyses, and Acceptance Criteria [4 sheets]," provides the general design commitments, inspections, tests, and analyses (ITA), and acceptance criteria of PSS included in the scope of the US-APWR standard design. In addition, Section 2.7.6.10, "Communication Systems," describes interplant and plant-to-offsite communications for security-related events and plant security communication systems. Table 2.6.6.1, "Plant Lighting Systems Inspections, Tests, Analyses, and Acceptance Criteria," includes design commitments for security lighting systems.

DCD Tier 2: DCD Tier 2, Chapter 1, Section 1.2, "General Plant Description," and Section 1.2.3, "Plant Description," provide descriptions of what is within the scope of the US-APWR standard design. Section 1.8.1, "COL Information Items," Tables 1.8.1 and 1.8.2, describes protection systems interfaces, related PSS, and associated ITAAC.

The applicant describes conformance with the NRC RGs in Subsection 1.9, "Conformance with Regulatory Guide." Table Numbers (Nos.) 1.9.1-1 through 1.9.1-4, contain evaluations of conformance to regulatory guides. Conformance with Division 5, "Materials and Plant Protection," RGs are described in Table 1.9.1-3, "US-APWR Conformance with Division 5 Regulatory Guides". Table 1.9.2-13, "US-APWR Conformance with Standard Review Plan Chapter 13 Conduct of Operations" provides specific details of applicability of standard review plans (i.e., NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition") and their conformance.

DCD Tier 2, Section 13.6, "Security," and Subsection 13.6.2, "US-APWR Physical Security," of the US-APWR DCD describes PSS incorporated as part of the US-APWR physical standard design. Subsection 13.6.1, "Physical Security—Combined License," describes a comprehensive physical security program and a commitment requiring the COL applicant to provide a physical protection system and programmatic requirements that are beyond the scope of the US-APWR standard design.

DCD Tier 2, Chapter 14, "Verification Programs," describes the physical security ITAAC for design commitments that will be verified to satisfy the acceptance criteria using ITA. The following sections discuss the ITAAC within the scope of the US-APWR standard design as described in Tier 2, Chapter 14, Section 14, "Verification Programs"; Chapter 14.2, "Initial Plant Test Program"; Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria"; and Section 14.3.4.12, "ITAAC for Physical Security Hardware." In Section 14.3.6, "Combined License Information," the applicant identifies COL Information Item 14.3(3), which requires a COL applicant referencing the US-APWR DC to provide site-specific ITAAC for the facility's PSS not addressed in the US-APWR standard design.

ITAAC: The ITAAC associated with Tier 1, Section 2.12 is given in Tier 1, Section 2.12.2.

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

COL information or action items: See Section 14.3.4.12.5 below.

Technical Reports (TRs):

MHI TR MUAP-10003, "US-APWR Physical Security Hardware ITAAC Abstracts"

MHI TR MUAP-08009, "US-APWR Test Program Description"

MHI TR UAP-SGI-08002, "US-APWR High Assurance Evaluation Assessment"

MHI TR UAP-SGI-08001, "Submittal of "US-APWR Design Certification Physical Security Element Review" MHI TR UAP-SGI-08001 and TR UAP-SGI-08002, which describe the security considerations in the US-APWR design, are incorporated by reference in DCD Tier 2, Chapter 13, "Conduct of Operations," Section 13.6, "Security."

The applicant submitted MHI TR UAP-SGI-08001 and TR UAP-SGI-08002, which describe the security considerations in the US-APWR design. These TRs are incorporated by reference in DCD Tier 2, Chapter 13, "Conduct of Operations," Section 13.6, "Security." The vital equipment must be located within vital areas in accordance with 10 CFR 73.55(e)(9)(i) and verified as security-related ITAAC. The information contained in these TRs is Safeguards Information or proprietary information; therefore, it is protected in accordance with 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements," and 10 CFR 2.390, "Public Inspections, Exemptions, Requests for Withholding," respectively.

The applicant submitted MHI TR MUAP-08009, "US-APWR Test Program Description," that provides additional detailed information supporting the programs and processes established in the DCD Tier 2, Chapter 14, "Verification Programs." Specific to physical protection, the technical report, MUAP-10003, "Physical Security Hardware ITAAC Abstracts," supplements the materials provided in DCD Tier 2, Chapter 14, "Verification Programs," for US-APWR standard design.

Topical Report(s): There are no topical reports associated with this area of review.

US-APWR Interface Issues identified in the DCD: There are no US-APWR interface issues associated with this area of review.

Site Interface Requirements Identified in the DCD: There are no site interface requirements associated with this area of review.

Cross-cutting Requirements (TMI, USI/GSI, Op Ex): None identified.

RTNSS: There are no RTNSS issues for this area of review.

10 CFR 20.1406: There are no 10 CFR 20.1406 issues related to this area of review.

14.3.12.3 Regulatory Basis

The relevant requirements of the Commission's regulations for this area of review, and the associated acceptance criteria, are given in Section 14.3.12 of NUREG-0800 and are summarized below. Review interfaces with other SRP sections can be found in Section 14.3.12 of NUREG-0800.

1. 10 CFR 73.1, as it relates to the prescribed requirements for the establishment and maintenance of a physical protection system and to protect against the design basis threat of radiological sabotage.

2. 10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants,” Subpart B, “Standard Design Certifications,” regarding certification of design, limits the application of regulatory requirements that are specific to PSS within the scope of the US-APWR standard design. According to 10 CFR Part 52, Subpart C, “Combined Licenses,” 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 US-APWR standard design.

3. 10 CFR 73.55, “Requirements for Physical Protection of Licensed Activities in Nuclear Power Reactors against Radiological Sabotage,” as it relates to the requirements for physical protection of licensed activities in nuclear power reactors against radiological sabotage. In accordance with 10 CFR 73.55(b), the COL applicant must establish and maintain a physical protection system and security organization whose objective will be to provide high assurance that activities involving SNM are not inimical to the common defense and security and do not constitute an unreasonable risk to the public health and safety. A physical protection system (i.e., detection, assessment, communications, and response), with capabilities to detect, assess, interdict, and neutralize, shall be designed to protect against the DBT of radiological sabotage. In accordance with 10 CFR 73.55(b)(2), the COL applicant must establish the performance requirements to protect a nuclear power plant against the DBT for radiological sabotage as described in 10 CFR 73.1(a)(1), “Radiological Sabotage.” The COL applicant must describe how it will meet regulatory requirements, including a high assurance objective for the protection against the DBT of radiological sabotage.

4. 10 CFR 73.54, “Protection of Digital Computer and Communication Systems and Networks”; 10 CFR 73.55, 10 CFR 73.56, “Personnel Access Authorization Requirements for Nuclear Power Plants”; and 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 designs of PSS, operational security requirements, management processes, and programs.

5. 10 CFR 73.70(f), as it relates to the requirements specific to design for alarm annunciation records.

6. 10 CFR 52.47, “Contents of Applications; Technical Information,” which requires that information submitted for a DC 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.

7. 10 CFR 52.47(b)(1), which requires that a DC application include 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 DC has been constructed and will operate in accordance with the DC, the provisions of the Atomic Energy Act, and the NRC's regulations.

An applicant may apply the latest revision of the following regulatory guidance documents, TRs, and accepted industry codes, standards, or guidance, to meet regulatory requirements on Section 14.3.12, "Physical Security Hardware—Inspections, Tests, Analyses, and Acceptance Criteria (PS–ITAAC)," Revision 1, May 2010, of NUREG-0800:

1. Regulatory Guide (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 (Light-Water Reactor (LWR) Edition)," Revision 0, 2007

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 use methods or approaches for implementing NRC regulations other than those discussed in agency guidance, provided that such measures satisfy the relevant and applicable NRC regulatory requirements.

14.3.12.4 Technical Evaluation

The staff's technical review consists of determining whether the applicant adequately described and proposed physical security ITAAC that provides reasonable assurance that, if the ITA is performed and the acceptance criteria are met, a plant that incorporates the US-APWR standard design will be built and operated in accordance with the US-APWR DC. 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, or performance of selected PSS for ITAAC verification and closure, in accordance with 10 CFR 52.47(b)(1).

The PSS described in the US-APWR standard design (and those specific to a COL application) must be reliable and available to ensure performance and to meet intended security functions. The PSS are required to meet applicable performance and prescriptive requirements of 10 CFR Part 73, "Physical Protection of Plants and Materials." Within this context, the applicant addresses PSS that are within the scope of the US-APWR DC. The design and technical bases for PSS within the scope of the US-APWR DC are described in DCD Tier 2, Chapter 13, Section 13.6, and MHI TR UAP-SGI-08001 and TR UAP-SGI-08002. These documents provide the systems designs and performance requirements supporting the identified ITAAC design commitments and acceptance criteria.

The staff review also included the following applicant's responses submitted to address the staff's RAI and resulting revisions to the DCD and referenced technical reports:

- MHI to the NRC, "MHI's Response to US-APWR DCD RAI No. 52-755, Revision 0," dated September 18, 2008.
- MHI to the NRC, "MHI's Response to US-APWR DCD RAI No. 282-1984, Revision 1," dated May 15, 2009.
- MHI to the NRC, "Partial Responses to US-APWR DCD RAI No. 282-1984. Revision 1," dated June 2009.

- MHI to the NRC, "MHI's Response to US-APWR DCD RAI No. 396-2723 Revision 1," dated July 17, 2009.
- MHI to the NRC, "MHI's Response to US-APWR DCD RAI No. 481-3756 Revision 0," dated November 10, 2009
- MHI to the NRC, "MHI's Response to US-APWR DCD RAI No. 673-5085 Revision 3 (SRP 14.03.12)," December 22, 2010.
- MHI to the NRC, "Amended MHI's Response to US-APWR DCD RAI No.613-4912, Revision (13.06.02)," March 14, 2011
- MHI TR MUAP-10003, "US-APWR Physical Security Hardware ITAAC Abstracts."
- MHI TR MUAP-08009, "US-APWR Test Program Description."
- MHI TR UAP-SGI-08002, "US-APWR High Assurance Evaluation Assessment."
- MHI TR UAP-SGI-08001, "Submittal of "US-APWR Design Certification Physical Security Element Review."

14.3.12.4.1 Design Commitments, Inspections, Tests, Analyses, and Acceptance Criteria

In DCD Tier 1, Chapter 2.0, "Design Description and ITAAC," Section 2.12, "Physical Security Hardware," the applicant describes the specific design commitments for physical security systems that are within the scope of the US-APWR DC.

In DCD Tier 1, Section 1.4.3, "ITAAC Tables," the applicant describes the arrangement of ITAAC tables applicable to PSS. Consistent with safety-related ITAAC, the first column proposes design requirements or commitments extracted from the design description that must be verified. The second and third columns identify proposed methods of verifications and objective criteria that demonstrate that design requirements or commitments are met, respectively.

In DCD Tier 1, Section 2.6.6, "Plant Lighting Systems," the applicant provides design descriptions for the plant's normal and emergency lighting. Table 2.6.6-1, "Plant Lighting System Inspections, Tests, Analyses, and Acceptance Criteria [2 sheets]," includes security lighting systems. Section 2.7.5.10, "Communication Systems," and Table 2.7.6.10-1, "Communication Systems Inspections, Tests, Analyses and Acceptance Criteria," provides design descriptions and the inspections and tests for the plant's communications systems for interplant and plant-to-offsite communications during normal, transient, fire, accidents, offnormal phenomena (e.g., loss of offsite power), and security related events. The communication systems include physically independent plant security communication systems, public address system, telephone system, plant radio, and offsite communication systems.

DCD Tier 1, Section 2.12, "Physical Security Hardware," provides design descriptions for PSS that are within the scope of the US-APWR standard design to detect, assess, and delay intrusion, communicate, and assist response to protect against the design-basis threat for radiological sabotage. The design descriptions include the following:

- vital equipment and central alarm station (CAS) locations
- bullet-resistant constructions for main control room and CAS

- lock, intrusion detection, and alarm of vital areas and access points
- alarm annunciation and video assessment capabilities
- secondary security power supply systems
- supervision, tamper, and trouble indications for security alarms
- intrusion detection system capabilities and recording of functions
- communications capabilities from CAS to various locations

DCD Tier 1, Table 2.12-1, "Physical Security Hardware Inspections, Tests, Analyses, and Acceptance Criteria [4 sheets]" provides the ITAAC for the PSS that are within the scope for the US-APWR standard design. The design commitments include those related to vital equipment locations, physical barriers, physical controls and security measures for vital areas, intrusion detection, assessment, CAS and secondary alarm station (SAS), secondary power supply, access controls of vital areas, and communications meeting requirements of 10 CFR 73, "Physical Protection of Plants and Materials." The applicant indicated that the descriptions of site-specific physical protection systems design and related ITAAC are to be addressed by the COL applicant that references the US-APWR DC.

DCD Tier 1, Table 2.12-1, "Physical Security Hardware Inspections, Tests, and Analyses, and Acceptance Criteria," identified the requirements for the following PSS as outside the scope of the DC: (a) applying low-light technology in accordance with 10 CFR 73.55(i)(6)(ii)); (b) applying real-time and playback and recorded video images assessment in accordance with (10 CFR 73.55(e)(7)(i)(C)); and equal and redundant central alarm station and SAS in accordance with 10 CFR 73.55(i)(4)(ii)(H)(iii)) that has been incorporated into the revised security rule issued in March 2009. The applicant revised Table 2.12-1 to show the physical security ITAAC within the scope of the US-APWR DC and identified those reserved for a COL applicant (i.e., site-specific PSS and ITAAC). The reserved ITAAC addressing these requirements are to be addressed as site-specific information provided by a COL applicant referencing the US-APWR DC (i.e., COL Information Item 14.3(3)).

The applicant stated in DCD Tier 2, Chapter 14, Subsection 14.3.4.12, that the "standard plant physical security ITAAC are consistent with the guidance provided in the generic ITAAC in SRP 14.3.12, "Physical Security Hardware—Inspections, Tests, Analyses, and Acceptance Tests." The verification of US-APWR standard design PSS includes those described in Tier 1, Section 2.12.

The staff finds the following:

- The applicant has adequately described attributes for a physical protection system meeting design bases and security functions of detection, assessment, communications, delays, and responses as ITAAC for verification. The Tier 1 of the US-APWR DCD identified general design commitments, ITAAC that conform with those described in SRP 14.3.12 that address vital areas and vital area access controls, illumination, bullet-resistant barriers, alarm stations, secondary power supply, intrusion detection system alarm indications, display and recording, systems signal transmission line supervision and monitoring, and security communications.

The applicant has identified other PSS, such as protected area barriers; isolation zones, protected area (PA) intrusion detection; personnel, vehicles, material access control, and

personnel identification systems, which are outside the scope of the US-APWR DC. COL Information Item 14.3(1) requires a COL applicant that references the US-APWR DC to provide ITAAC for the site-specific portions of the plant systems specified in Section 14.3.5, "Interface Requirements." COL Information Item 14.3(3) requires a COL applicant that references the US-APWR DC to provide ITAAC and test abstracts that are not addressed in the DCD. The staff concludes that the identified PSS and ITAAC selected for verification, in parts within the scope of the DC, are adequate to verify and demonstrate that the construction, installation, or configurations will operate and meet intended security functions in accordance with the design bases of the US-APWR standard design.

14.3.12.4.2 Verification Programs and System Acceptance Process

In MHI TR MUAP-08009, "US-APWR Test Program Description," the applicant stated the following:

> This Technical Report supplements the US-APWR "Design Control Document," Chapter 14, Section 14.2, with a description of the administrative control program used to develop and administer the initial plant test program. This document describes the organizational structure of the test organization and organizational interfaces, test review groups, organizational responsibilities for testing, transfer of jurisdictional controls from construction to operations, the use of test specifications, development, review, approval, and closure of test procedures, and controls related to performance of testing, test results reports, and certification of test personnel.

The ITP included the structure of the test organization and interfaces with the plant operation, construction, and engineering organizations and vendors during turnover from construction, installation testing, preoperational and acceptance testing, and startup testing. In MHI TR MUAP-08009, Section 4.1, "Construction Tests," described construction acceptance tests, installation tests, and preoperational and acceptance tests. Section 4.2, "Preoperational and Acceptance Tests," described the management controls and processes that will be applied for operational and acceptance tests.

The following is a summary of the applicant's descriptions of verification process, as described in MHI TR MUAP-08009, for construction, installation, and operational verification of PSS:

- Construction Acceptance Tests: "During plant installation and erection, [Construction] performs construction acceptance tests to verify proper installation and code compliance. These tests include hydrostatic tests, HVAC integrity tests, and cable integrity tests. Some of these tests also satisfy the test requirement identified in ITAAC such as hydrostatic, pressure integrity and preoperational nondestructive examination (NDE) requirements. Construction acceptance tests are controlled by the [Construction] work control process."
- Installation Tests: "This phase of testing immediately follows turnover from [Construction] and includes: (a) verification that the plant is configured in accordance with the design by piping walk downs, equipment verifications, and electrical scheme checks; (b) component-level testing to verify functionality and controls interface, including initial energization of electrical distribution systems, motor rotation verification, instrument calibrations, control device setups, and proper functionality verification; (c) establishment of system cleanliness through flushing, air blows, and steam blows, etc., verified to meet Regulatory Guide (RG) 1.37 (Reference 12.1) cleanliness criteria; and (d) installation testing is performed using approved procedures based on equipment vendor specifications, installation/setup manuals,

applicable industry standards, engineering design, and system operating requirements. Procedures are developed for specific equipment types or repetitive activities, where possible, and used to perform testing on multiple components, with each usage documented independently. Where practical, plant maintenance procedures are used to perform these tests."

Additionally, Subsection 4.1.2 of MHI TR MUAP-08009 provided and established the performance of installation tests in preparation for acceptance tests. The applicant stated, that "[t]he specification of required installation tests is identified for each system and tracked to completion as prerequisites for preoperational and acceptance tests. This process is defined and procedurally controlled in the test administrative manual, including controls for the preparation, review, approval, closeout, and records retention of installation test procedures."

- Preoperational Tests: "Preoperational tests are procedurally controlled in the test administrative manual, including controls for the preparation, review, approval, closeout, and records retention of test procedures. Preoperational test activities which satisfy ITAAC requirements are identified."
- Acceptance Testing Program: "Acceptance testing program addresses system-level and integrated tests performed on systems and components that are outside of the scope of the initial test program (ITP)." The applicant indicated that acceptance test process is defined and procedurally controlled in the test administrative manual, preparation, review, approval, closeout, and records. Acceptance test activities that satisfy ITAAC requirements are identified.

In Section 1.0 of MHI TR MUAP-08009, the applicant provided an outline of the administrative control program used to develop and administer the Initial Test Program, as defined by Section 14.2 of the US-APWR DCD. The applicant's TR supplements the program descriptions in Section 14.2 of the DCD. However, the scope of the test program described in MHI TR MUAP-08009 is not limited to the ITP scope defined in Section 14.2 of the DCD. Specifically, Subsection 4.2.2 of MHI TR MUAP-08009 described controls for accep[illegible] system-level and integrated testing performed on systems or compone[illegible] of the ITP defined in Section 14.2 of the DCD. The descriptions of the administrative controls and responsibilities for the performance of construction acceptance tests, installation tests, and acceptance tests provided in Sections 4.1.1, 4.1.2, and 4.2.2 of MHI TR MUAP-08009 are not restricted to systems or components within the ITP scope defined in Section 14.2 of the US-APWR DCD.

Editorial Comment: Missing space between TR and MUAP-08009.

In **RAI 396-2723, Question 14.03.12-24**, the staff asked the applicant to provide clarification regarding the applicability of DCD Sections 14.2.4 through 14.2.6 for inspection and testing of non-nuclear and non-safety systems and components for satisfying physical security. Based on responses to RAI No. 52-755, No. 14.03.12-4 and No. 14.03.12-5, the staff also requested clarification to understand whether the applicant has integrated verification of security system (i.e., non-nuclear and non-safety systems) within the umbrella of its initial test program that includes a commitment to verify the design features for the facility and the balance of the plant. In its response to **RAI 396-2723, Question 14.03.12-24**, dated July 17, 2009 the applicant stated that "MUAP-08009 described and provides for the inspections and testing of non-nuclear and non-safety systems and components, including physical security systems and credited features of the US-APWR standard plant design for satisfying physical security requirements."

Editorial Comment: There is an extra "0" in the document number, it should be MUAP-08009.

In **RAI 481-3756, Question 14.03.12-30**, the staff asked the applicant to reconcile the statement in **RAI 396-2723, Question 14.03.12-24** response that "MUAP-080009 describes and provides for the inspection and testing of non-nuclear and non-safety-related systems and components, including physical security systems and credited features of the USAPWR standard plant design for satisfying physical security requirements" with the statement that "this Technical Report provides an outline of the administrative control program used to develop and administer the initial test program (ITP) as defined by Section 14.2 of the US-APWR Design Control Document (DCD). This Technical Report supplements the program description n Section 14.2 of the DCD." In its response to **RAI 481-3756, Question 14.03.12-30**, dated November 10, 2009, the applicant indicated that its response to **Question 14.03.12-24** that MUAP-08009 describes and provides for inspection and testing of non-nuclear and non-safety systems and components, including physical security systems and credited features of the US-APWR standard plant design for satisfying physical security requirements and is consistent with the response to **RAI 481-3756, Question 14.03.12-30** that MHI TR MUAP-08009 provides an "outline of the administrative control program used to develop and administer the initial test program (ITP) as defined in Section 14.2 of the DCD" for safety-related components and systems. Furthermore, the applicant indicated that revision to Subsection 14.3.4.12 of the DCD will provide specific reference and commitment to MHI TR MUAP-08009 for the testing of physical security systems.

In accordance with the applicant's response to **RAI 481-3756, Question 14.3.12-30**, dated March 4, 2010,and proposed revision to Tier 2 Chapter 14, pages 14.3-24 through 14.3-26 and 14.3-30, the applicant revised (i.e., Revision 3) DCD Tier 2, Section 14.3.4.12, to state the following:

> "System tests of physical protection design systems and related design features are performed as acceptance tests under the US-APWR Test Program Description, MHI TR MUAP-08009 (Reference 14.3-39). Tests of installed physical security hardware to verify proper installation and functionality of security hardware components are performed as construction acceptance tests and installation tests as specified in MUAP-08009 (Reference 14.3-39). The organization processes and controls for system acceptance tests, construction acceptance tests, and installation tests are as specified in TR MUAP-08009 (Reference 14.3-39). Descriptions of the specific inspections, tests, and analyses for the US-APWR physical protection systems provided in Table 2.12-1 of Tier 1 of the DCD are specified in the "US-APWR Physical Hardware ITAAC Abstracts, MUAP-10003" (Reference 14.3-40)."

The applicant's revision of DCD Tier 2 document also indicated that "[t]he COL applicant provides proposed ITAAC for the facility's physical security hardware not addressed in the DCD, in accordance with RG 1.206 (Reference 14.3-1) as appropriate, and provides abstracts describing the specific inspections, tests and analyses for the facility's physical security hardware ITAAC not addressed in the DCD." The applicant indicated that the PSS between the vital area barriers and the protected areas and owner controlled areas are outside the scope of the standard US-APWR design.

The applicant's amended response to **RAI 396-2723, Question 14.03.12-20**, dated March 4, 2010, stated the following:

- "Descriptions of the specific inspections, tests and analyses for the physical protection systems provided in Table 2.12-1 of Tier 1 of the DCD are specified in "US-APWR Physical -Security Hardware ITAAC Abstracts," MAUP 1003 (Reference

14.3.40). The ITAAC abstracts in MUAP-10003 are consistent with the test abstracts included in Subsection 14.2.12.1 with respect to format and level of detail."

- "System-level testing of plant systems that are not included in the preoperational tests defined in Subsection 14.2.12.1 is performed using acceptance tests. The scope of the preoperational test program for the US-APWR, defined in Section 14.2.1, is consistent with Regulatory Guide 1.68, Revision 3 (2007), which specifically states that the initial test program (ITP) is to verify performance of structures, systems and components (SSCs) important to safety. Plant physical security features are not considered as important to safety SSCs and are therefore outside the scope of the ITP and of the preoperational testing program."
- "Acceptance tests, and programmatic controls for acceptance tests, are described in Technical Report MUAP-08009, "US-APWR Test Program Description," Revision 1 (2009), ADAMS#093070200. This test program description technical report is to be referenced in Section 14.2 of the US-APWR DCD per the changes identified by the applicant in the letter transmitting the technical report to the NRC. "Transmittal of Technical Report "US-APWR Test Program Description," Revision 1 (MUAP-08009)," MHI Reference UAP-HF-09494 (September 26, 2009), ADAMS #ML093070197. As stated in MHI TR MUAP-08009, the test procedure format (for both preoperational and acceptance tests) is consistent with Section 14.2.3.5. Furthermore, the testing process for acceptance tests is defined and procedurally controlled in the test administrative manual, including controls for the preparation, review, approval, closeout, and records retention of test procedures."

The MHI TR MUAP-08009 described the management controls and processes for the test program that includes the following:

- Test specifications describing test objectives, prerequisites, initial conditions and plant configuration, special considerations, acceptance criteria, test methods, data collection, result evaluations, and restoring requirement, along with a process for preparation and approval procedures
- Conducting tests that include controls and processes for configuration management, coordinating tests, controls of procedures and changes, documenting performance and conduct of tests, and managing of test deficiencies
- Review, approval, closure, and documentation of test activities, which satisfies ITAAC test requirements, managing unresolved test deficiencies, test closure and records
- Certification and qualification of test personnel, to include training and supervisor qualification

The staff finds the following:

- The applicant, in MHI TR MUAP-08009, described the organizational structures of test organizations and the management controls and processes for the performance of systems acceptance testing program that addresses systems-level and integrated testing performed on PSS outside of the scope of the initial test program. The applicant has established requirements that acceptance tests are procedurally controlled, documented in the test administrative manual, and included controls for the preparations, reviews, approvals, closeouts, and records. The acceptance test activities that satisfy ITAAC requirements are identified.

- The applicant indicated that the ITA of installed PSS to verify proper installation and the performances and functions are performed as construction acceptance tests and installation tests as specified in MHI TR MUAP-08009. The organization, processes, and controls for system acceptance tests, construction acceptance tests, and installation tests are specified in MHI TR MUAP-08009.
- The system acceptance and installation test process, as described in MHI TR MUAP-08009—which the COL applicant must establish by referencing the US-APWR DCD — if adequately implemented will demonstrate through acceptance testing that all engineered systems or structures, systems, or components credited to perform physical protection functions will be available and reliable.
- The staff concludes that the applicant has appropriately established, in the US-APWR DC, the requirements that a COL applicant referencing the US-APWR certified design would establish a process that verifies PSS installation, constructions, and performance that are identified for ITAAC under verification programs and those PSS that are not specifically identified as ITAAC.

14.3.12.4.3 Test Abstracts for Physical Security Systems ITAAC

The applicant described test abstracts in MHI TR MUAP-10003, Revision 1, issued March 2011, to support ITA for verifying the identified physical security ITAAC in Tier 1 of the DCD. The applicant stated that the "ITAAC abstracts are provided in the same format used for safety-related and other plant system preoperational tests described in the US-APWR DCD Chapter 14." The test abstracts provided the framework for the development of the detailed test procedures for the conduct of inspections, tests, and analyses that will be performed and the acceptance criteria that, if met, will demonstrate that the plant incorporated the DC and the identified PSS built will operate in accordance with the DC.

The MHI TR MUAP-10003 described test abstracts consisting of objectives, prerequisites, test methods (ITA), data required, and acceptance criteria for the verification of the following PSS:

- vital area and vital area boundaries inspections
- bullet-resistant barriers
- locking devices and intrusion detection
- CAS alarm annunciation and location
- secondary security power
- security alarms tamper indication and supervision
- alarm annunciation in the CAS
- security alarm record (i.e., intrusion detection systems recording)
- vital area emergency exits
- CAS communications

The staff finds that the applicant's descriptions for elements of the test abstracts (also referred to as test protocols) for PSS (i.e., objectives, prerequisites, test methods, data required, and acceptance criteria) are adequate. The test abstracts support the DCD Tier 1 descriptions of

ITAAC for meeting 10 CFR 52.47(b)(1), which requires a DC application to contain the proposed ITAAC that are necessary and sufficient to provide reasonable assurance that inspections, tests, and analyses are performed and the acceptance criteria are met. The staff concludes that the test abstracts for PSS conform to NRC guidance provided in NUREG-0800, and are adequate and reasonable for describing the framework for developing specific ITA for the verification of PSS identified as ITAAC within the scope of the DC.

14.3.12.4.3.1 Inspections, Tests, and Analyses for Vital Areas and Vital Equipment

The applicant, in MHI TR MUAP-10003, Subsection 3.1, test abstract for ITAAC No. 1a, "Vital Area and Vital Area Boundaries Inspection," describes the inspection, test, and analysis protocol for verifying design commitments for meeting regulatory requirements and design specific requirements for the vital area. The applicant stated that the objective is to demonstrate that vital equipment is located within the vital areas protected in accordance with regulatory requirements. The applicant stated that the verification method included inspections of the installed location of vital equipment listed in "US-APWR Design Certification Physical Security Element Review," MHI TR-UAP-SGI-080001 (Reference 4-2). The acceptance criterion is the vital equipment listed is located within a vital area.

The test abstract for ITAAC No. 10.a, "Unoccupied Vital Area," states that the objectives are to demonstrate that the unoccupied vital areas are locked with activated intrusion detection systems, and to demonstrate that activated intrusion detection systems annunciate in the CAS in the event of an attempted breach of an unoccupied vital area. The test methods included testing of locking devices on penetrations into the vital areas and initiating intrusion detection alarms for indication at the CAS.

Physical security ITAAC No. 15.a, "Vital Area Emergency Exits," identified that the objective is to demonstrate that emergency exits through vital area boundaries are alarmed and secured by locking devices to allow emergency egress. The test methods identified include inspections and tests of alarm initiation and indication and the tests of locking devices.

The prerequisites identified in the test abstracts included the completion of constructions for physical barriers, protection of penetrations, installation of locking devices, intrusion detection and alarm systems, completion of CAS, etc., before verification by selected test methods. The acceptance criteria identified for the ITAAC related to the vital areas are the successful inspections and tests that verify locking, intrusion detection, and alarms in accordance with requirements of 10 CFR 73.55(e)(9)(i) through (iii).

The staff finds that the applicant has provided adequate and reasonable descriptions of the test objectives, perquisites, test methods, and acceptance criteria that support the identified ITAAC related to the vital equipment and vital areas in DCD Tier 1, Chapter 2, Section 2.12, "Physical Security Hardware," Subsection 2.12.1, "Design Description," and Table 2.12.1, "Physical Security Hardware Inspections, Tests, Analyses, and Acceptance Criteria."

14.3.12.4.3.2 Inspections, Tests, and Analyses for Alarms, System Supervision, Assessment, and Records

The applicant states in the test abstract for ITAAC No. 11.a.i and 11.b.i, "CAS Alarm Annunciation and Location," that the objectives are: (a) to demonstrate that the security alarm annunciation is available in the CAS; (b) to demonstrate that video assessment information is

available in the CAS; and (c) to demonstrate that the CAS is within the protected area and the interior of the CAS is not visible from the protected area boundary. The test methods included testing of intrusion detection systems, security alarm annunciation, and video assessment capabilities in the CAS and inspection verification of the protection of CAS. The acceptance criteria identified for the ITAAC related to the CAS are the successful inspections and tests that verify alarm indications and video assessment capabilities in accordance with prescriptive requirements of 10 CFR 73.55(i)(2) and at location of the CAS in accordance with 10 CFR 73.55(i)(4)(ii)(A).

The test abstract for ITAAC No. 13.a.i, "Security Alarms Tamper Indication and Self Check," has as the objective "to demonstrate that security alarm devices including transmission lines to annunciators are tamper indicating and self-checking." The test methods that will be applied are tests to verify tamper indication from security alarm devices and alarm system circuit self-checking functions. The acceptance criteria stated is "the security alarm devices including transmission lines to annunciators are tamper indicating and self-checking to meet the requirements of 10 CFR 73.55(i)(3)(iv) and 10 CFR 73.55(i)(3)(iv)."

The test abstract for ITAAC No. 13.b.i, "Alarm Annunciation in the CAS," identified the objectives "to demonstrate that security alarm annunciation in the CAS indicates the type of alarm and location of alarm," and "to demonstrate that intrusion detection systems provide visual display and audible annunciation in the CAS." The prerequisites identified include complete installation of security alarms, assumes completed construction of CAS and equipment in ITAAC No. 11.a.i and 11.b.i. The acceptance criteria that establish the framework for detailed acceptance criteria is that the security alarm indicates the types of alarms and their locations with visual and audible indications in accordance with requirements of 10 CFR 73.55(i)(3)(ii).

The applicant indicated in the test abstract for ITAAC No. 14, "Security Alarm Record," that the objective is to demonstrate that intrusion detection systems record onsite security alarm annunciation and disposition of each alarm. The test method identified is to test alarm system recording equipment performance for recording the types of alarms and their dispositions. The acceptance criteria includes verifying recording of types of alarms, locations of alarms, alarm circuit, dates, and time and status alarm, in accordance with 10 CFR 73.55(i)(4)(ii)(H).

The staff finds that the applicant has provided adequate and reasonable descriptions of the test objectives, perquisites, test methods, and acceptance criteria that support the identified ITAAC related to security alarms, system supervision, assessment, and intrusion detection system recording in DCD Tier 1, Chapter 2, Section 2.12, "Physical Security Hardware," Subsection 2.12.1, "Design Description," and Table 2.12.1, "Physical Security Hardware Inspections, Tests, Analyses, and Acceptance Criteria."

14.3.12.4.3.3 Inspections, Tests, and Analyses for Security Communications

The applicant indicated, in the test abstract for ITAAC No. 16.a.i, 16.b.i, and 16.c.i ,"CAS Communications," that the objectives are: (a) "to demonstrate that the CAS has conventional (landline) telephone service with local law enforcement authorities;" (b) "to demonstrate that the CAS has the capability of communication with the main control room;" (c) "to demonstrate that the CAS has the capability of continuous communication with security personnel;" and (d) "to demonstrate that non-portable communications equipment in the CAS remains operable (without disruption) during loss of normal power."

The test methods include a performance test of communications systems to verify availability of voice communications with offsite local law enforcement authorities, a test to verify communications between CAS and MCR, a test of the portable radio system and backup plant system between CAS and security personnel and defensive positions, and a test to verify continuity of communications capabilities on loss of normal power. The test method included the verification of systems capabilities for open and clear communications. The identified prerequisites include the complete installation of plant communication systems and components for assuring availability and reliability of security communications.

The acceptance criteria identified included: (a) CAS has conventional telephone service to provide open and clear communications with law enforcement authorities; (b) portable radio system is available and reliable to effectively communicate between CAS and security personnel; (c) alternative plant communication system provides for communication with the CAS and between CAS and MCR; and (d) secondary power supply allows for continued capabilities for security communications, in accordance with 10 CFR 73.55(j)(4)(i) through (4)(ii) and 10 CFR 73.55(j)(3).

The staff finds that the applicant has provided an adequate and reasonable description of the test objectives, perquisites, test methods, and acceptance criteria that support the identified ITAAC related to security communications in Tier 1, Chapter 2, Section 2.12, "Physical Security Hardware," Subsection 2.12.1, "Design Description," and Table 2.12.1, "Physical Security Hardware Inspections, Tests, Analyses, and Acceptance Criteria."

14.3.12.4.3.4 Inspections, Tests, and Analyses for Security Secondary Power Systems

The applicant indicated for ITAAC No.12, "Secondary Security Power," that the objectives are "to demonstrate that the secondary power supply for alarm annunciation equipment is located within a vital area," and "to demonstrate that the secondary security power supply for non-portable communications equipment is located within a vital area." The inspections include the locations of the secondary security power supply for alarm annunciation equipment and non-portable communications equipment. The description of acceptance criteria is that the secondary power supply for alarm system and non-portable communication equipment be located in vital areas in accordance with requirements of 10 CFR 73.55(e)(9)(vi).

The staff finds that the applicant has provided adequate and reasonable descriptions of the test objectives, perquisites, test methods, and acceptance criteria that support the verification of identified ITAAC related to security secondary power systems in Tier 1, Chapter 2, Section 2.12, "Physical Security Hardware," Subsection 2.12.1, "Design Description," and Table 2.12.1, "Physical Security Hardware Inspections, Tests, Analyses, and Acceptance Criteria."

14.3.12.4.3.5 Inspections, Tests, and Analyses for Security Lighting Systems

DCD Tier 1, Table 2.6.6-1, "Plant Lighting Systems Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 2)," describes the design commitments for the plant lighting systems, which include normal, emergency, and security lighting systems and identifies inspection of as-built for these lighting systems.

The applicant described in DCD Tier 2, Chapter 14, Subsections 14.2.12.1.42, "Emergency Lighting System Preoperational Test," and Subsection 14.2.12.1.43, "Normal Lighting Systems

Preoperational Tests," that required verifications and demonstration of capabilities for emergency and normal lighting must provide illumination of plant areas within the nuclear island or structures. In addition, Subsection 14.3.4.6, "ITAAC for Electric System," also includes verification of lighting, and the continuity of power sources for plant lighting systems, to ensure that portions of the plant lighting remain available during accident scenarios and power failures.

The illumination requirement identified in Subsection 14.2.12.1.42 for emergency lighting is a minimum of 10 foot-candles at various areas of plant operations. The minimum of 0.2-foot-candles at the ground level is a typical standard required for emergency exit, equivalent to the minimum specified for physical protection.

The verification requirements described above address the interior lighting that may be credited by security and safety program for reliability of illumination to perform required response in the event of a safety or security event. However, the applicant has not explicitly stated that plant lighting (emergency and normal) system credited for interior security lighting are verified and performed as intended for security assessment and response functions within facilities. In **RAI 673-5085**, **Question 14.03.12-31,** the staff requested the applicant to describe ITA for the illumination requirements for security within the facility. In its response to **RAI 673-5085**, **Question 14.03.12-31** dated December 22, 2010, the applicant stated that US-APWR standard plant design does not provide interior or exterior security lighting. The normal lighting systems, including battery supplied emergency lighting system, are provided for interior illumination.

The US-APWR DCD Tier 1, Section 2.6.6, "Plant Lighting Systems," provides design descriptions for the plant's normal and emergency lighting. The normal and emergency lighting systems are not specifically designed for security purposes, but may be used for security response. The applicant identified, in MHI TR MUAP-10003, the ITAAC No 5, "Isolation Zone and Exterior Protected Area Illumination," as an item to be addressed by the COL applicant referencing the US-APWR standard design. On the basis that the ITACC No. 5 focus on exterior lighting requirements for security only, the applicant clarified in the RAI response that lighting systems for interior illumination are not included. The applicant further stated that the normal and emergency lighting systems are tested under the preoperational testing program, identified in DCD Sections 14.2.12.1.43 and 14.2.12.42, for normal lighting and emergency lighting systems, respectively. The applicant stated that the preoperational tests ensure that either of these systems will be available for use by the security force as deemed necessary.

Regulations under 10 CFR 73.55(i)(6)(i) require that "the licensee shall ensure 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." Section 73.55(i)(6)(ii) requires a minimum of illumination level of 0.2-foot-candles in the isolation zones and appropriate exterior areas within the protected areas. Section 73.55(i)(6)(iii) requires the applicant to describe in the security plans how the lighting requirements for this section will be met. The applicant described design and performance requirements of security lighting within the facilities in Tier 1, Section 2.6.6, "Plant Lighting Systems," which provides design descriptions for the plant normal and emergency lighting, along with Tier 1, Table 2.6.6-1, "Plant Lighting System Inspections, Tests, Analyses, and Acceptance Criteria [2 sheets]," which includes security lighting systems, and Tier 2, Chapter 14, Sections 14.2.12.1.43 and 14.2.12.42 that address the verification of interior plant lighting systems relied on to perform normal, emergency, and security (e.g., implementing security functions and the protective strategy). In these sections, the applicant provided information that adequately and reasonably described the ITA that specifically addressed the verification of plant lighting for meeting the requirements of 10 CFR 73.55(i)(6)(i).

The staff finds the following:

- The applicant has provided adequate and reasonable descriptions of the test objectives, perquisites, test methods, required data, and acceptance criteria for plant emergency and normal lighting that may be credited to support security functions. MHI TR MUAP-10003 provided sufficient detail and support of identified ITAAC related to illumination of all areas of the facility in accordance with requirements of 10 CFR 73.55(h)(6)(i), for the interior lighting supporting security functions of assessment and response. The applicant has addressed requirement related to DCD Tier 1, Chapter 2, Section 2.12, "Physical Security Hardware," Subsection 2.12.1, "Design Description," and Table 2.12.1, "Physical Security Hardware Inspections, Tests, Analyses, and Acceptance Criteria."

- The ITA described in the test abstract provided in MHI TR MUAP-10003 for security lighting only partially address the requirement of 10 CFR 73.55(i)(6)(i). NRC **RAI 673-5085, Question 14.03.12-31**, was issued to request the applicant to indicate and describe the ITA for how illumination within facilities will be verified. The staff accepts the applicant's response submitted on December 22, 2010. The applicant described the design and performance requirements of security lighting within the facilities in DCD Tier 1, Section 2.6.6, "Plant Lighting Systems," which provides design descriptions for the plant normal and emergency lighting. DCD Tier 1, Table 2.6.6-1, "Plant Lighting System Inspections, Tests, Analyses, and Acceptance Criteria [2 sheets]," includes security lighting systems and DCD Tier 2, Chapter 14, Sections 14.2.12.1.42 and 14.2.12.43, addresses the verification of interior plant lighting systems relied on to perform security functions and implement the protective strategy.

- The staff concludes that the selected physical security system ITAAC addresses verification of the requirements of 10 CFR 73.55(i)(6)(i) and conforms to staff guidance provided in SRP 14.3.12. The verification of PSS performance meeting the requirement of 10 CFR 73.55(i)(6)(i), which includes areas within the interior of the facility, is not specifically necessary to conform to SRP 14.3.12 for physical security ITTAC, and is addressed by ITAAC identified in Table 2.6.6-1 and test abstracts in Sections 14.2.12.1.42 and 14.2.12.43.

14.3.12.4.3.6 Inspections, Tests, and Analyses for Verifying Physical Barriers

The test abstract for ITAAC No. 6.a, "Bullet Resistant Barriers for MCR and CAS," required as objectives: (a) "to demonstrate that the exterior walls, ceiling, doors and floors in the central alarm station (CAS) and the MCR are bullet resistant," and "to demonstrate that penetrations and other openings in the CAS and the MCR are bullet resistant." The prerequisites identified include the completion of construction of the structural aspects of the CAS and the MCR and availability of analysis, engineering documents, vendor documents, and type tests for minimum concrete thickness, door assemblies, penetrations, and other structural components.

The test methods required inspections and reviews of engineering and vendor documents, analyses and "type tests for exterior walls, ceiling, doors, floors, penetrations and other openings in the CAS and MCR." The applicant described the acceptance criteria that "the exterior walls, ceiling, doors and floors in the CAS and the MCR are bullet resistant to meet the requirements of 10 CFR 73.55(e)(5) and the penetrations and other openings in the CAS and the MCR are of bullet resistant materials and construction to meet the requirements of 10 CFR 73.55(e)(5) (Reference 4-3)."

The staff finds that the applicant has provided an adequate and reasonable description of the test objectives, prerequisites, test methods, required data, and acceptance criteria in MHI TR MUAP-10003 that support the identified ITAAC related to bullet resistance in Tier 1, Chapter 2, Section 2.12, "Physical Security Hardware," and Table 2.12.1, "Physical Security Hardware Inspections, Tests, Analyses, and Acceptance Criteria," for verification of the design features that will be incorporated for physical protection in the US-APWR standard design.

14.3.12.5 Combined License Information Items

Table 14.3-12 – COL Information Items Identified in DCD Table 1.8-2

Table 14.3-12
US-APWR Combined License Information Items

Item No.	Description	Section
14.3(1)	A COL applicant that references the US-APWR DC will provide ITAAC for the site-specific portion of the plant systems specified in Section 14.3.5, "Interface Requirements."	14.3.4.6, 14.3.4.7
14.3(2)	A COL applicant referencing the US-APWR DC will provide ITAAC for the facility's emergency planning not addressed in the DCD, and that is not related to security or the scope within the security review or discussions.	14.3.4.10
14.3(3)	A COL applicant referencing the US-APWR DC will provide ITAAC for the facility's physical security hardware not addressed in the DCD in accordance with RG 1.206 as appropriate, and provide abstracts describing the specific inspections, tests, and analyses for the facility's physical security hardware ITAAC not addressed in the DCD."	14.3.4.12

COL Information Items Not Identified in DCD Table 1.8 2: None.

COL Information Item 13.6(1) requires a COL applicant that references the US-APWR DC "to develop and provide a plant overall security plan (consisting of the physical security plan, safeguards contingency plan, and the guard training and qualification plan) and the cyber security plan and the implementation schedule for security programs" that will demonstrate how the performance requirements of 10 CFR 73.55(a) are met for the initial implementation of the security programs.

Additional COL information items (i.e., Nos. 13.6(2) through 13.6(5)) are identified specifically for describing a physical protection systems and programs beyond the scope of the DC. The COL applicant is to revise the nonstandard plant vital areas and vital equipment information in the reference MHI TR UAP-SGI-08001 and address site-specific design or conditions. The information from COL information items identified in Tier 2, Section 13.6, are relied on to identify key design commitments and acceptance requirements that must be verified through ITAAC for PSS constructed and installed to perform security functions as designed and relied on to implement the security programs.

DCD Tier 1, Chapter 2, Table 2.12.1 and TR MHI UAP-10003, Revision 1, identified (i.e., reserved) physical security hardware ITAAC that a COL applicant will provide. The reserved ITAAC that will be provided by a COL applicant are the following:

- ITAAC No. 1.b, Two Barriers for Access to Vital Equipment
- ITAAC No. 2.a, 2.b, and 2.c, Protected Area Barriers
- ITAAC No. 3.a, 3.b, and 3c Isolation Zone
- ITAAC No. 4.a, 4.b, and 4.c, Protected Area Perimeter Intrusion Detection System
- ITAAC No. 5, Isolation Zones and Exterior Protected Area Illumination
- ITAAC No. 6.b, Bullet Resistant Barriers for SAS and Last Access Control Function
- ITAAC No. 7, Vehicle Barrier System
- ITAAC No. 8.a and 8.b, Access Control Points
- ITAAC No. 9, Picture Badge Identification System
- ITAAC No. 11.a.ii and 11.b.ii, SAS Alarm Annunciation and Location
- ITAAC No. 11.c, Single DBT Act Does Not Disable Both CAS and SAS
- ITAAC No. 11.d, Functional Redundancy of the CAS and SAS
- ITAAC No. 11.e, SAS is Constructed, Located, Protected, and Equipped to Same Standard as CAS
- ITAAC No. 13.b.ii, Alarm Annunciation in SAS
- ITAAC No. 15.b, Protected Area Emergency Exits
- ITAAC No. 16.a.ii,16.b.ii, and 16.c.ii, SAS Communications

The staff finds the following:

- The applicant has adequately described the ITTAC outside the scope of the US-APWR DC and established clearly the ITAAC that must be addressed by a COL applicant that references the US-APWR certified design. The combined ITAAC described within the scope of the US-APWR DC and those described for fulfilling COL Information Item 14.3(3) conforms to staff guidance SRP 14.3.12, “Physical Security Hardware–Inspections, Tests, Analyses, and Acceptance Criteria (PS–ITAAC).”

- The applicant has provided an adequate and reasonable description of test abstracts supporting physical security ITAAC within the scope of the DC, and established COL Information Item 14.3(3) for a COL applicant referencing the US-APWR standard design to describe specific ITTAC and abstracts for PSS outside the scope of the US-APWR DC.

14.3.12.6 Conclusions

On the basis of its review, the staff concludes the following:

- The applicant has proposed and adequately described attributes for physical security ITAAC for verification.

- The applicant has identified an appropriate and reasonable set of design commitments, test methods (inspections, tests, or analyses), and acceptance criteria for certification of the US-APWR standard design.

- The applicant has appropriately established in the DC the requirement that a COL holder (i.e., licensee) that references the US-APWR certified design establish a process that will identify requirements, construction verifications that review the as-built systems and conditions, and compliance determination for PSS performance and acceptance tests not specifically identified as ITAAC.

- The applicant has provided adequate descriptions of elements of the test abstracts (or protocols) for PSS (i.e., objectives, prerequisites, test methods, data required, and acceptance criteria) that support Tier 1 descriptions of physical security ITAAC to meet the regulatory requirement of 10 CFR 52.47(b)(1).

- The applicant has identified appropriate and reasonable descriptions of test abstracts that establish the framework for developing the detailed test procedures for conducting ITA that will be performed and, if met, will demonstrate that the plant incorporated the certified standard design, and the identified PSS built or installed and will operate in accordance with the DC.

- The applicant has provided an adequate and reasonable description of requirements (i.e., COL Information Items 14.3(1) and 14.3(3)) for a COL applicant referencing the US-APWR standard design to describe the ITAAC for PSS that are outside the scope of the US-APWR DC.

The staff further concludes that the applicant has met 10 CFR Part 52, Subpart B, Section 52.47, which requires information submitted for a DC to 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. The applicant has met 10 CFR 52.47(b)(1), which requires a US-APWR DC application to contain the proposed ITAAC 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 US-APWR has been constructed and will operate in accordance with the US-APWR DC.