16.0 TECHNICAL SPECIFICATIONS

Section 50.36 of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50 requires that each operating license issued by the Commission contain technical specifications (TS) that set forth the safety limits (SLs), limiting safety system settings (LSSSs), limiting conditions for operation (LCOs), and other limitations on facility operation deemed necessary for the protection of public health and safety. Section 50.36(a)(2) requires, among other things, that each applicant for design certification include in its application proposed generic TS (GTS) for the portion of the plant that is within the scope of the design certification application.

Paragraph (a)(11) of 10 CFR 52.47 and paragraph (a)(30) of 10 CFR 52.79 states that a design certification (DC) applicant and a combined license (COL) applicant respectively are to propose TS prepared in accordance with 10 CFR 50.36 and 50.36a. COL applicants that reference a certified design are to propose plant-specific TS, including the GTS approved during the DC review. The COL applicant may propose deviations from the certified generic TS prior to issuance of the COL by requesting an exemption from the associated 10 CFR Part 52 appendix that codifies the certified design. A holder of a COL may propose changes to the TS in accordance with 10 CFR 50.90 in order to adopt approved changes to the standard technical specifications (STS) when such changes apply.

16.1 Introduction

This safety evaluation report chapter documents the U.S. Nuclear Regulatory Commission (NRC) staff review of the GTS proposed by the DC applicant for the United States – Advanced Pressurized Water Reactor (US-APWR) design and their associated Bases. The review is for completeness and correctness in regard to NRC requirements and guidance, and for consistency with related portions of the design control document (DCD). The US-APWR DCD provides the GTS in accordance with 10 CFR 50.36, 10 CFR 50.36a and 10 CFR 52.47(a)(11). The TS are derived from the analyses and evaluations in the DCD.

16.2 Summary of Application

DCD Tier 1: There are no DCD Tier 1 entries for this area of review.

DCD Tier 2: The applicant has provided GTS for the US-APWR in DCD Tier 2, Chapter 16, summarized here in part, as follows:

The US-APWR GTS were provided by the DC applicant, Mitsubishi Heavy Industries, Ltd. (MHI), for NRC review and approval in accordance with 10 CFR 50.36, "Technical Specifications," and 10 CFR 50.36a, "Technical Specifications on Effluents from Nuclear Power Reactors." In its application, MHI stated that the US-APWR GTS were developed utilizing Revision 3.1 of the Westinghouse STS, NUREG-1431.

In accordance with 10 CFR 50.36(a), MHI also provided a "Bases" document in Chapter 16B of the US-APWR DCD that included a summary statement of the Bases (underlying considerations) for such TS. Consistent with this requirement, Bases were not provided for Section 1.0 "Use and Application," Section 4.0 "Design Features," and Section 5.0 "Administrative Controls," as is appropriate.

In its application, MHI also stated that the US-APWR DCD was prepared using the guidance in NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants,” and to the extent applicable for DC, the DCD was prepared using Regulatory Guide (RG) 1.206, Revision 0, “Combined License Applications for Nuclear Power Plants (LWR Edition),” as a guide for format and content.

The US-APWR design is a basic, four-loop, pressurized-water reactor (PWR) with a primary system design, loop configuration, and main components similar to those of currently operating PWRs. The US-APWR design contains unique design features, including four redundant trains of emergency core cooling (including uniquely designed cold-leg accumulators), advanced fuel design, an integrated digital instrumentation and control (I&C) system for the reactor protection system and the engineered safety feature actuation system (ESFAS), and a core melt retention system for severe accident mitigation. The applicant described its compliance with 10 CFR Part 50, Appendix A, “General Design Criteria for Nuclear Power Plants,” in DCD Section 3.1. MHI’s conformance with RG’s and the Standard Review Plan (SRP) is described in DCD Section 1.9. A listing of the key operating parameters is provided in DCD Section 1.3.

Inspection, Test, Analysis, and Acceptance Criteria (ITAAC): There are no ITAAC for this area of review.

TS: TS are given in DCD Tier 2, Chapter 16.

16.3 Regulatory Basis

The relevant requirements of the NRC’s regulations for this area of review, and the associated acceptance criteria, are given in Chapter 16 of NUREG-0800, the SRP, and are summarized below. Review interfaces with other SRP sections can be found in Chapter 16 of NUREG-0800.

Section 182a of the Atomic Energy Act of 1954 (AEA), as amended, requires that applicants for nuclear power plant operating licenses will state:

> such technical specifications, including information of the amount, kind, and source of special nuclear material required, the place of the use, the specific characteristics of the facility, and such other information as the Commission may, by rule or regulation, deem necessary in order to enable it to find that the utilization of special nuclear material will be in accord with the common defense and security and will provide adequate protection to the health and safety of the public. Such technical specifications shall be a part of any license issued.

In 10 CFR 50.36, the NRC established its regulatory requirements related to the content of TS. In doing so, the NRC placed emphasis on those matters related to the prevention of accidents and the mitigation of accident consequences. As recorded in the Statements of Consideration, “Technical Specifications for Facility Licenses; Safety Analysis Reports” (33 *Federal Register* (*FR)* 18610, December 17, 1968), the NRC noted that applicants were expected to incorporate into their TS “...those items that are directly related to maintaining the integrity of the physical barriers designed to contain radioactivity.” Accordingly, 10 CFR 50.36(c) requires that TS contain (1) safety limits and limiting safety system settings, (2) limiting conditions for operation, (3) surveillance requirements, (4) design features, and (5) administrative controls.

Paragraph (c)(2)(ii) of 10 CFR 50.36 requires that a LCO be established in TS for each item meeting one or more of the following four criteria:

- Criterion 1 - Installed instrumentation that is used to detect, and indicate in the control room, a significant abnormal degradation of the reactor coolant pressure boundary (RCPB).

- Criterion 2 - A process variable, design feature, or operating restriction that is an initial condition of a design-basis accident (DBA) or transient analysis that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.

- Criterion 3 - A structure, system, or component (SSC) that is part of the primary success path and which functions or actuates to mitigate a design-basis accident or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.

- Criterion 4 - An SSC shown by operating experience or a probabilistic safety assessment to be significant to public health and safety.

In accordance with 10 CFR Part 50, Appendix A, General Design Criteria (GDC) 17, 21, 34, 35, 38, 41, and 44, those SSCs shown to be significant to public health and safety need to have sufficient independence, redundancy, and testability to perform their safety functions.

Section 50.36a, "Technical Specifications on Effluents from Nuclear Power Reactors," of 10 CFR Part 50 requires that TS contain procedures for control of radioactive effluents.

Paragraph (a)(11) of 10 CFR 52.47 requires that a DC applicant propose TS prepared in accordance with 10 CFR 50.36 and 50.36a.

For the reasons discussed in detail below, the acceptance criteria adequate to meet the above requirements are included in the STS documents. The STS for PWRs are contained in three NRC documents. For each document, Volume 1 contains the TS, and Volume 2 contains the associated TS Bases. The STS include Bases for SLs, limiting safety system settings, LCOs, and associated action and surveillance requirement (SR). For the reasons discussed below, documents applicable to the US-APWR include:

- NUREG-1431, "Standard Technical Specifications Westinghouse Plants"

The STS reflect the detailed effort used to apply the criteria discussed in the Interim Policy Statement on Technical Specifications Improvements for Nuclear Power Reactors (52 FR 3788, February 6, 1987) to generic system functions, which were published in a "Split Report" and issued to the nuclear steam supply system (NSSS) vendor owners groups in May 1988. In addition, extensive discussions during the development of the STS were used to ensure that the application of the TS criteria and the Writer's Guide would consistently reflect detailed system configurations and operating characteristics for all NSSS designs. As such, Bases documents include an abundance of information regarding the STS model requirements necessary to protect public health and safety.

On July 22, 1993, the NRC issued its Final Policy Statement (58 *FR* 39132), expressing the view that satisfying the guidance in the policy statement also satisfies Section 182a of the AEA and 10 CFR 50.36. In the final policy statement, the NRC described the safety benefits of the STS and encouraged licensees, to the extent applicable, to use the STS for plant-specific TS (PTS) amendments and for complete conversions to improved TS. Major revisions to the STS were published in 1995 (Revision 1), 2001 (Revision 2), and 2004 (Revision 3).

The format and content for GTS and Bases prepared for a DC should use STS and applicable Bases to the extent possible, notwithstanding design-specific characteristics. As is appropriate, deviation from the STS, as well as design-specific characteristics, should be technically justified by an applicant and reviewed in detail by the NRC prior to approval.

The following pending STS generic changes, known as Technical Specification Task Force (TSTF) travelers, are considered needed improvements or corrections to existing STS, and need to be considered in the development of GTS and PTS:

- TSTF-448-A, Revision 3, "Control Room Habitability"
- TSTF-449-A, Revision 4, "Steam Generator Tube Integrity"
- TSTF-471-A, Revision 1, Eliminate use of term CORE ALTERATIONS in ACTIONS and Notes
- TSTF-479-A, Revision 0, Changes to Reflect Revision of 10 CFR 50.55a
- TSTF-482-A, Revision 0, Correct LCO 3.0.6 Bases
- TSTF-485-A, Revision 0, Correct Example 1.4-1
- TSTF-497-A, Revision 0, Limit Inservice Testing Program SR 3.0.2 Application to Frequencies of 2 Years or Less
- TSTF-490, Revision 0, "Deletion of E Bar Definition and Revision to RCS Specific Activity"

16.4 Technical Evaluation

The staff reviewed and evaluated the GTS and Bases to verify their accuracy and completeness. The staff also reviewed the GTS to confirm the appropriateness of the restrictions imposed by the GTS to ensure that an operating US-APWR will operate within its SLs and LSSSs, as described in the final safety analysis report (FSAR). The GTS must ensure that a plant designed and constructed in accordance with the US-APWR design will be operated so as to maintain the validity of the analyses in the FSAR during the operating lifetime of the plant. In particular, the GTS must require a US-APWR licensee to take specified actions, up to and including shutting down the plant, if one or more SSCs are not functioning as designed, such that the plant may not respond as predicted in the FSAR, including the accident analyses in FSAR Tier 2, Chapter 15. In addition, the GTS must include provisions to govern every SSC that meets one or more of the four criteria in 10 CFR 50.36(c)(2)(ii).

As described in more detail below, the staff verified the adequacy of the GTS primarily by comparing them with the STS developed for the operating fleet of power reactors. For the current operating fleet of power reactors, the staff developed STS applicable to the designs of each of the four vendors, namely, Westinghouse, Combustion Engineering, Babcock and Wilcox and General Electric. The STS for the designs of these four vendors represent guidelines for model TS for a 4 Loop PWR, a 2 Loop PWR, a 2 Loop PWR with once through Steam Generators (SG), and a Boiling Water Reactor (BWR) design, respectively. These STS are found in NUREG-1431, "Standard Technical Specifications − Westinghouse Plants," NUREG-1432, "Standard Technical Specifications Combustion Engineering (CE) Plants," NUREG-1430, "Standard Technical Specifications − Babcockand Wilcox Plants," and

NUREG-1434, "Standard Technical Specifications − General Electric Plants (BWR/6)," respectively. The staff developed each of these sets of STS by generically applying the criteria of 10 CFR 50.36(c)(2)(ii) to the SSCs included in the respective designs. Whether any set of STS is adequate to govern the operation of a particular power reactor cannot be determined without an evaluation of the TS as applied to the SSCs of the particular plant, considering the design as a whole. Currently, 75 of the 104 units of the operating fleet of nuclear plants use the STS, in whole or in part; the majority of these units use the Westinghouse STS in NUREG-1431.

While the staff has not approved the STS on a generic basis, it has implicitly approved them on a case-by-case basis through staff review of license amendment requests in which licensees of currently operating reactors have proposed to incorporate STS provisions in the existing custom TS (CTS) in their operating licenses. Some amendments have involved adoption of applicable STS on an item-by-item basis, while others have involved entire conversions of a plant's CTS to improved TS incorporating most, if not all, of the STS applicable to the particular design involved. The staff has evaluated and confirmed the adequacy of the model STS to ensure that particular plant SSCs will be operated in accordance with the analyses in individual plant FSARs in the context of these amendment requests. In addition, licensees of currently existing plants have employed STS pursuant to amendment requests granted by the NRC to govern the operation of their plants, and the staff has not identified any adverse effect on plant safety due to the adoption of the STS. Accordingly, the STS can be used as a model for the GTS to govern the operation of SSCs to the extent the US-APWR SSCs are similar in design and function to those governed by the STS. Use of the STS as guidance for the evaluation of the GTS in this manner will allow the staff to determine whether the operation of SSCs in accordance with the GTS will assure that the analyses in the FSAR for these SSCs remain valid during plant operation.

Since the US-APWR design is a 4 Loop PWR, it is most similar to the Westinghouse design. The Westinghouse and US-APWR designs have SSCs with similar names and functions. Both the US-APWR design and the Westinghouse design, which provides a model set of STS, use systems with 100 percent trains. For systems for which the FSAR specifies a long accident response time, the 4 Loop PWR Westinghouse design is composed of two, 100 percent trains, as is the US-APWR design. For systems for which the FSAR specifies a short accident response time, however, the Westinghouse design is composed of two, 100 percent trains, while the US-APWR is composed of four, 50 percent trains. Despite the US-APWR design provisions for four, 50 percent trains for systems with short accident response times, the US-APWR is sufficiently similar to the Westinghouse design. In view of its 4 Loop PWR design and the similarity of the design and function of many of its SSCs to the SSCs of a Westinghouse 4 Loop design, so that the Westinghouse STS in NUREG-1431 can be applied as guidance in evaluating most of the US-APWR GTS.

In some instances, detailed information regarding site-specific design features, equipment selection, instrumentation settings, or other plant/site-specific characteristics is needed to establish the provisions to be included in the PTS. Locations for this site-specific information are signified by "square brackets" to indicate where US-APWR COL applicants must provide plant-specific values or alternative text. COL applicants must also include technical justification for the site-specific information provided in their applications. This includes COL Information Item 16-1, located in the US-APWR DCD Chapter 1, Table 1.8-2.

In addition, the US-APWR GTS contain "Reviewer Notes" stating conditions that an applicant (or licensee) must satisfy in order to adopt a particular TS provision; e.g., incorporation of an NRC-approved methodology into a plant's licensing basis, or a staff determination that a licensee's probabilistic risk assessment (PRA) is of adequate scope and quality.

A comparison of the US-APWR GTS and Bases with NUREG-1431, the STS for Westinghouse plants, and the evaluation of any differences between the two is provided in Sections 16.4.1.0 through 16.4.5.0.

16.4.1.0 Use and Application

Introduction

The US-APWR GTS, Section 1.0, "Uses and Applications," provides the definitions for terms; explains the logical connectors; establishes "the Completion Time" convention (*i.e.*, the time within which a particular LCO requires completion of an identified action, given the operability status of the equipment governed by the LCO); and defines the proper use and application of surveillance frequency requirements utilized throughout the US-APWR GTS.

Evaluation

In general, the US-APWR GTS, Section 1.0, is modeled after NUREG-1431, "Westinghouse Standard Technical Specification," Section 1.0, "Uses and Applications." Although the GTS, Section 1.0, closely models the STS in format and content, the staff noted the following differences that warranted clarification beyond what was given in Section 1.0 of the GTS:

- In Subsection 1.1, "Definition of Terms," MHI proposed to expand the definitions of several existing terms listed in the Westinghouse STS to account for testing of the new digital I&C components and systems used in the US-APWR design. In Requests for Additional Information (RAIs) 16-118, 16-121, 16-122 and 16-123, the applicant was asked to provide further clarification for the additional text. In its response letter, dated February 20, 2009, the applicant proposed to revise the new text to clearly define the scope of testing for respective analog and digital components. Refer to Subsection 14.6.3.3 below for applications of these tests on instrumentation systems. The staff finds this response acceptable, and confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to, in the RAI response; therefore RAIs 16-118, 16-121, 16-122 and 16-123 are considered resolved. MHI also proposed to delete other terms that are applicable to equipment in the Westinghouse design that do not exist in the US-APWR design, e.g. Master and Slave Relay Tests. The staff finds these omissions acceptable.

- In Subsection 1.3, "Completion Times," MHI added a new example to show the application of the newly proposed Configuration Risk Management Program (CRMP). In RAI 16-134, the applicant was asked to justify the format used in lieu of that proposed in the NRC approved guidance, provided in Nuclear Energy Institute (NEI) 06-09, which establishes the text content for the Required Actions and associated Completion Times. In its response letter dated January 20, 2009, the applicant stated that their proposed example offers more flexibility and ease of implementation of the same set of rules, repeatedly in many different places in the US-APWR GTS. The staff finds the stated approach reasonable and acceptable since the Required Actions and associated Completion Times are clearly stated in a consistent format; therefore, RAI 16-134 is considered resolved.

- Also, in RAI 16-117, the applicant was asked to describe the process used and the results of applying Criterion 4 of 10 CFR 50.36(c)(2)(ii) to identify the SSCs and parameters for which LCOs were included in the US-APWR GTS. In its response letter dated March 19, 2009, the applicant provided details of a two-step process which involves, first, selection of risk-important SSCs, and then application of a set of screening criteria (qualitative) to each risk-important SSC on this list to determine if a TS LCO should be established for its operation. The applicant confirmed that the US-APWR GTS TS LCOs cover all risk-important SSCs, as necessary, but further stated:

  > "Disposition of each risk-important SSC that will not be included in the TS LCO, will be presented in the face to face meeting scheduled in mid-April 2009."

  At the April 14, 2009, meeting, MHI informed the staff that it was not prepared to discuss the disposition of risk-significant SSCs that were not placed in TS. This issue remains as an open item (OI-SRP-16-CTSB-1769/117).

The remaining portions of US-APWR GTS Section 1.0 are similar to the applicable STS such that the staff finds them acceptable.

There is one Open Item in Section 1.0 of the US-APWR DCD, Revision 1:

OI-SRP-16-CTSB-1769/117

Conclusion

The applicant adhered to the definitions for terms, logical connectors, conventions for completion times, and frequency requirements as provided in the Westinghouse STS, with some differences as noted above. Therefore, except for the open item described above, the staff finds that Section 1.0 of the US-APWR GTS is acceptable.

16.4.2.0 Safety Limits

Introduction

Section 2.0 of the US-APWR GTS and Bases include requirements for SLs, to ensure that the fuel design limits are not exceeded during steady-state conditions, normal operational transients and anticipated operational occurrences (AOO).

Evaluation

The US-APWR GTS, Section 2.0, is modeled after Section 2.0 of the STS for Westinghouse plants, and contains three reactor core SLs, namely: departure from nucleate boiling ratio (DNBR), peak fuel centerline temperature, and reactor coolant system (RCS) pressure.

In RAI 1814, Question 16-100, the staff requested the applicant to justify the safety limit of 2735 psig as the maximum RCS pressure allowed. Table 5.2.2-1 of the FSAR states the design pressure of the RCS system is 2485 psig. This pressure yields a 110 percent value (maximum allowed for RCS pressure vessel per ASME Code, Section III) of 2733.5 psig. Therefore, a safety limit of less than or equal to 2735 psig would exceed the maximum pressure allowed by the ASME Code. In a 2/20/2009 dated response, the applicant stated the RCS pressure safety limit would be revised to 2733.5 psig to be in alignment with the ASME Code. The staff finds this response acceptable and has verified that the changes have been accurately incorporated into Revision 2 of the DCD. Therefore, the staff considers RAI 1814, Question 16-100 closed.

The methodologies for the derivation of peak fuel centerline temperature is contained in Section 4.4.1.2 - Fuel Temperature of the DCD, and their acceptability is evaluated in Section 4.4.1 of this report.

The methodologies for the derivation of the departure from nucleate boiling ratio (DNBR) and the correlations used are contained in Section 4.4.2.2.1 – DNB Correlation and Analysis of the DCD. The acceptability of these methodologies and correlations is evaluated in Section 4.4.2 of this report.

Conclusion

The applicant adhered to the SL information as provided in the Westinghouse STS. In addition, the US-APWR GTS, Section 2.0, and its Bases do not contain any “bracketed information” or “Reviewer’s Notes.” Therefore, and in view of the foregoing, the staff finds that Section 2.0 of the US-APWR GTS and Section B 2.0 of the US-APWR Bases are acceptable.

16.4.3.0 LCO Applicability and SR Applicability

Introduction

The US-APWR GTS, Section 3.0, and Bases, Section B 3.0, “LCO Applicability and SR Applicability,” include the general provisions regarding determination of equipment operability and performance of SRs used throughout the GTS, Sections 3.1 through 3.9.

Evaluation

In general, the US-APWR GTS, Section 3.0, is modeled after Section 3.0 of the STS for Westinghouse plants. Although the GTS, Section 3.0, closely models the STS in format and content, the staff noted differences regarding LCO 3.0.6 that warranted clarification beyond what was given in Section 3.0 of the GTS and its applicable Bases.

- In RAI 16-128, the applicant was asked to provide clarifications on these differences between the US-APWR GTS and the STS. In its response letter dated February 4, 2009, the applicant revised the affected information in the US-APWR GTS Bases to remove the noted differences. The staff finds this response acceptable, and confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to, in the RAI response. Therefore, RAI 16-128 is considered resolved.

Conclusion

The applicant adhered to the LCO information as provided in the Westinghouse STS. In addition, the US-APWR GTS, Section 3.0, and its Bases do not contain any "bracketed information" or "Reviewer's Notes." Therefore, the staff finds that Section 3.0 of the US-APWR GTS and Section B 3.0 of the US-APWR Bases are acceptable.

16.4.3.1 Reactivity Control Systems

Introduction

Section 3.1 of the US-APWR GTS and Bases include requirements for the reactivity control systems, which are designed to reliably control reactivity changes and ensure that the capability to cool the core is maintained under accident conditions.

Evaluation

In general, Section 3.1 of the US-APWR GTS is modeled after Section 3.1 of the STS for Westinghouse plants, with one difference within the Physics Test program. The US-APWR GTS, Section 3.1, Reactivity Control Systems, corresponds to the Westinghouse STS (Revision 3.1) in the following manner:

STS	US-APWR GTS	TITLE (*STS TITLE, if different)
3.1.1	3.1.1	Shutdown Margin
3.1.2	3.1.2	Core Reactivity
3.1.3	3.1.3	Moderator Temperature Coefficient
3.1.4	3.1.4	Rod group Alignment Limits
3.1.5	3.1.5	Shutdown Bank Insertion Limits
3.1.6	3.1.6	Control Bank Insertion Limits
3.1.7	3.1.7	Rod Position Indication
---	3.1.8	Physics Tests – Mode 1
3.1.8	3.1.9	Physics Tests – Mode 2

The US-APWR GTS contains Section 3.1.8 Physics Tests – Mode 1, while the Westinghouse STS, Revision 3.1, does not contain this section. For this TS, the applicant conformed to the Westinghouse STS, Revision 1.0, which does contain a section for Physics Testing in Mode 1.

Section XI of 10 CFR Part 50, Appendix B requires that a test program be established to ensure that SSCs will perform satisfactorily in service. To accomplish this objective, testing is performed prior to initial criticality, during startup, during low power operations, during power ascension, at high power, and after each refueling. The physics test requirements for reload fuel cycles ensure that the operating characteristics of the core are consistent with the design predictions and that the core can be operated as designed.

Regarding this matter, the staff has issued guidance in RG 1.68 – Initial Test Programs for Water-Cooled Nuclear Power Plants, which contains physics test information in Appendix A. Section 14.2 of the DCD defines requirements for initial testing of the facility, including a summary of the physics tests to be performed and a conformance matrix to RG 1.68, Appendix A. The DCD matrix indicated that the US-APWR design conforms to RG 1.68 with respect to physics tests.

Load fuel cycle physics test are defined in ANSI/ANS-19.6.1-2005 – Reload Physics Test Requirements for Pressurized Water Reactors. This ANSI code contains a detailed description of the physics tests performed and is a widely used tool throughout industry. The physics test descriptions from the ANSI code are those referenced throughout the Bases portions of the Westinghouse STS, which the NRC staff has accepted as adequate, as described above. Since the US-APWR TS reference this ANSI code for the same purpose it is referenced in the Westinghouse STS, it is acceptable.

Therefore, the staff finds that the physics test program is acceptable.

Conclusion

The applicant adhered to the Reactivity Control Systems information as provided in the Westinghouse STS, utilizing both Revision 1.0 and 3.1. In addition, the US-APWR GTS, Section 3.1 and its Bases do not contain any "bracketed information" or "Reviewer's Notes" other than those associated with the option to implement the newly proposed CRMP and Surveillance Frequent Control Program (SFCP) as referenced in TS 5.5.18 and 5.5.19. Therefore, the staff finds that Section 3.1 of the US-APWR GTS and Section B 3.1 of the US-APWR Bases are acceptable.

16.4.3.2 Power Distribution Limits

Introduction

Section 3.2 of the US-APWR GTS and Bases include requirements for power distribution limits, which are designed to ensure that in-core conditions during reactor operation reliably remain within core thermal limits with necessary margin and to achieve core power distribution within the bounds of the design safety analysis.

Evaluation

In general, Section 3.2 of the US-APWR GTS is modeled after Section 3.2 of the STS for Westinghouse plants in format and content. The US-APWR GTS, Section 3.2, Power Distribution Limits, corresponds to the Westinghouse STS in the following manner:

STS	US-APWR GTS	TITLE (*STS TITLE, if different)
3.2.1C	3.2.1	Heat Flux Hot Channel Factor (CAOC Methodology)
3.2.2	3.2.2	Nuclear Rise Enthalpy Hot Channel Factor
3.2.3A	3.2.3	Axial Flux Difference (CAOC Methodology)
3.2.4	3.2.4	Quadrant Power Tilt Ratio

The methodologies for the derivation of the quanities governed by the above listed US-APWR GTS are contained in Section 4.3.2.2 – Power Distribution of the DCD, which includes Sub-sections 4.3.2.2.1 – Power Distribution Characteristics, 4.3.2.2.2 – Limiting Power Distribution, and 4.3.2.2.3 – Power Distribution Monitoring and Experimental Verification. There is additional discussion of the US-APWR GTS 3.2.1 and 3.2.2 in Section 4.4.2.2.2 – Hot Channel Factors of the DCD. The acceptability of these methodologies is evaluated in the corresponding sections of this report.

Conclusion

The applicant adhered to the Power Distribution Limits information as provided in the Westinghouse STS. In addition, the US-APWR GTS, Section 3.2, and its Bases do not contain any "bracketed information" or "Reviewer's Notes" other than those associated with the option to implement the newly proposed CRMP and SFCP as referenced in TS 5.5.18 and 5.5.19. Therefore, the staff finds that Section 3.2 of the US-APWR GTS and Section B 3.2 of the US-APWR Bases are acceptable.

16.4.3.3 Instrumentation

Introduction

The US-APWR GTS, Section 3.3, and Bases, Section B 3.3, "Instrumentation," include requirements for instrumentation systems that (1) initiate reactor trip and engineered safety features (ESF) actuations, (2) provide information relied upon by operators to evaluate plant safety status and perform manual actions specified in emergency operating procedures (EOPs), (3) provide operators with the capability to place and maintain the plant in a safe shutdown condition from a location outside the control room, (4) initiate Class 1E gas turbine generator (GTG) start signals upon a loss of voltage or degraded-voltage condition in the switchyard, and (5) provide non-Class 1E diverse instrumentation for monitoring, control and actuation of safety and non-safety systems called upon to cope with abnormal plant conditions concurrent with a common cause failure that disables all functions of the Protection and Safety Monitoring System (PSMS) and Plant Control and Monitoring System (PCMS). The US-APWR GTS, Section 3.3, "Instrumentation," corresponds to the Westinghouse STS in the following manner:

STS	US-APWR GTS	TITLE (*STS TITLE, if different)
3.3.1	3.3.1	Reactor Trip System (RTS) Instrumentation
3.3.2	3.3.2	ESFAS Instrumentation
3.3.3	3.3.3	Post Accident Monitoring (PAM) System
3.3.4	3.3.4	Remote Shutdown Console (RSC), (*Remote Shutdown System)
3.3.5	3.3.5	Loss of Power (LOP) Class 1E GTG Start Instrumentation (*LOP Diesel Generator (DG) Start Instrumentation)
---	3.3.6	Diverse Actuation System (DAS) Instrumentation
3.3.6	---	Containment Purge and Exhaust Isolation Instrumentation
3.3.7	---	CREFS Actuation Instrumentation
3.3.8	---	Fuel Building Air Cleanup System (FBACS) Actuation Instrumentation
3.3.9	---	Boron Dilution Protection System

STS 3.3.6 and STS 3.3.7 are included in US-APWR GTS 3.3.2. STS 3.3.8 and STS 3.3.9 are not relevant to the US-APWR GTS. STS 3.3.8 does not apply because the fuel handling accident (FHA) analysis, as described in APWR DCD Section 15.7.4 for a postulated accident in the spent fuel storage area, does not credit the removal of gaseous iodine by a safety-related filtration system similar to the one currently used in Westinghouse PWR plants in the United States (U.S.), for mitigation of dose consequences to the public. STS 3.3.9 does not apply because the boron dilution event analysis, as described in APWR DCD Section 15.4.6, credits operator action as the means to terminate dilution flow. An inadvertent decrease in boron concentration in the RCS is classified as an AOO. The boron dilution event, which is evaluated in all modes of operation, can occur due to the addition of low-boron-concentration water into the RCS resulting from either a malfunction or improper operation of the chemical and volume control system (CVCS). The CVCS design inherently limits the maximum boron dilution rate so boron dilution transients proceed relatively slowly. This slow rate, together with alarms and trips that alert the operator to an unplanned moderator dilution, ensure that sufficient time exists so

that reactivity transients can be terminated by manual action to prevent criticality or a return to criticality.

Evaluation

In general, Section 3.3 of the US-APWR GTS is modeled after Section 3.3 of the STS for Westinghouse plants, with differences to reflect US-APWR unique design features, most notably, the four train safety-related I&C design, the analog diverse instrumentation and control system, and the fully digital Mitsubishi Electric Total Advanced Controller (MELTAC) I&C platform.

Although the US-APWR GTS, Section 3.3, models the STS to the greatest extent possible, the staff noted differences that require technical justification and clarification beyond what is given in Section 3.3 of the GTS and its Bases. Additional information has been requested for each of the following items in order to evaluate the adequacy and completeness of the US-APWR GTS, Section 3.3, and Bases, Section B 3.3. Details regarding the responses associated with RAIs 166-1784 (Questions 16-158 through 16-195), and 167-1769 (Questions 16-196 through 16-297) are described below:

- In RAI-SRP-16-CTSB-1769/205, the staff requested an explanation for why the NOTE in Condition F (LCO 3.3.1) only applied to the High Power Range Neutron Flux instrumentation. The NOTE, which was revised as described in the response to Question 16-206 to address not only this issue, but the fact that the US-APWR PSMS has installed bypass test capability, conflicts with another revision to the NOTE as described in the response to RAI 166-1784, Question 16-161. [In Question 16-161, the staff requested a justification for the NOTE allowing an inoperable channel to be bypassed for up to 12 hours for surveillance testing]. In a teleconference on May 13, 2009, the applicant acknowledged the conflict resulting from separate revisions to the NOTE, and agreed to make the necessary changes. At the staff's request, the applicant also agreed to: (1) clarify the proposed Bases discussion provided in the response to Question 16-205 by identifying the actual functions in lieu of the phrase "PR Neutron Flux Change Rate," and (2) add the proposed Bases discussion to the individual Bases sections for each of the identified functions rather than to the Bases for ACTIONS F.1 and F.2. Verification that the referenced changes are correct and properly incorporated into the US-APWR DCD is Confirmatory Item CI-SRP-16-CTSB-1769/205.

- In RAI-SRP-16-CTSB-1769/206, the staff requested an explanation regarding the exclusion of NOTE-related information associated with installed bypass test capability from Conditions E, F and L of LCO 3.3.1. Although the NOTES for each of the stated conditions were revised to reflect the fact that the US-APWR PSMS does have installed bypass test capability, the following discrepancies were noted based on evaluation of the response:

    - Condition E Bases do not incorporate the REVIEWER'S NOTE text contained in the Bases of comparable Condition D of NUREG-1431, Page B 3.3.1-37. In a teleconference on May 13, 2009, the applicant acknowledged the staff's concerns and agreed to revise the Bases accordingly.

- Condition F NOTE revision conflicts with another revision to the NOTE as described in the response to RAI 166-1784, Question 16-161. This issue was previously identified in RAI-SRP-16-CTSB-1769/205. Verification of conflict resolution is covered under Confirmatory Item CI-SRP-16-CTSB-1769/205.

- Condition F Bases does not incorporate the REVIEWER'S NOTE text contained in the Bases of comparable Condition E of NUREG-1431, Page B 3.3.1-39. In a teleconference on May 13, 2009, the applicant acknowledged the staff's concerns and agreed to revise the Bases accordingly.

- Condition L NOTE revision conflicts with another revision to the NOTE as described in the response to RAI 166-1784, Question 16-162. In Question 16-162, the staff requested a justification for the NOTE allowing an inoperable channel to be bypassed for up to 12 hours for surveillance testing of other channels except for Pressurizer Pressure, Pressurizer Level, and SG Water Level. In a teleconference on May 13, 2009, the applicant acknowledged the conflict resulting from separate revisions to the NOTE, and agreed to make the necessary changes.

- Condition L Bases does not incorporate the REVIEWER'S NOTE text contained in the Bases of comparable Condition K of NUREG-1431, Page B 3.3.1-42. In a teleconference on May 13, 2009, the applicant acknowledged the staff's concerns and agreed to revise the Bases accordingly.

- LCO 3.3.2, Condition D NOTE revision conflicts with another revision to the NOTE as described in the response to RAI 166-1784, Question 16-179. [In Question 16-179, the staff requested: 1) a justification for the NOTE allowing an inoperable channel of Containment Pressure or Main Steam Line Pressure to be bypassed for up to 12 hours for surveillance testing of other channels, and 2) an explanation regarding the exclusion of NOTE related information associated with installed bypass test capability from Conditions D and E LCO 3.3.2]. In a teleconference on May 13, 2009, the applicant acknowledged the conflict resulting from separate revisions to the NOTE, and agreed to make the necessary changes.

- LCO 3.3.2, Condition D Bases does not incorporate the REVIEWER'S NOTE text contained in the Bases of comparable Condition D of NUREG-1431, Page B 3.3.2-41. In a teleconference on May 13, 2009, the applicant acknowledged the staff's concerns and agreed to revise the Bases accordingly.

Verification that the above referenced changes are correct and properly incorporated into the US-APWR DCD is Confirmatory Item CI-SRP-16-CTSB-1769/206.

- In RAI-SRP-16-CTSB-1769/216, the staff requested an explanation for why the NOTE in Condition L of LCO 3.3.1 excludes instrumentation associated with the

Pressurizer Pressure, Pressurizer Level, and SG Water Level functions. This issue is identified and addressed under RAI-SRP-16-CTSB-1784/162. Therefore, the staff considers RAI-SRP-16-CTSB-1769/216, closed.

- In RAI-SRP-16-CTSB-1769/220, the staff requested a technical justification for: (1) specifying RTS Instrumentation Allowable Values in terms of "Channel Uncertainty Allowances" instead of specific values with inequality signs, and (2) expressing RTS Allowable Value units for various functions as "percent of span" (Functions 5, 8a, 8b, 9, 12a, 12b, 15a, 15d), "percent of rated flow" (Function 10), and "percent rated pump speed" (Function 11), in lieu of units that are function specific. These are deviations from NUREG-1431. The applicant states there is no setpoint drift for functions whose digital trip setpoint values reside within the PSMS software, and that the only potential setpoint error is related to analog instrument loop uncertainties (i.e., sensor reference accuracy, sensor measuring and test equipment uncertainty, sensor drift and digital controller uncertainty). The applicant therefore concludes that the digital function Allowable Value in Table 3.3.1-1 is a maximum deviation, or two-sided OPERABILITY limit defined in terms that are pertinent to the five calibration setpoints 0 percent, 25 percent, 50 percent, 75 percent and 100 percent of the instrument range that can be measured during CHANNEL CALIBRATION. This approach, which deviates from the established convention for Allowable Values included in the STS and all TS issued for operating plants, is described in Technical Report MUAP-09022-P, "US-APWR Instrument Setpoint Methodology." MUAP-09022-P is being evaluated in Chapter 7 of the Safety Evaluation Report (SER). In addition, the applicant did not address the staff's request regarding Allowable Value units as described in Item 2. These issues have been identified as Open Item OI-SRP-16-CTSB-1769/220.

- In RAI-SRP-16-CTSB-1769/242, the staff requested a technical justification for: (1) specifying ESFAS Instrumentation Allowable Values in terms of "Channel Uncertainty Allowances" instead of specific values with inequality signs, and (2) expressing ESFAS Allowable Value units as "percent of span" for Functions 1.c, 1.d, 1.e, 2.c, 4.c, 4.d(1), 4.d(2), 5A.a, 5B.c, 6.c, 6.e, 7.c, 7.d, 8.c, 9.c, 11.b, 12.e, 13.c(1), 13.c(2), 13.c(3), and ESFAS Trip Setpoint units as "percent of span" for Functions 5B.c, 6.c, 7.c, 8.c, 9.c, in lieu of units that are function specific. These are deviations from NUREG-1431. The applicant's response was to see the answer to RAI 1769, Question 16-220. The Allowable Value approach utilized is described in Technical Report MUAP-09022-P, "US-APWR Instrument Setpoint Methodology." MUAP-09022-P is being evaluated in Chapter 7 of the SER. In addition, the applicant did not address the staff's request regarding ESFAS Allowable Value and Trip Setpoint units as described in Item 2. These issues have been identified as Open Item OI-SRP-16-CTSB-1769/242.

- In RAI-SRP-16-CTSB-1769/228, the staff requested an explanation regarding inconsistencies between the US-APWR GTS and the Westinghouse STS in the BACKGROUND section of the RTS Instrumentation Bases (B 3.3.1). The inconsistencies identified are directly associated with the issue described in RAI-SRP-16-CTSB-1769/220 in which the applicant considers the digital function Allowable Value in Table 3.3.1-1 to be a maximum deviation, or two-sided OPERABILITY limit defined in terms that are pertinent to the five calibration setpoints 0 percent, 25 percent, 50 percent, 75 percent and 100 percent of the instrument range. Determinations regarding the referenced inconsistencies are dependent upon the resolution of Open Item OI-SRP-16-CTSB-1769/220. These determinations have been identified as Open Item OI-SRP-16-CTSB-1769/228.

- In RAI-SRP-16-CTSB-1769/274, the staff requested an explanation regarding inconsistencies between the US-APWR GTS and the Westinghouse STS in the BACKGROUND section of the ESFAS Instrumentation Bases (B 3.3.2). The inconsistencies identified are directly associated with the issue described in RAI-SRP-16-CTSB-1769/242 in which the applicant considers the digital function Allowable Value in Table 3.3.2-1 to be a maximum deviation, or two-sided OPERABILITY limit defined in terms that are pertinent to the five calibration setpoints 0 percent, 25 percent, 50 percent, 75 percent and 100 percent of the instrument range. Determinations regarding the referenced inconsistencies are dependent upon the resolution of Open Item OI-SRP-16-CTSB-1769/242. These determinations have been identified as Open Item OI-SRP-16-CTSB-1769/274.

- In RAI-SRP-16-CTSB-1769/238, the staff requested an explanation regarding an inconsistency between the US-APWR GTS and the Westinghouse STS in the APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY section of the RTS Instrumentation Bases (B 3.3.1). The inconsistency identified is directly associated with the issue described in RAI-SRP-16-CTSB-1769/220 in which the applicant considers the digital function Allowable Value in Table 3.3.1-1 to be a maximum deviation, or two-sided OPERABILITY limit defined in terms that are pertinent to the five calibration setpoints 0 percent, 25 percent, 50 percent, 75 percent and 100 percent of the instrument range. Determination regarding the referenced inconsistency is dependent upon the resolution of Open Item OI-SRP-16-CTSB-1769/220. This determination has been identified as Open Item OI-SRP-16-CTSB-1769/238.

- In RAI-SRP-16-CTSB-1769/275, the staff requested an explanation regarding an inconsistency between the US-APWR GTS and the Westinghouse STS in the APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY section of the ESFAS Instrumentation Bases (B 3.3.2). The inconsistency identified is directly associated with the issue described in RAI-SRP-16-CTSB-1769/242 in which the applicant considers the digital function Allowable Value in Table 3.3.2-1 to be a maximum deviation, or two-sided OPERABILITY limit defined in terms that are pertinent to the five calibration setpoints 0 percent, 25 percent, 50 percent, 75 percent and 100 percent of the instrument range. Determination regarding the referenced inconsistency is dependent upon the resolution of Open Item OI-SRP-16-CTSB-1769/242. This determination has been identified as Open Item OI-SRP-16-CTSB-1769/275.

- In RAI-SRP-16-CTSB-1769/209, the staff requested an explanation for why the US-APWR GTS, Table 3.3.1-1, High Power Range Neutron Flux Rate, Positive and Negative Rate Function Allowable Values do not include Time Constants. This is a deviation from NUREG-1431. The applicant states that Allowable Values are not provided because Time Constants are digital values set in the application software and that there is no drift or adjustments for these Time Constants. The staff was unable to make a conclusive determination regarding exclusion of the Time Constants on the basis of the information provided. In a teleconference on May 13, 2009, at the staff's request, the applicant agreed to review and substantiate its position. This issue has been identified as Open Item OI-SRP-16-CTSB-1769/209.

- In RAI-SRP-16-CTSB-1769/241, the staff requested an explanation for why the US-APWR GTS, Table 3.3.2-1, Function 1.e, 4.d (1), and 4.d (2) Allowable Values do not include Time Constants used in the lead/lag controller. This is a deviation from NUREG-1431. The applicant states that Allowable Values are not provided because Time Constants are digital values set in the application software and that there is no drift or adjustments for these Time Constants. The staff was unable to make a conclusive determination regarding exclusion of the Time Constants on the basis of the information provided. In a teleconference on May 13, 2009, at the staff's request, the applicant agreed to review and substantiate its position. This issue has been identified as Open Item OI-SRP-16-CTSB-1769/241.

- In RAI-SRP-16-CTSB-1769/230, the staff requested a technical justification explaining how the CHANNEL OPERATIONAL TEST (COT) SR (SR 3.3.1.7) specified for RTS Functions 2.a, 2.b, 3.a, 3.b, 4, 5, 6, 7, 8.a, 8.b, 9, 10, 11, 12.a, 12.b, 15.a, 15.c, and 15.d in Table 3.3.1-1, ensures that those functions are adequately tested. The COT as originally defined in NUREG -1431, has been revised under the US-APWR GTS to accommodate aspects of the fully digital MELTAC I&C platform design. The US-APWR GTS COT for the PSMS consists of a software memory integrity check. This is an adaptation of the NUREG-1431 definition, which is a verification of channel device operability based on the injection of a simulated or actual signal into the channel as close to the sensor as practicable, including the adjustment of setpoints required for operability. The applicant states that for the digital system, the continuous self-testing along with the software integrity confirmation (COT in US-APWR GTS) covers the confirmation of the setpoint and the bi-stable the same as in the conventional analog system (COT in Westinghouse STS). The staff was unable to make a conclusive determination regarding the capability of the COT to adequately test the referenced functions, on the basis of the information provided and the revised definition in the US-APWR GTS. This issue has been identified as Open Item OI-SRP-16-CTSB-1769/230.

- In RAI-SRP-16-CTSB-1769/270, the staff requested a technical justification explaining how the COT SR (SR 3.3.2.3) specified for ESFAS Instrumentation Functions 1.c, 1.d, 1.e, 2.c, 4.c, 4.d(1), 4.d(2), 5A.a, 5B.c, 6.c, 7.c, 7.d, 8.c, 9.c, 11.b, 12.e, 13.c(1), 13.c(2), and 13.c(3) in Table 3.3.2-1, ensures that those functions are adequately tested. The COT as originally defined in NUREG - 1431, has been revised under the US-APWR GTS to accommodate aspects of the fully digital MELTAC I&C platform design. The US-APWR GTS COT for the PSMS consists of a software memory integrity check. This is an adaptation of the NUREG-1431 definition, which is a verification of channel device operability based on the injection of a simulated or actual signal into the channel as close to the sensor as practicable, including the adjustment of setpoints required for operability. The applicant's response was to see the answer to RAI 167-1769, Question 16-230, which states that for the digital system, the continuous self-testing along with the software integrity confirmation (COT in US-APWR GTS) covers the confirmation of the setpoint and the bi-stable the same as in the conventional analog system (COT in Westinghouse STS). The staff was unable to make a conclusive determination regarding the capability of the COT to adequately test the referenced functions, on the basis of the information provided and the revised definition in the US-APWR GTS. This issue has been identified as Open Item OI-SRP-16-CTSB-1769/270.

- In RAI-SRP-16-CTSB-1769/231, the staff requested a technical justification explaining how the ACTUATION LOGIC TEST (ALT) SR (SR 3.3.1.5) specified for RTS Functions 14, 15.b and 18 in Table 3.3.1-1 ensures that those functions are adequately tested. The ALT as originally defined in NUREG -1431, has been revised under the US-APWR GTS to accommodate aspects of the fully digital MELTAC I&C platform design. The US-APWR GTS ALT for the PSMS consists of a software memory integrity check. This is an adaptation of the NUREG-1431 definition, which is a verification of required output logic for a given combination of input signals in conjunction with each possible interlock logic state required for operability of a logic circuit, including at a minimum, a continuity check of output devices. The applicant's response was to see the answer to RAI 167-1769, Question 16-230, which states that for the digital system, the continuous self-testing along with the software integrity confirmation (ALT in US-APWR GTS) covers the confirmation of the voting logic and automatic actuation signals the same as in the conventional analog system (ALT in Westinghouse STS). The staff was unable to make a conclusive determination regarding the capability of the ALT to adequately test the referenced functions, on the basis of the information provided and the revised definition in the US-APWR GTS. This issue has been identified as Open Item OI-SRP-16-CTSB-1769/231.

- In RAI-SRP-16-CTSB-1769/271, the staff requested a technical justification explaining how the ALT SR (SR 3.3.2.2) specified for ESFAS Instrumentation Functions 1.b, 2.b, 3.a (2), 3.b (2), 4.b, 5B.b, 6.b, 7.b, 8.b, 9.a, 12.c, and 13.b in Table 3.3.2-1, ensures that those functions are adequately tested. The ALT as originally defined in NUREG -1431, has been revised under the US-APWR GTS to accommodate aspects of the fully digital MELTAC I&C platform design. The US-APWR GTS ALT for the PSMS consists of a software memory integrity check. This is an adaptation of the NUREG-1431 definition, which is a verification of required output logic for a given combination of input signals in conjunction with each possible interlock logic state required for operability of a logic circuit, including at a minimum, a continuity check of output devices. The applicant's response was to see the answer to RAI 167-1769, Question 16-230, which states that for the digital system, the continuous self-testing along with the software integrity confirmation (ALT in US-APWR GTS) covers the confirmation of the voting logic and automatic actuation signals the same as in the conventional analog system (ALT in Westinghouse STS). The staff was unable to make a conclusive determination regarding the capability of the ALT to adequately test the referenced functions, on the basis of the information provided and the revised definition in the US-APWR GTS. This issue has been identified as Open Item OI-SRP-16-CTSB-1769/271.

- In RAI-SRP-16-CTSB-1769/232, the staff requested a technical justification explaining how the CHANNEL CALIBRATION SR (SR 3.3.1.9, SR 3.3.1.10, SR 3.3.1.11) for RTS Functions 2.a, 2.b, 3.a, 3.b, 4, 5, 6, 7, 8.a, 8.b, 9, 10, 11, 12.a, 12.b, 13.a, 13.b, 15.a, 15.c, and 15.d in Table 3.3.1-1, ensures that those functions are adequately tested. The Channel Calibration SR, as originally defined in NUREG -1431, has been revised under the US-APWR GTS to accommodate aspects of the fully digital MELTAC I&C platform design. The US-APWR GTS extend the application of a Channel Calibration to binary measurements. Under this application, a Channel Calibration confirms the accuracy of the channel's state change. This is an adaptation of the NUREG-1431 definition, which consists of an adjustment, as necessary, of the channel output such that it responds within the necessary range and accuracy to known values of the parameter that the channel monitors. The response changed the revised definition of CHANNEL CALIBRATION to more clearly state that the Channel Calibration surveillance confirms the accuracies of both analog and binary measurements, as described in Topical Report, MUAP-07004, "Safety I&C System Description and Design Process," Sections 4.4.1 and 4.4.2. The staff was unable to make a conclusive determination regarding the capability of the CHANNEL CALIBRATION to adequately test the referenced functions on the basis of the information provided and the revised definition in the US-APWR GTS. This issue has been identified as Open Item OI-SRP-16-CTSB-1769/232.

- In RAI-SRP-16-CTSB-1769/272, the staff requested a technical justification explaining how the CHANNEL CALIBRATION SR (SR 3.3.2.7) for ESFAS Instrumentation Functions 1.c, 1.d, 1.e, 2.c, 4.c, 4.d(1), 4.d(2), 5A.a, 5B.c, 6.c, 6.e, 7.c, 7.d, 8.c, 9.c, 11.b, 13.e, 13.c(1), 13.c(2), and 13.c(3) in Table 3.3.2-1, ensures that those functions are adequately tested. The Channel Calibration SR, as originally defined in NUREG -1431, has been revised under the US-APWR GTS to accommodate aspects of the fully digital MELTAC I&C platform design. The US-APWR GTS extend the application of a Channel Calibration to binary measurements. Under this application, a Channel Calibration confirms the accuracy of the channel's state change. This is an adaptation of the NUREG-1431 definition, which consists of an adjustment, as necessary, of the channel output such that it responds within the necessary range and accuracy to known values of the parameter that the channel monitors. The applicant's response was to see the answer to RAI 167-1769, Question 16-232, which changed the revised definition of CHANNEL CALIBRATION to more clearly state that the Channel Calibration surveillance confirms the accuracies of both analog and binary measurements, as described in Topical Report, MUAP-07004, "Safety I&C System Description and Design Process," Sections 4.4.1 and 4.4.2. The staff was unable to make a conclusive determination regarding the capability of the CHANNEL CALIBRATION to adequately test the referenced functions on the basis of the information provided and the revised definition in the US-APWR GTS. This issue has been identified as Open Item OI-SRP-16-CTSB-1769/272.

- In RAI-SRP-16-CTSB-1769/233, the staff requested a technical justification explaining how the TRIP ACTUATING DEVICE OPERATIONAL TEST (TADOT) SR (SR 3.3.1.4, SR 3.3.1.12) for RTS Functions 1, 13.a, 13.b, and 17 in Table 3.3.1-1, ensures that those functions are adequately tested. The TADOT, as originally defined in the STS (NUREG-1431), was revised under the US-APWR GTS to accommodate aspects of the fully digital MELTAC I&C platform design. Unlike the STS, the definition for TADOT in Revision 1 of the GTS did not include provisions for adjustment of the trip actuating device as a means of ensuring actuation at the required setpoint. Therefore, the TADOT, as defined in Revision 1, typically applied only to binary devices not subject to drift. The RAI response updated the TADOT definition in the GTS to state that there are two types of binary devices, those that have no drift potential and those that do have drift potential. The operability of devices that have drift potential is confirmed through CHANNEL CALIBRATION and/or RESPONSE TIME TESTING. The operability of devices that have no drift potential is confirmed through TADOT. The CHANNEL CALIBRATION confirms the accuracy of the devices' binary state change with regard to their setpoint requirements and the RESPONSE TIME TEST confirms the accuracy of the devices' state change with regard to their timing requirements. The TADOT confirms only the state change operability (i.e., there is no setpoint or timing accuracy confirmation needed). Revision 2 of the GTS subsequently reintroduced the sentence from the STS TADOT definition that states "The TADOT shall include adjustment, as necessary, of the trip actuating device so that it actuates at the required setpoint within the necessary accuracy." The staff was unable to make a conclusive determination regarding the capability of the TADOT to adequately test the referenced functions on the basis that ambiguities associated with TADOT performance specifics (i.e., adjustment versus confirmation) exist relative to information provided in the RAI response and information contained in the definition for TADOT in Revision 2 of the GTS. This issue has been identified as Open Item OI-SRP-16-CTSB-1769/233.

- In RAI-SRP-16-CTSB-1769/273, the staff requested a technical justification explaining how the TADOT SR (SR 3.3.2.4, SR 3.3.2.5, SR 3.3.2.6, SR 3.3.2.9) for ESFAS Instrumentation Functions 1.a, 1.b, 2.a, 2.b, 3.a(1), 3.a(2), 3.b(2), 4.a, 4.b, 5B.a, 5B.b, 6.a, 6.b, 6.e, 6.f, 7.a, 7.b, 8.a, 8.b, 9.a, 11.a, 12.c, 13.a, and 13.b in Table 3.3.2-1, ensures that those functions are adequately tested. The TADOT, as originally defined in the STS (NUREG-1431), was revised under the US-APWR GTS to accommodate aspects of the fully digital MELTAC I&C platform design. Unlike the STS, the definition for TADOT in Revision 1 of the GTS did not include provisions for adjustment of the trip actuating device as a means of ensuring actuation at the required setpoint. Therefore, the TADOT, as defined in Revision 1, typically applied only to binary devices not subject to drift. The applicant's response was to see the answer to RAI 167-1769, Question 16-233, which updated the TADOT definition in the GTS to state that there are two types of binary devices, those that have no drift potential and those that do have drift potential. The operability of devices that have drift potential is confirmed through CHANNEL CALIBRATION and/or RESPONSE TIME TESTING. The operability of devices that have no drift potential is confirmed through the TADOT. The CHANNEL CALIBRATION confirms the accuracy of the devices' binary state change with regard to its setpoint requirement and the RESPONSE TIME TEST confirms the accuracy of the devices' state change with regard to its timing requirement. The TADOT confirms only the state change operability (i.e., there is no setpoint or timing accuracy confirmation needed). Revision 2 of the GTS subsequently reintroduced the sentence from the STS TADOT definition that states "The TADOT shall include adjustment, as necessary, of the trip actuating device so that it actuates at the required setpoint within the necessary accuracy." The staff was unable to make a conclusive determination regarding the capability of the TADOT to adequately test the referenced functions on the basis that ambiguities associated with TADOT performance specifics (i.e., adjustment versus confirmation) exist relative to information provided in the RAI response and information contained in the definition for TADOT in Revision 2 of the GTS. This issue has been identified as Open Item OI-SRP-16-CTSB-1769/273.

- In RAI-SRP-16-CTSB-1769/290, the staff requested a technical justification explaining how the TADOT SR (SR 3.3.5.2) for the LOP Class 1E GTG Start Instrumentation Functions, ensures that the undervoltage (UV) relays are adequately tested. The TADOT, as originally defined in the STS (NUREG-1431), was revised under the US-APWR GTS to accommodate aspects of the fully digital MELTAC I&C platform design. Unlike the STS, the definition for TADOT in Revision 1 of the GTS did not include provisions for adjustment of the trip actuating device as a means of ensuring actuation at the required setpoint. Therefore, the TADOT, as defined in Revision 1, typically applied only to binary devices not subject to drift. The TADOT specified in accordance with SR 3.3.5.2 for both the US-APWR GTS and STS has a 31-day Surveillance Frequency. Under the STS, UV relay trip setpoints are checked and any necessary adjustments made every 31 days during performance of a TADOT. For the US-APWR GTS, the UV relay is confirmed to actuate for a loss of voltage condition every 31 days during performance of a TADOT, and UV relay trip setpoints/time delays are verified and any necessary adjustments made every 24 months during performance of a CHANNEL CALIBRATION. The applicant states that TADOT SR 3.3.5.2 confirms UV relay operation with reasonable accuracy based on technician judgment and that checking the setpoint accuracy more frequently than 24 months is unnecessary because the total channel uncertainty, including setpoint drift over the 24 month calibration interval, is included in determination of the Nominal Setpoint and Allowable Value. Revision 2 of the GTS subsequently reintroduced the sentence from the STS TADOT definition that states "The TADOT shall include adjustment, as necessary, of the trip actuating device so that it actuates at the required setpoint within the necessary accuracy." The staff was unable to make a conclusive determination regarding the capability of the TADOT to adequately test the LOP UV relays, on the basis of information provided in the RAI response and ambiguities associated with TADOT performance specifics (i.e., adjustment versus confirmation) that exist relative to information contained in the definition for TADOT in Revision 2 of the GTS. This issue has been identified as Open Item OI-SRP-16-CTSB-1769/290.

- In RAI-SRP-16-CTSB-1769/224, the staff requested an explanation regarding the reference to the word "channel" as opposed to "train" in the Condition Statement for Condition C of LCO 3.3.1. Although Condition C was appropriately revised to reflect the train orientation for the Manual Reactor Trip Function, the response also changed the wording for Required Action C.1 which resulted in an inconsistency between the Required Action wording of Conditions B.1 and C.1. In a teleconference on May 13, 2009, the applicant acknowledged the inconsistency and agreed to make the necessary change. Verification that the referenced change is correct and that all changes are properly incorporated into the US-APWR DCD, is Confirmatory Item CI-SRP-16-CTSB-1769/224.

- In RAI-SRP-16-CTSB-1769/225, the staff requested an explanation regarding discrepancies associated with Turbine Inlet Pressure P-13 interlock Function 15.d (LCO 3.3.1), in the US-APWR GTS and Bases. Although the US-APWR GTS was revised to reflect the actual number of Required Channels and the appropriate units, the response also changed the wording in the Bases describing the condition required for actuation of the Turbine Inlet Pressure P-13 interlock. The Bases change resulted in a less than accurate description of the condition. In a teleconference on May 13, 2009, the applicant acknowledged the Bases deficiency and agreed to make the necessary change. Verification that the referenced change is correct and that all changes are properly incorporated into the US-APWR DCD, is Confirmatory Item CI-SRP-16-CTSB-1769/225.

- In RAI-SRP-16-CTSB-1769/236, the staff requested an explanation regarding discrepancies associated with the Overtemperature ΔT and Overpower ΔT protection setpoint equations in the APWR DCD and GTS. Although equations for both ΔT functions were revised to include terms necessary for unit consistency, the associated markup changes for the Overpower ΔT equation were not incorporated into Table 3.3.1-1, Note 2, of the GTS, Revision 2. Verification that the changes identified in the markup are properly incorporated into the US-APWR DCD is Confirmatory Item CI-SRP-16-CTSB-1769/236.

- In RAI-SRP-16-CTSB-1769/249, the staff requested an explanation for why the US-APWR GTS, Table 3.3.2-1, does not specify a footnote for MODE 3 of Function 5B.c, indicating that the Main Feedwater Isolation Function for certain equipment is capable of being automatically actuated above P-11 after having been manually bypassed below the interlock (similar to footnote (a) for Functions 1.d, 1.e, 4.d(1) and footnote (f) for Function 4.2(d)). Although the footnote was included in Revision 2 of the GTS, its applicability to Function 5B.c in MODE 3 is being reevaluated with respect to footnote (i) and the equipment affected by the manual operating bypass for this function below the Pressurizer Pressure P-11 setpoint. Verification that the footnote information specified for Function 5B.c in the US-APWR DCD is accurate is Confirmatory Item CI-SRP-16-CTSB-1769/249.

- In RAI-SRP-16-CTSB-1769/252, the staff requested an explanation regarding several discrepancies associated with Main Feedwater Isolation Function 5B in the US-APWR Bases (B 3.3.2). With the exception of the following item, the response was found to be acceptable to the staff. The second paragraph of Bases section 5B.d (revised to include references to the Main Feedwater Bypass Regulation Valves (MFBRVs) and the SG Water Filling Control Valves (SGWFCVs)), was not moved to a stand-alone paragraph in 5B in order to apply to sections 5B.a, 5B.b, 5B.c, and 5B.d, as stated in the response. In a teleconference on June 8, 2009, the applicant acknowledged the discrepancy and agreed to make the necessary change. Verification that the referenced change is correct and properly incorporated into the US-APWR DCD is Confirmatory Item CI-SRP-16-CTSB-1769/252.

- In RAI-SRP-16-CTSB-1769/250, the staff requested an explanation regarding potential discrepancies associated with the footnote in LCO Table 3.3.2-1 which states “During movement of irradiated fuel assemblies within containment.” With the exception of the following item, the response was otherwise found to be acceptable to the staff because the placement and labeling discrepancies associated with the referenced footnote have been satisfactorily resolved. Table 3.3.2-1 does not specify the footnote as an applicable Mode for the Containment Purge Isolation Function. Considering the potential exists for an accident that could release significant fission product radioactivity into the containment in Conditions other than MODES 1 through 4, and the fact that NUREG-1431 specifies the same footnote as an applicable Mode for each of the Containment Purge and Exhaust Isolation Functions in LCO 3.3.6, Table 3.3.6-1 (Note that LCO 3.3.6 is actually part of LCO 3.3.2 in the US-APWR GTS), an explanation was warranted. The response states that events involving the release of radioactivity into containment other than Modes 1 to 4 include the FHA and that the US-APWR analysis takes into consideration a FHA in the state in which the containment is not isolated. For this case, in which the FHA occurs without containment being isolated, the doses at the exclusion area boundary, at the low population zone outer boundary, and in the main control room (MCR) will be below the regulatory criteria. In a teleconference on May 13, 2009, the applicant stated that Chapter 15 Safety Analysis Section 15.7.4 would be revised to include the assumption made in the FHA evaluation that the containment is not isolated. In addition, the applicant agreed to revise the discussion in the last paragraph of Bases B 3.3.2, Section 12.e, regarding operability of containment purge isolation instrumentation "…without fuel handling in progress…" in order to ensure alignment with the analysis. Verification that the referenced changes are correct and that all changes are properly incorporated into the US-APWR DCD, is Confirmatory Item CI-SRP-16-CTSB-1769/250.

- In RAI-SRP-16-CTSB-1769/253, the staff requested an explanation regarding potential discrepancies identified in the Emergency Feedwater (EFW) Actuation Function Sections of the US-APWR Bases (B 3.3.2). With the exception of the following item, the response was otherwise found to be acceptable to the staff because the Class 1E bus UV device required channel operability requirement and EFW Actuation functional reference discrepancies have been corrected in Bases B 3.3.2, Section 6.e. Although US-APWR Bases Section 6.f, "Emergency Feedwater Actuation - Trip of All Main Feedwater Pumps," was revised to eliminate the reference to EFW Actuation on Reactor Coolant Pump UV, editorial errors remain. In a teleconference on June 8, 2009, the applicant acknowledged the errors and agreed to make the necessary changes. Verification that the referenced changes are correct and that all changes are properly incorporated into the US-APWR DCD, is Confirmatory Item CI-SRP-16-CTSB-1769/253.

- In RAI-SRP-16-CTSB-1769/267, the staff requested an explanation regarding a number of potential discrepancies associated with Condition N of LCO 3.3.2 in the US-APWR GTS and Bases. The MCR isolation function actuates the Main Control Room HVAC System (MCRVS) which consists of two trains (A and D) of the Main Control Room Emergency Filtration System (MCREFS) and four trains of the Main Control Room Air Temperature Control System (MCRATCS). In Condition N, MCRVS should be placed in the Emergency Mode and additional trains restored to Operable status in accordance with the Required Actions of MCRVS LCO 3.7.10. Although Required Actions M.1, N.1.1 and N.1.2 were revised to clarify the relationship between the MCR isolation function and the MCRVS with respect to subsystem impact, potential ambiguities remain. In addition, revisions to the number of Required Trains and designation of train specifics for MCR Isolation Functions 13.a and 13.b in Table 3.3.2-1 are not reflected in corresponding sections of the Bases. Several editorial errors have also been identified. In a teleconference on May 26, 2009, the applicant acknowledged these issues and agreed to make the necessary changes.

Verification that the referenced changes are correct and that all changes are properly incorporated into the US-APWR DCD, is Confirmatory Item CI-SRP-16-CTSB-1769/267.

- In RAI-SRP-16-CTSB-1769/279, the staff requested an explanation regarding the Surveillance Frequency of the ALT (SR 3.3.2.2) specified for MCR Isolation Function 13.b in Table 3.3.2-1 of the US-APWR GTS. The applicant states that the 92-day STAGGERED TEST BASIS Frequency currently specified is incorrect and that the actual Frequency should be 24 months. This issue is identified and addressed under RAI 166-1784, Question 16-191, which is being tracked as an open item. Therefore, the staff considers RAI-SRP-16-CTSB-1769/279 closed.

- In RAI-SRP-16-CTSB-1769/281, the staff requested an explanation for why NOTE 1 was added to the ACTIONS Section of LCO 3.3.3, PAM Instrumentation. NOTE 1 states "LCO 3.0.4 not applicable." This is a deviation from NUREG-1431. Although LCO 3.3.3 ACTIONS Section was revised to eliminate the NOTE, the associated Bases discussion on Page B 3.3.3-9 of the DCD, Revision 2, was not revised to reflect the deletion. Verification that the necessary Bases changes are correct and properly incorporated into the US-APWR DCD is Confirmatory Item CI-SRP-16-CTSB-1769/281.

- In RAI-SRP-16-CTSB-1769/282, the staff requested an explanation regarding the implementation of Condition C in LCO 3.3.3 for PAM Functions 2, 3, 10 and 16 in Table 3.3.3-1. Condition C states "One or more Functions with two required channels inoperable." Table 3.3.3-1 "Required Channels" column only specifies "1 per loop" for Functions 2 and 3, and "1 per steam generator" for Functions 10 and 16. Comparable functions in the Westinghouse STS, Table 3.3.3-1, specify "2 per loop" and "2 per steam generator" in the "Required Channels" column. The applicant states that since there are four loops and four SGs, there are four required channels for each of these parameters. RCS Cold Leg Temperature Wide Range (Function 2) is used in conjunction with RCS Hot Leg Temperature Wide Range (Function 3) to verify unit conditions necessary to establish natural circulation in the RCS. RCS Hot Leg Temperature Wide Range and RCS Cold Leg Temperature Wide Range of the same loop constitute a PAM "pair function." Similarly, SG Water Level Wide Range (Function 10) and EFW Flow (Function 16) of the same loop make up a PAM "pair function" as well. Revisions include the addition of a NOTE to Table 3.3.3-1 describing the PAM "pair functions," and dedicated NOTES to Conditions A and C providing implementation guidance with respect to Functions 2, 3, 10 and 16. The staff questions the applicant's position regarding PAM "pair functions" on the basis of what appears to be a change of intent regarding implementation of the functional concept within the confines of LCO 3.3.3, and the introduction of potential ambiguities. In a teleconference on May 13, 2009, the applicant acknowledged the staff's concerns and agreed to reexamine their approach. This issue is identified as Open Item OI-SRP-16-CTSB-1769/282.

- In RAI-SRP-16-CTSB-1769/284, the staff requested the applicant provide a summary of the analyses to confirm that the list of PAM instrumentation contained in the APWR GTS, Table 3.3.3-1, includes the entire population of instruments relied upon to address the requirements of GDC 13, 19 and 64, the guidance in Revision 4 of RG 1.97, and the selection criteria included in Institute of Electrical and Electronics Engineers (IEEE) Standard 497-2002. Endorsed IEEE Standard 497-2002 provides criteria for selecting PAM instrumentation variables, instead of providing a list of variables to monitor (which was the approach taken in Revision 3 of RG 1.97). The discussion of these criteria on Page iv of IEEE Standard 497-2002 states "Accident monitoring variable selection must be consistent with the plant specific EOPs and abnormal operating procedures (AOPs). The variables selected from these procedures need to be the minimum set to assess that safety-related functions are performed and safety systems operate acceptably." The applicant's response (provided in Chapter 7 RAI item No. 238-2030, Question 07.05-8), does not describe how it is possible to provide a "complete" PAM Instrumentation Technical Specification prior to COL issuance, when PAM variable selection criteria in RG 1.97, Revision 4, depend on prior development of Emergency Procedure Guidelines, EOPs and AOPs, guidelines and procedures which cannot be developed before COL issuance. Followup RAI 463-3746, Question 16-299 was issued to document and address the staff's concerns relative to the response. Therefore, RAI-SRP-16-CTSB-1769/284 is considered closed. OI-SRP-16-CTSB-3746/299 is being tracked as an open item to ensure resolution of this issue.

- In RAI-SRP-16-CTSB-1769/289, the staff requested an explanation regarding the reference to only "two channels" as opposed to "two or more channels" in the Condition Statement for Condition B of LCO 3.3.5. Although Condition B was appropriately revised to reflect the proper number of channels for the Loss of Voltage and Degraded Voltage Functions, the response also changed the wording of Condition A, resulting in conflicting Condition Statements between Conditions A and B. In a teleconference on May 28, 2009, the applicant acknowledged the discrepancy and agreed to make the necessary change. Verification that the referenced change is correct and that all changes are properly incorporated into the US-APWR DCD, is Confirmatory Item CI-SRP-16-CTSB-1769/289.

- In RAI-SRP-16-CTSB-1769/297, the staff requested enhancement of the REFERENCES Section for INSTRUMENTATION Bases B 3.3.1, B 3.3.2, B 3.3.3, B 3.3.4, B 3.3.5, and B 3.3.6. With the exception of the following item, the response was otherwise found to be acceptable to the staff because the TSTF-GG-05-01, "Writer's Guide for Plant-Specific Improved Technical Specifications," guidance on the inclusion of references was properly incorporated into Revision 2 of the Instrumentation Bases for the remaining items. The markup for Reference 8 on Page B 3.3.2-57 of the DCD, Revision 1, was not provided in the original response. The amended response, dated July 3, 2009, subsequently stated that Reference 8 was not necessary and would be deleted from the References Section of Bases B 3.3.2. Revision 2 of the APWR DCD incorporated the guidance cited in RAI 167-1769, Question 16-297, for Reference 8 instead of making the deletion. Verification that the Reference 8 Bases issue is resolved and that any necessary changes are correct and properly incorporated into the US-APWR DCD, is Confirmatory Item CI-SRP-16-CTSB-1769/297.

- In RAI-SRP-16-CTSB-1784/172, the staff requested an explanation regarding the methodologies for obtaining allocations for signal conditioning and actuation logic response times for RTS Instrumentation. The US-APWR Bases discussion for SR 3.3.1.13, RTS RESPONSE TIME, states that the allocations for signal conditioning and actuation logic response times may be obtained from the same methodologies used to determine sensor allocation response times. The comparable Bases discussion for SR 3.3.1.16 in NUREG-1431, defines the methods for obtaining allocations for sensor response times distinctly from the methods for obtaining allocations for signal conditioning and actuation logic response times. The Bases for SR 3.3.1.16 also cites two topical reports, one that provides the basis and methodology for using allocated sensor response times (WCAP-13632-P-A), and one that provides the basis and methodology for using allocated signal conditioning and actuation logic response times (WCAP-14036-P). For the US-APWR, the applicant maintains that the same methods are used for obtaining response time allocations for all three portions of the system. The staff questioned the applicant's position regarding response time allocations for RTS Instrumentation on the basis that 1) all technical references associated with the STS appear to have been removed without providing comparable replacement references, and 2) differences in the methods used by the US-APWR and STS have not been clearly delineated. In a teleconference on May 26, 2009, the applicant acknowledged the staff's concerns and indicated that response time allocation issues would be appropriately addressed in a dedicated technical report describing response time specifics for the safety I&C system. This issue is identified as Open Item OI-SRP-16-CTSB-1784/172.

- In RAI-SRP-16-CTSB-1784/173, the staff requested a justification for why the references to Topical Reports WCAP-13632-P-A and WCAP-14036-P in the NUREG-1431 Bases discussion for SR 3.3.1.16, RTS RESPONSE TIME, have been excluded from the comparable Bases discussion for SR 3.3.1.13 in the US-APWR Bases. This issue is identified and addressed under RAI-SRP-16-CTSB-1784/172. Therefore, the staff considers RAI-SRP-16-CTSB-1784/173 closed.

- In RAI-SRP-16-CTSB-1784/186, the staff requested an explanation regarding the methodologies for obtaining allocations for signal conditioning and actuation logic response times for ESFAS Instrumentation. The US-APWR Bases discussion for SR 3.3.2.8, ESFAS RESPONSE TIMES, states that the allocations for signal conditioning and actuation logic response times may be obtained from the same methodologies used to determine sensor allocation response times. The comparable Bases discussion for SR 3.3.2.10 in NUREG-1431, defines the methods for obtaining allocations for sensor response times distinctly from the methods for obtaining allocations for signal conditioning and actuation logic response times. The Bases for SR 3.3.2.10 also cites two topical reports, one that provides the basis and methodology for using allocated sensor response times (WCAP-13632-P-A), and one that provides the basis and methodology for using allocated signal conditioning and actuation logic response times (WCAP-14036-P). For the US-APWR, the applicant maintains that the same methods are used for obtaining response time allocations for all three portions of the system. The staff questioned the applicant's position regarding response time allocations for ESFAS Instrumentation on the basis that 1) all technical references associated with the STS appear to have been removed without providing comparable replacement references, and 2) differences in the methods used by the US-APWR and STS have not been clearly delineated. In a teleconference on May 26, 2009, the applicant acknowledged the staff's concerns and indicated that response time allocation issues would be appropriately addressed in a dedicated technical report describing response time specifics for the safety I&C system. This issue is identified as Open Item OI-SRP-16-CTSB-1784/186.

- In RAI-SRP-16-CTSB-1784/187, the staff requested a justification for why the references to Topical Reports WCAP-13632-P-A and WCAP-14036-P in the NUREG-1431 Bases discussion for SR 3.3.2.10, ESFAS RESPONSE TIMES, have been excluded from the comparable Bases discussion for SR 3.3.2.8 in the US-APWR Bases. This issue is identified and addressed under RAI-SRP-16-CTSB-1784/186. Therefore, the staff considers RAI-SRP-16-CTSB-1784/187 closed.

- In RAI-SRP-16-CTSB-1784/174, the staff requested a justification for why the information associated with dynamic transfer functions in the NUREG-1431 Bases discussion for SR 3.3.1.16, RTS RESPONSE TIME, was excluded from the comparable Bases discussion for SR 3.3.1.13 in the US-APWR Bases. The applicant states that Reactor Trip Breakers (RTBs) and Resistance Temperature Detectors (RTDs) are known to have aging or wear-out mechanisms that can impact response time and thus require response time measurement. Response times for other components can be affected by random failures or calibration discrepancies, which can be detected by other testing and calibration methods required by other surveillances. Consequently, response time testing is provided for RTBs and RTDs, but not for other PSMS components, including digital components of the PSMS which implement dynamic transfer functions. The applicant therefore concludes that the discussion of response time testing for dynamic transfer functions is not applicable to the digital PSMS. The staff questioned the applicant's position regarding the applicability of response time testing for dynamic transfer functions on the basis of insufficient information associated with other testing, calibration methods, and SR specifics for digital PSMS instrumentation that includes dynamic transfer functions. It is not clear from the response that the justification provided warrants exclusion of the STS discussion on dynamic transfer functions from the US-APWR Bases. In a teleconference on May 26, 2009, the applicant acknowledged the staff's concerns and agreed to review the issue. This issue is identified as Open Item OI-SRP-16-CTSB-1784/174.

- In RAI-SRP-16-CTSB-1784/188, the staff requested a justification for why the information associated with dynamic transfer functions in the NUREG-1431 Bases discussion for SR 3.3.2.10, ESFAS RESPONSE TIMES," was excluded from the comparable Bases discussion for SR 3.3.2.8 in the US-APWR Bases. The applicant states that Electro-mechanical components in the ESFAS have aging or wear-out mechanisms that can impact response time and thus require response time measurement. Response times for other components can be affected by random failures or calibration discrepancies, which can be detected by other testing and calibration methods required by other surveillances. Consequently, response time testing is provided for Electro-mechanical components in the ESFAS, but not for other PSMS components, including digital components of the PSMS which implement dynamic transfer functions. The applicant therefore concludes that the discussion of response time testing for dynamic transfer functions is not applicable to the digital PSMS. The staff questioned the applicant's position regarding the applicability of response time testing for dynamic transfer functions on the basis of insufficient information associated with other testing, calibration methods, and SR specifics for digital PSMS instrumentation that includes dynamic transfer functions. It is not clear from the response that the justification provided warrants exclusion of the STS discussion on dynamic transfer functions from the US-APWR Bases. In a teleconference on May 26, 2009, the applicant acknowledged the staff's concerns and agreed to review the issue. This issue is identified as Open Item OI-SRP-16-CTSB-1784/188.

- In RAI-SRP-16-CTSB-1784/177, the staff requested a justification regarding the initial Completion Time of 72 hours for Condition B of LCO 3.3.2 in the US-APWR GTS, compared to 48 hours for Condition B of LCO 3.3.2 in NUREG-1431. The applicant states that the initial Completion Time of 48 hours in NUREG-1431, Revision 3.1, is based on the two-channel configuration of the associated ESFAS Manual Initiation Functions in conventional plants. When one required Manual Initiation channel is inoperable, the two-channel system does not meet the single failure criteria for the Manual Initiation Function. The applicant justifies the 72 hour Completion Time, in part, based on the claim that the US-APWR adopts a 2-out-of-4 channel configuration for the ESFAS Manual Initiation Functions, which significantly improves the tolerance to single failures from the conventional two-channel plant. The response does not consider the fact that the Containment Phase A Isolation Manual Initiation Function only has two required trains, A and D. Also, the last sentence in the first paragraph of the Bases description for Condition B does not accurately reflect the two-train configuration for this Function. In a teleconference on May 28, 2009, the applicant acknowledged the discrepancies and agreed to make the necessary changes. This issue is being tracked as an Open Item under OI-SRP-16-CTSB-1784/177.

- In RAI-SRP-16-CTSB-1784/180, the staff requested a justification regarding the initial Completion Time of 72 hours for Condition F of LCO 3.3.2 in the US-APWR GTS, compared to 48 hours for Condition F of LCO 3.3.2 in NUREG-1431. The applicant states that the initial Completion Time of 48 hours in NUREG-1431, Revision 3.1, is based on the two-channel configuration of the associated ESFAS Manual Initiation Functions in conventional plants. When one required Manual Initiation channel is inoperable, the two-channel system does not meet the single failure criteria for the Manual Initiation Function. The applicant justifies the 72 hour Completion Time in part, based on the claim that the US-APWR adopts a 2-out-of-4 channel configuration for the ESFAS Manual Initiation Functions, which significantly improves the tolerance to single failures from the conventional two-channel plant. The response does not consider the fact that the majority of the Manual Initiation Functions associated with Condition F only have two required trains, the exception being EFW Actuation Function 6.a. In a teleconference on May 28, 2009, the applicant acknowledged that the justification was insufficient for two-train Manual Initiation Functions and agreed to make the necessary changes. This issue is being tracked as an Open Item under OI-SRP-16-CTSB-1784/180.

- In RAI-SRP-16-CTSB-1784/179, the staff requested an explanation regarding the exclusion of NOTE-related information associated with installed bypass test capability from Conditions D and E of LCO 3.3.2. Although this issue was addressed for Condition D, the response did not consider Condition E. In a teleconference on May 26, 2009, the applicant acknowledged the oversight and agreed to make any necessary changes. This issue is being tracked as an Open Item under OI-SRP-16-CTSB-1784/179.

- In RAI-SRP-16-CTSB-1784/192, the staff requested a justification for why Condition F of LCO 3.3.3 in NUREG-1431 was not included in LCO 3.3.3 of the US-APWR GTS as a Referenced Condition in Table 3.3.3-1 for "Reactor Vessel Water Level" and "Containment High Range Area Radiation" PAM Instrumentation. Condition F of NUREG-1431, Revision 3.1, requires the unit to "initiate action in accordance with Specification 5.6.5," which is a 14 day report. NUREG-1431 Bases B 3.3.3 for Condition F states that alternate means of monitoring Reactor Vessel Level and Containment Area Radiation have been developed and tested for the reference unit, and that the alternate means may be temporarily installed if the normal PAM channel cannot be restored to OPERABLE status within the allotted time. If these alternate means are used, the Required Action is not to shut down the unit, but rather to follow the directions of Specification 5.6.5 in the Administrative Controls of the TS. The applicant concludes that Condition F of NUREG-1431 can be applied to both Reactor Vessel Water Level monitoring and Containment High Range Area Radiation monitoring in the US-APWR GTS, since they consider Pressurizer Level an alternate method of monitoring for Reactor Vessel Water Level and Containment Pressure an alternate method of monitoring for Containment High Range Area Radiation. The staff questioned the applicant's position regarding the applicability of Condition F to LCO 3.3.3 of the US-APWR GTS, on the basis that an analysis has not been provided that 1) describes the degree to which the alternate instrumentation is equivalent to the installed PAM channels, and 2) justifies the areas in which they are not equivalent. In a teleconference on May 13, 2009, the applicant acknowledged the staff's concerns and gave consideration to the development of an equivalency analysis. This issue is identified as Open Item OI-SRP-16-CTSB-1784/192.

- The staff reviewed the response for each of the RAIs listed below regarding the justification of Completion Times, Surveillance Frequencies, and Required Action Note allowance times for bypassing inoperable channels/trains. Basis considerations include continuous automatic self-testing, automatic channel checks, sufficient operable trains (redundancy), improved tolerance to single failures, low probability of event occurrence, low channel failure rates, nature of the function, and expected reliability of the PSMS. Continuous self-testing and online diagnostic monitoring capabilities are being evaluated in Chapter 7 of this report to determine the extent to which these features may be credited towards Completion Times and surveillance testing. In a letter dated March 18, 2009 (Response to US-APWR DCD RAI No. 166-1784, Revision 0, Questions 16-158 through 16-195), the applicant states for each Completion Time, Surveillance Frequency, and Required Action Note allowance time identified in the referenced RAIs, that: (1) the specified value is "justified in the PSMS reliability analysis," (2) the "result of the PSMS reliability analysis is evaluated and confirmed in the US-APWR PRA Chapter 19," and (3) a detailed explanation and Fault Tree Analysis will be added to the next revised version of US-APWR Technical Report MUAP-07030, "Probabilistic Risk Analysis." In a teleconference on May 28, 2009, the applicant, at the staff's request, agreed to reference the technical report in the applicable Bases sections and to include both PRA Chapter 19 and Technical Report MUAP-07030 in the references sections of the affected LCO Bases. Note that the PSMS Reliability Analysis has not been approved. Each RAI listed below is being tracked separately as an Open Item. Open Item resolution will entail (a) staff verification that the requested information for each RAI is properly incorporated into the US-APWR DCD, (b) staff review of the PSMS Reliability Analysis, and (c) staff evaluation, in SER Chapter 7, of whether the applicant has justified taking credit for continuous self-testing and online diagnostic monitoring capabilities.

RAI-SRP-16-CTSB-1784/160	Open Item: OI-SRP-16-CTSB-1784/160
RAI-SRP-16-CTSB-1784/161	Open Item: OI -SRP-16-CTSB-1784/161
RAI-SRP-16-CTSB-1784/162	Open Item: OI -SRP-16-CTSB-1784/162
RAI-SRP-16-CTSB-1784/163	Open Item: OI -SRP-16-CTSB-1784/163
RAI-SRP-16-CTSB-1784/164	Open Item: OI -SRP-16-CTSB-1784/164
RAI-SRP-16-CTSB-1784/166	Open Item: OI -SRP-16-CTSB-1784/166
RAI-SRP-16-CTSB-1784/167	Open Item: OI -SRP-16-CTSB-1784/167
RAI-SRP-16-CTSB-1784/168	Open Item: OI -SRP-16-CTSB-1784/168
RAI-SRP-16-CTSB-1784/177	Open Item: OI -SRP-16-CTSB-1784/177
RAI-SRP-16-CTSB-1784/178	Open Item: OI -SRP-16-CTSB-1784/178
RAI-SRP-16-CTSB-1784/179	Open Item: OI -SRP-16-CTSB-1784/179
RAI-SRP-16-CTSB-1784/180	Open Item: OI -SRP-16-CTSB-1784/180
RAI-SRP-16-CTSB-1784/181	Open Item: OI -SRP-16-CTSB-1784/181
RAI-SRP-16-CTSB-1784/184	Open Item: OI -SRP-16-CTSB-1784/184
RAI-SRP-16-CTSB-1784/189	Open Item: OI -SRP-16-CTSB-1784/189
RAI-SRP-16-CTSB-1784/190	Open Item: OI -SRP-16-CTSB-1784/190
RAI-SRP-16-CTSB-1784/191	Open Item: OI -SRP-16-CTSB-1784/191
RAI-SRP-16-CTSB-1784/194	Open Item: OI -SRP-16-CTSB-1784/194

Conclusion

The US-APWR GTS, Section 3.3.2 and its Bases, consolidates Westinghouse STS Sections 3.3.2 (ESFAS Instrumentation), 3.3.6 (Containment Purge and Exhaust Isolation Instrumentation), and 3.3.7 (CREFS Actuation Instrumentation). The US-APWR GTS, LCO 3.3.4, RSC, is functionally equivalent to the Westinghouse STS, LCO 3.3.4, Remote Shutdown System. The RSC provides operations personnel with the same functional control and monitoring capability as in the MCR. The RSC displays and controls are provided by four trains of safety Visual Display Units (VDUs) and non-safety operational VDUs. The RSC uses Safety VDUs to communicate with the digital platform PSMS rather than a set of hard-wired functions routed to a remote shutdown panel. Because the RSC has the same capability for control of equipment as the MCR via the PSMS, it is not restricted to a select set of Normal and Safe-Shutdown Functions. For these reasons, SRs for the RSC are not based on verifying the OPERABILITY of specific functions as done in the Westinghouse STS. For the US-APWR, the SRs verify the capability of the transfer switches to transfer control from the MCR to the RSC and communicate properly with the PSMS. The US-APWR GTS, LCO 3.3.6, DAS Instrumentation, provides a non-Class 1E diverse capability to trip the reactor and actuate specified safety-related equipment. The DAS consists of conventional, analog, and hard-wired equipment that is totally diverse and independent from the digital MELTAC platform of the safety-related PSMS and the non-safety-related PCMS. The DAS is unique to the US-APWR and satisfies criterion 4 of 10 CFR 50.36(c)(2)(ii). Sections 3.3.8 (FBACS Actuation System) and 3.9 (Boron Dilution Protection System) of the Westinghouse STS, are not included in the design of the US-APWR. STS 3.3.8 does not apply because the FHA analysis, as described in APWR DCD Section 15.7.4 for a postulated accident in the spent fuel storage area, does not credit the removal of gaseous iodine by a safety-related filtration system similar to the one currently used in Westinghouse PWR plants in the United States, for mitigation of dose consequences to the public. STS 3.3.9 does not apply because the boron dilution event analysis, as described in APWR DCD Section 15.4.6, credits operator action as the means to terminate dilution flow.

In general, the applicant adhered to the Instrumentation Systems information as provided in the Westinghouse STS, with differences to reflect US-APWR unique design features. With respect to US-APWR unique design features, the GTS are sufficient to assure operation of these features within the bounds of the safety analyses. The staff has issued the RAIs described above along with other Instrumentation System RAIs to address minor items such as verification of information and editorial changes associated with Section 3.3 of the US-APWR GTS and its Bases.

Changes incorporated into Revision 2 of the US-APWR DCD, resulting from responses to the RAIs listed below, need editorial revision. General Comments RAI SRP-16-CTSB-4183, Question 16-323 was issued to document and address editorial items associated with questions pertaining to RAI Numbers 166-1784 and 167-1769. Therefore, the staff considers the following list of RAIs closed. RAI SRP-16-CTSB-4183, Question 16-323 is being tracked as a confirmatory item.

RAI-SRP-16-CTSB-1769/202
RAI-SRP-16-CTSB-1769/222
RAI-SRP-16-CTSB-1769/229
RAI-SRP-16-CTSB-1769/235
RAI-SRP-16-CTSB-1769/246
RAI-SRP-16-CTSB-1769/248
RAI-SRP-16-CTSB-1769/263
RAI-SRP-16-CTSB-1769/268
RAI-SRP-16-CTSB-1769/276
RAI-SRP-16-CTSB-1769/291
RAI-SRP-16-CTSB-1769/294
RAI-SRP-16-CTSB-1784/169
RAI-SRP-16-CTSB-1784/195

The following list summarizes Confirmatory Items identified in the Evaluation section above. Verification that changes associated with the RAIs listed below are correctly incorporated into the US-APWR DCD is via the corresponding RAI Confirmatory Item identifier referenced below:

RAI-SRP-16-CTSB-1769/205	Confirmatory Item: CI-SRP-16-CTSB-1769/205
RAI-SRP-16-CTSB-1769/206	Confirmatory Item: CI-SRP-16-CTSB-1769/206
RAI-SRP-16-CTSB-1769/224	Confirmatory Item: CI-SRP-16-CTSB-1769/224
RAI-SRP-16-CTSB-1769/225	Confirmatory Item: CI-SRP-16-CTSB-1769/225
RAI-SRP-16-CTSB-1769/236	Confirmatory Item: CI-SRP-16-CTSB-1769/236
RAI-SRP-16-CTSB-1769/249	Confirmatory Item: CI-SRP-16-CTSB-1769/249
RAI-SRP-16-CTSB-1769/250	Confirmatory Item: CI-SRP-16-CTSB-1769/250
RAI-SRP-16-CTSB-1769/252	Confirmatory Item: CI-SRP-16-CTSB-1769/252
RAI-SRP-16-CTSB-1769/253	Confirmatory Item: CI-SRP-16-CTSB-1769/253
RAI-SRP-16-CTSB-1769/267	Confirmatory Item: CI-SRP-16-CTSB-1769/267
RAI-SRP-16-CTSB-1769/281	Confirmatory Item: CI-SRP-16-CTSB-1769/281
RAI-SRP-16-CTSB-1769/289	Confirmatory Item: CI-SRP-16-CTSB-1769/289
RAI-SRP-16-CTSB-1769/297	Confirmatory Item: CI-SRP-16-CTSB-1769/297

There are a total of 42 Open Items pertaining to Section 3.3 of the US-APWR DCD, Revision 2. Open Items are listed below:

OI-SRP-16-CTSB-1769/209
OI-SRP-16-CTSB-1769/220
OI-SRP-16-CTSB-1769/228
OI-SRP-16-CTSB-1769/230
OI-SRP-16-CTSB-1769/231
OI-SRP-16-CTSB-1769/232
OI-SRP-16-CTSB-1769/233
OI-SRP-16-CTSB-1769/238
OI-SRP-16-CTSB-1769/241
OI-SRP-16-CTSB-1769/242
OI-SRP-16-CTSB-1769/270
OI-SRP-16-CTSB-1769/271
OI-SRP-16-CTSB-1769/272
OI-SRP-16-CTSB-1769/273
OI-SRP-16-CTSB-1769/274
OI-SRP-16-CTSB-1769/275
OI-SRP-16-CTSB-1769/282
OI-SRP-16-CTSB-1769/290
OI-SRP-16-CTSB-1784/160
OI-SRP-16-CTSB-1784/161
OI-SRP-16-CTSB-1784/162
OI-SRP-16-CTSB-1784/163
OI-SRP-16-CTSB-1784/164
OI-SRP-16-CTSB-1784/166
OI-SRP-16-CTSB-1784/167
OI-SRP-16-CTSB-1784/168
OI-SRP-16-CTSB-1784/172
OI-SRP-16-CTSB-1784/174
OI-SRP-16-CTSB-1784/177
OI-SRP-16-CTSB-1784/178
OI-SRP-16-CTSB-1784/179
OI-SRP-16-CTSB-1784/180
OI-SRP-16-CTSB-1784/181
OI-SRP-16-CTSB-1784/184
OI-SRP-16-CTSB-1784/186
OI-SRP-16-CTSB-1784/188
OI-SRP-16-CTSB-1784/189
OI-SRP-16-CTSB-1784/190
OI-SRP-16-CTSB-1784/191
OI-SRP-16-CTSB-1784/192
OI-SRP-16-CTSB-1784/194
OI-SRP-16-CTSB-3746/299

The remaining portions of the US-APWR GTS, Section 3.3, were found to be reasonably similar to the Westinghouse STS or sufficiently accurate and complete such that they were determined to be acceptable to the staff. The US-APWR GTS, Section 3.3, and its Bases contain "bracketed information," including "bracketed information" associated with options to implement the newly proposed CRMP and SFCP as referenced in TS 5.5.18 and 5.5.19. The staff reviewed each piece of "bracketed information" to understand its intent and to determine whether each was site-specific and appropriately deferred to applicants for construction permits or COLs that reference the US-APWR GTS. The staff concluded that each such item was indeed plant- or site-specific. Therefore, except for the confirmatory items discussed above, and resolution of the outstanding open items, the staff finds that Section 3.3 of the US-APWR GTS and Section B 3.3 of the US-APWR Bases are acceptable.

16.4.3.4 Reactor Coolant System

Introduction

The US-APWR GTS and Bases, Section 3.4, include requirements for RCS parameters such as RCS pressure, temperature, flow, and specific activity; RCS subsystems, components and parameters such as RCS loops, the pressurizer, and low-temperature over pressure (LTOP); and RCS leakage limits, to ensure that fuel integrity and RCPB integrity are preserved during all modes of plant operation.

Evaluation

In general, Section 3.4 of the US-APWR GTS is modeled after Section 3.4 of the STS for Westinghouse plants, with differences to reflect US-APWR unique design features. These unique design features include four 50-percent residual heat removal (RHR) trains and no RCS loop isolation valves. The US-APWR GTS, Section 3.4, RCS, corresponds to the Westinghouse STS in the following manner:

STS	US-APWR GTS	TITLE (*STS TITLE, if different)
3.4.1	3.4.1	RCS Pressure, Temperature, and Flow Departure from Nucleate Boiling Limits
3.4.2	3.4.2	RCS Minimum Temperature for Criticality
3.4.3	3.4.3	RCS Pressure and Temperature (P/T) Limits
3.4.4	3.4.4	RCS Loops - MODES 1 and 2
3.4.5	3.4.5	RCS Loops - MODE 3
3.4.6	3.4.6	RCS Loops - MODE 4
3.4.7	3.4.7	RCS Loops - MODE 5, Loops Filled
3.4.8	3.4.8	RCS Loops - MODE 5, Loops Not Filled
3.4.9	3.4.9	Pressurizer
3.4.10	3.4.10	Pressurizer Safety Valves
3.4.11*	3.4.11	Safety Depressurization Valves (*Pressurizer Power-Operated Relief Valves)
3.4.12	3.4.12	LTOP System
3.4.13	3.4.13	RCS Operational LEAKAGE
3.4.14	3.4.14	RCS Pressure Isolation Valve (PIV) Leakage
3.4.15	3.4.15	RCS Leakage Detection Instrumentation
3.4.16	3.4.16	RCS Specific Activity
3.4.17*	None	N/A (*RCS Loop Isolation Valves)
3.4.18*	None	N/A (*RCS Isolated Loop Startup)
3.4.19*	None	N/A (*RCS Loops - Test Exceptions)
3.4.20	3.4.17	SG Tube Integrity

Unlike the typical Westinghouse PWR design currently in operation in the United States, the US-APWR design does not contain RCS loop isolation valves. RCS loop isolation valves are used in the Westinghouse PWR design for performing maintenance in Modes 5 and 6, while the US-APWR does not have this feature. As a result, the US-APWR GTS need not contain operability requirements for these components as is provided in the Westinghouse STS 3.4.17 and 3.4.18. The staff finds these omissions in the US-APWR GTS to be acceptable.

Although the GTS, Section 3.4, does model the STS in format and content, the staff noted differences that warranted technical justification and clarification beyond what was given in Section 3.4 of the GTS and its Bases. The following items are summaries of the concerns raised during the staff's review of the US-APWR GTS, Section 3.4:

- US-APWR GTS 3.4.6 contains operability requirements for RCS Loops – MODE 4. US-APWR GTS 3.4.6 models the RCS Loops – MODE 4 operability requirements in the Westinghouse STS. As part of its review, however, the staff noted that LCO 3.4.6 requirements for RHR equipment do not reflect the US-APWR design of four 50 percent RHR trains. In RAI 16-71, the applicant was asked to justify that when RHR equipment is used to provide RCS circulation, only two RHR trains are required to be operable and one RHR train is required to be in operation for decay heat removal. In its response letter, dated February 4, 2009, the applicant revised TS 3.4.6 and the associated Bases to reflect the correct minimum level of RHR equipment in LCO 3.4.6. The staff finds this response acceptable because the revised TS 3.4.6 and Bases reflect the design and operation of the RHR system described in DCD Section 5.4.7. Further, the staff has confirmed that Revision 2 of the US APWR DCD, dated October 27, 2009, contains most of the changes committed to in the RAI response, except for a change to the SR 3.4.6.1 discussion in the Bases; therefore, RAI 16-71 remains as a confirmatory item (CI-SRP-16-CTSB-146-1804/71).

- In a July 13, 2009, response to staff RAI 399, Question 16-298 regarding the adequacy of the value specified in the LCO of TS 3.4.9 for pressurizer water level, the applicant stated that the maximum pressurizer water level proposed in TS 3.4.9 is 92 percent and the safety analyses assume nominal pressurizer water level of 44 percent as the initial condition to begin the analyzed transient. This nominal pressurizer water level is maintained by a non-safety-grade control system. The applicant asserted that this is an acceptable approach. The staff does not agree with this applicant assertion. The only nominal values allowed to be used in safety analyses are, for departure from nucleate boiling events, the parameters involved in calculating DNBR using the Revised Thermal Design Procedure in which sufficient safety margins have been built into the methodology. For parameters involving the peak system pressure and/or potential pressurizer overfill evaluations, the initial conditions may be justified only if they are within the restrictions of LCOs in plant TS. This is required by Criterion 2 of 10 CFR 50.36(c)(2)(ii). There is a significant safety concern with this issue. Since the non-safety grade systems are not credited in the licensing safety analyses, it is likely that a transient initiated at a pressurizer water level of 92 percent would lead to overfill of the pressurizer shortly after the initiation of an increased RCS inventory event (Sections 15.5.1-2) or heatup events (Section 15.2.1-7). Such events could cause pressurizer safety relief valves to stick open due to liquid or two-phase relief through these valves (The safety relief valves in US-APWR design may not be qualified for these relief conditions). Thus, these potential scenarios could become unanalyzed events. Based on the above stated safety concern and regulatory requirements, the staff requested that the applicant modify the proposed TS to support the analyses assumptions made in Chapter 15 of the DCD so that the safety analyses documented in the DCD will remain valid for events initiated within the plant configuration restricted by plant TS. This issue will remain as an open item (OI-SRP-16-CTSB-399-2992/298) in the staff review until it is satisfactory resolved.

- US-APWR GTS 3.4.10 contains operability requirements for pressurizer safety valves. US-APWR GTS 3.4.10 models similar requirements in the Westinghouse STS. As part of its review, however, the staff noted that the discussion of SR 3.4.10.1 in the Bases regarding the valve lift setpoint was not consistent with requirements specified in LCO 3.4.10. In RAI 16-74, the applicant was asked to provide further clarification on this inconsistency. In its response letter, dated February 4, 2009, the applicant revised the supporting information in the Bases to make it consistent with requirements of LCO 3.4.10 and the referenced ASME Code, Section III, NB 7500. The staff finds this response acceptable because it aligns the LCO and its bases in regard to the valve lift setpoint. Further, the staff has confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI response; therefore, RAI 16-74 is considered resolved.

- US-APWR GTS 3.4.12 contains operability requirements for the LTOP system, which are modeled after similar requirements in the Westinghouse STS. As part of its review, the staff noted differences between the US-APWR GTS and the Westinghouse STS regarding the use of the RHR suction relief valves as means to prevent an overpressure condition in the RCS pressure boundary at low RCS temperature (below 350 degrees F). It is not clear in the Bases discussion if the single-failure criterion was considered when TS requirements were formulated in this regard. In RAI 16-79, the applicant was asked to provide further clarification on this staff concern. In its response letter, dated February 4, 2009, the applicant stated:

> "The RHR suction relief valves are considered passive components since these valves are a spring-loaded type. Therefore, there is no need to consider single active component failure."

The staff disagrees with the above stated position since the valve is changing its state from closed to open position when the lift setpoint is reached. A technical justification should be provided for not applying the single failure criterion to the spring-loaded relief valve design. This is an open item (OI-SRP-16-CTSB-146-1804/79).

- In RAI 16-80, the applicant was asked to provide basis information for the selected value of 2.6 square inch for the minimum vent area. In its response letter, dated February 4, 2009, the applicant proposed a change to the listed value, stating:

> "The vent size is determined based on pressure drop calculation. When an overpressure event occurs, RCS water is discharged from the RCS vent. In this condition, RCS pressure depends on the pressure drop of the vent portion. This vent size enables [it] to relieve maximum mass input (actuation of safety injection pumps) and the RCS pressure within the PTLR [*Pressure-Temperature Limit Report, DCD Section 5.3.2*] limit. Vent size will be revised to be 4.7 sq. inch since 2.6 sq. inch is incorrect. The pressure drop of the vent portion, which size is 4.7 sq. inch, is approx. 540 psi with assuming maximum mass input. This means the RCS pressure becomes approx. 540 psig, and so it is below the LTOP limit. (See DCD Figures 5.3-2 and 5.3-3.)" [sic]

The staff finds this response acceptable because revised GTS 3.4.12 and its Bases reflect the design and operation of the LTOP system described in DCD Section 5.2.2. Further, the staff has confirmed that Revision 2 of the US APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI response; therefore, RAI 16-80 is considered resolved.

- US-APWR GTS 3.4.14 contains RCS PIV leakage limits. US-APWR GTS 3.4.14 models the RCS PIV leakage limits in the Westinghouse STS. As part of its review, however, the staff noted that the applicant did not include a condition to address the RHR closure interlock feature that is verified to be operable under SR 3.4.14.2 and is discussed in the Bases. In RAI 16-92, the applicant was asked to provide justification for this omission. In its response letter, dated February 4, 2009, the applicant added Condition C for an inoperable RHR suction valve interlock function. The staff finds this response acceptable because the revised GTS 3.4.14 and its Bases conform to guidance in the Westinghouse STS. Further, the staff has confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI response; therefore, RAI 16-92 is considered resolved.

- In RAIs 16-93, 16-94, 16-95 and 16-96, the applicant was asked to address additional differences between US-APWR GTS 3.4.14 and the Westinghouse STS. In its response letter, dated February 4, 2009, the applicant proposed to revise the affected information in the Bases to resolve the noted differences, and conform GTS 3.4.14 to the corresponding STS provision. The staff finds these responses acceptable, and confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI responses; therefore, RAIs 16-93, 16-94, 16-95, and 16-96 are considered resolved.

- US-APWR GTS 3.4.15 contains RCS Dose Equivalent I-131 and Dose Equivalent Xe-133 limits. US-APWR GTS 3.4.15 models the RCS Dose Equivalent I-131 and Dose Equivalent Xe-133 limits in the Westinghouse STS. As part of its review, however, the staff noted that GTS 3.4.15 and its Bases contain information that was not consistent with the information contained in TSTF-490, "Deletion of E Bar Definition and Revision to RCS Specific Activity Technical Specification", Revision 0. In RAI 16-97, the applicant was asked to provide a justification for inconsistencies between the GTS Bases and TSTF-490. In its response letter, dated February 4, 2009, the applicant revised US-APWR GTS 3.4.15 and its Bases to fully incorporate the model requirements of TSTF-490, Revision 0. The staff finds this response acceptable and confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI response; therefore, RAI 16-97 is considered resolved.

- The US-APWR GTS do not include requirements equivalent to those shown in STS 3.4.19, which allow exception to TS 3.4.4 for performance of physics testing at power levels below 25 percent (e.g., the natural recirculation test). In RAI 16-99, the applicant was asked to justify this omission. In its response letter, dated February 4, 2009, the applicant proposed to add these TS requirements as US-APWR GTS 3.4.18, "RCS Loops - Test Exceptions," and its associated Bases in a future revision of the US-APWR DCD. The staff finds the addition acceptable and confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI response; therefore, RAI 16-99 is considered resolved.

- In RAIs 16-66, 16-70, 16-74, 16-84, 16-88 and 16-91, the applicant was asked to correct editorial errors found in TS Section 3.4. In its response letter, dated February 4, 2009, the applicant acknowledged the need to revise TS Section 3.4 to reflect these corrections. The staff has confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI responses; therefore, RAIs 16-66, 16-70, 16-74, 16-84, 16-88 and 16-91 are considered resolved.

- In addition, in RAIs 16-77, 16-78, 16-82, 16-83, 16-86, 16-87, and 16-89, the applicant was asked to address various missing details that leave the applicable discussion in the Bases incomplete. In its response letter, dated February 4, 2009, the applicant provided the omitted details. The staff finds these responses acceptable, and confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI responses except for one editorial error on Page B 3.4.12-4: "Refs 5 and 6" should be "Refs 6 and 7"; therefore, RAIs 16-77, 16-78, 16-82, 16-83, 16-86, and 16-87 are considered resolved, but RAI 16-89 remains as a confirmatory item (CI-SRP-16-CTSB-146-1804/89).

The remaining portions of US-APWR GTS Section 3.4 are similar to the applicable Westinghouse STS such that the staff finds them acceptable.

Verification that the RAI changes listed below are correctly incorporated into the US-APWR DCD is necessary via the corresponding RAI Confirmatory Item identifier referenced below:

RAI-SRP-16-CTSB-146-1804/71	Confirmatory Item: CI-SRP-16-CTSB-146-1804/71
RAI-SRP-16-CTSB-146-1804/89	Confirmatory Item: CI-SRP-16-CTSB-146-1804/89

The RAI items listed below are Open Items:

RAI-SRP-16-CTSB-146-1804/79	Open Item: OI-SRP-16-CTSB-146-1804/79
RAI-SRP-16-CTSB-399-2992/298	Open Item: OI-SRP-16-CTSB-399-2992/298

Conclusion

The applicant adhered to the RCS information as provided in the Westinghouse STS, with differences to reflect US-APWR unique design features. With respect to US-APWR unique design features, the GTS are sufficient to assure operation of these features within the bounds of the safety analyses. In addition, the US-APWR GTS, Section 3.4, and its Bases do not contain any "bracketed information" or "Reviewer's Notes" other than those associated with options to implement the newly proposed CRMP and SFCP as referenced in TS 5.5.18 and 5.5.19. Therefore, except for the confirmatory items discussed above, and resolution of the outstanding open items, the staff finds that Section 3.4 of the US-APWR GTS and Section B 3.4 of the US-APWR Bases are acceptable.

16.4.3.5 Emergency Core Cooling Systems

Introduction

The US-APWR GTS and Bases, Section 3.5, include requirements for the safety-related equipment designed for emergency core safety injection, decay heat removal, and RCS emergency water makeup source.

Evaluation

In general, Section 3.5 of the US-APWR GTS is modeled after Section 3.5 of the STS for Westinghouse plants, with differences to reflect US-APWR unique design features. These unique design features include the special design of two-flow-rate accumulators and only one subsystem for safety injection instead of three subsystems in the Westinghouse PWR design.

The US-APWR GTS for the Emergency Core Cooling System (ECCS) corresponds to the Westinghouse STS in the following manner:

STS	US-APWR GTS	TITLE (*STS TITLE, if different)
3.5.1	3.5.1	Accumulators
3.5.2*	3.5.2	Safety Injection System (SIS) - Operating (*ECCS - Operating)
3.5.3*	3.5.3	SIS - Shutdown (*ECCS - Shutdown)
3.5.4*	3.5.4	Refueling Water Storage Pit (*Refueling Water Storage Tank (RWST))
None	3.5.5	pH Adjustment (*N/A)
3.5.5*	None	N/A (*Seal Injection Flow)
3.5.6*	None	N/A (*Boron Injection Tank (BIT))

Unlike the typical Westinghouse PWR design currently in operation in the U.S. the US-APWR design does not use the charging pumps to perform any safety-related the safety injection function (e.g., STS Sections 3.5.5 and 3.5.6, seal injection flow and BIT, respectively) during a design basis event. As a result, the US-APWR GTS does not contain operability requirements for the boron injection by charging pumps as are provided in the Westinghouse STS, Sections 3.5.5 and 3.5.6. The staff determined this omission in the US-APWR GTS to be acceptable because the safety analyses in DCD Chapter 15 do not take credit for charging pump operation to mitigate any DBA.

Although the GTS, Section 3.5, does model the STS in format and content, the staff noted differences that warranted technical justification and clarification beyond what was given in Section 3.5 of the GTS and its Bases. The following items are summaries of the key concerns raised during the staff’s review of the US-APWR GTS, Section 3.5:

- In RAI 16-49, the applicant was asked to justify the specified volume range in SR 3.5.1.2 for each accumulator. In its response letter, dated February 4, 2009, MHI identified the dead volume associated with the accumulator as 3434 gallons. The dead volume is not taken into account in the large-break and small-break loss-of-coolant accident (LOCA) analyses. MHI also proposed to revise the values associated with SR 3.5.1.2 to match the volumes assumed in the safety analyses. MHI further indicated that the water volume in the accumulators is controlled by using water level gauges in consideration of instrument uncertainty. The staff finds this response acceptable, and confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI response; therefore, RAI 16-49 is considered resolved.

- US-APWR GTS, Section 3.5.1, contains operability requirements for accumulators as a source of safety injection during large-break LOCA. Section 3.5.1 of the US-APWR GTS models the accumulator operability requirements in the Westinghouse STS. During its review, however, the staff noted that the applicant adopted TSTF-370, “Increase Accumulator Completion Time From 1 Hour to 24 Hours (WCAP-15049),” Revision 0, without providing a detailed plant risk assessment as described in Topical Report WCAP-15049. In RAI 16-50, the applicant was asked to provide further justification for this TSTF adoption. In its response letter, dated February 4, 2009, MHI provided an evaluation of the applicability of the conclusion of TSTF-370 to the US-APWR TS. As the US-APWR is a four-loop PWR plant based on the same basic design concept as conventional PWRs, including the design basis success criteria of the accumulators, the basis of the 24 hour completion time discussed in TSTF-370 was considered applicable to the US-APWR TS. Therefore, the core damage scenarios after LOCA events, when an accumulator is unavailable, are equivalent to conventional plants. MHI performed a sensitivity study to assess the impact of accumulator outage on the core damage frequency (CDF). In the sensitivity study, the CDF, assuming one accumulator and one safety train out of service, was quantified. The result of this sensitivity study, documented in DCD Section 19.1.4.1.2 indicated that the increment of CDF is very low. MHI also proposed to revise the supporting information in the TS Bases, Section B 3.5.1, to include additional details regarding the applicability of TSTF-370 and a specific reference to the evaluation of the impact of accumulator outage on CDF. The staff finds this response acceptable and confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI response; therefore, RAI 16-50 is considered resolved.

- In RAI 16-51, the applicant was asked to justify identifying only two safety injection (SI) Pump Accumulator Makeup valves that require power lockout in SR 3.5.2.1. DCD Chapter 6 also identifies the four SI Pump Full Flow Test Line stop valves as being normally closed with control power locked out. In its response letter, dated February 4, 2009, the applicant stated:

> SR 3.5.2.1 addresses Safety Injection Pump Accumulator Makeup Valves (SIS-AOV-201 B and C). These valves are provided in the cross line between B and C safety injection trains, thereby misalignment of these valves could lead to simultaneous unavailability of two trains. Each of the Safety Injection Pump Full-Flow Test Line Stop Valves (SIS-MOV-024A, B, C and D) is provided in the associated independent train, and misalignment of these valves could not cause simultaneous unavailability of two or more trains … the second sentence of BASES for SR 3.5.2.1, "Misalignment of these valves could render its associated SIS train inoperable" will be corrected to "Misalignment of these valves could render two SIS trains inoperable." [sic]

The staff reviewed the discussion on SR 3.5.2.1 in the STS and determined that operating experiences documented in NRC Information Notice (IN) 87-01 are cited as the basis for this SR. The staff believes MHI has misinterpreted the safety implication of the staff conclusions in IN 87-01. If misalignment of a valve could render any SIS train inoperable (an unanalyzed configuration), that valve should be listed in SR 3.5.2.1. This is an open item (OI-SRP-16-CTSB-135-1818/51).

- US-APWR GTS, Section 3.5.2, contains operability requirements for the ECCS when the plant is in Mode 3 or above. Aside from the accumulators, the US-APWR ECCS design consists of only one medium head safety injection subsystem in contrast to the three SI subsystems in Westinghouse PWR plants. The US-APWR charging pumps do not perform safety injection function as mentioned earlier and the unique two-flow-rate design of the US-APWR accumulators obviates the need for the low head safety injection subsystem. The US-APWR ECCS operability requirements were formulated following the guidance from the Westinghouse STS with respect to equipment redundancy, potential loss of applicable safety function(s), and the relative importance of each system component in the plant accident/safety analyses. During its review, however, the staff noted that the applicant did not include a SR to verify the operability of ECCS valves which are manually operated during a design basis event. In RAI 16-53, the applicant was asked to justify this SR omission. In its response letter, dated February 4, 2009, MHI stated that remote manually operated valves are considered to have higher reliability than automatic valves. MHI also stated that, based on NUREG-1431, periodic actuation verification is not required for remote manually operated valves. The staff has determined that this response is unacceptable in that MHI does not provide any evaluation or justification for the statement that remote manually operated valves are considered to have higher reliability than automatic valves. MHI should provide some basis for this assertion, including addressing resolution of issues identified in GL 89-10 and GL 96-05. This is an open item (OI-SRP-16-CTSB-135-1818/53).

- In addition, in RAIs 16-54 and 16-55, the applicant was asked to address differences between the US-APWR GTS and the Westinghouse STS regarding discussion of safety injection pump performance criteria in the TS Bases. In its response letter, dated February 4, 2009, the applicant revised the TS Bases to add the requested details. The staff finds these responses acceptable, and confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI responses; therefore, RAIs 16-54 and 16-55 are considered resolved.

- US-APWR GTS, Section 3.5.4, contains operability requirements for the refueling water storage pool. Section 3.5.4 of the US-APWR GTS models the RWST operability requirements in the Westinghouse STS. During its review, however, the staff noted an inconsistency between the supporting information provided in the TS Bases and the referenced US-APWR DCD Subsection 15.5.1. In RAI 16-57, the applicant was asked to address this inconsistency. In its response letter dated February 4, 2009, the applicant revised GTS Bases B 3.5.4 to make them conform to DCD Subsection 15.5.1. The staff finds this response acceptable, and confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI response; therefore, RAI 16-57 is considered resolved.

- US-APWR GTS, Section 3.5.5, contains US-APWR design-specific operability requirements for the pH adjustment baskets, which do not exist in Westinghouse PWR plants. The pH adjustment system requirements were formulated following the guidance from the Westinghouse STS with respect to equipment availability, and potential loss of applicable safety function(s) in the plant accident/safety analyses. However, in RAI 16-58, the applicant was asked to provide further clarification regarding determination of system operability during plant power operation (Modes 1 through 4) while all applicable SRs are performed only during the plant refueling window (Mode 6). In its response letter dated February 4, 2009, MHI stated that although the established action statements and surveillance testing only make sense for Mode 4 in terms of system equipment readiness to fulfill their safety function and may not be realistic for Modes 1 through 3, Mode restriction for the applicability of specified action statements to only Mode 4 is not necessary because no equipment misoperation or any other problem is expected. Since this surveillance testing will be performed in Mode 5 before entry into Mode 4, and this surveillance testing is not feasible in Modes 1 through 3, the staff finds this response acceptable. Therefore, RAI 16-58 is considered resolved.

- In RAIs 16-48 and 16-52, the applicant was asked to correct editorial errors found in TS Section 3.5. In its response letter dated February 4, 2009, the applicant acknowledged the need to revise TS Section 3.5 to reflect these corrections. The staff has confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI responses; therefore, RAIs 16-48 and 16-52 are considered resolved.

The remaining portions of the US-APWR GTS, Section 3.5, are similar to the applicable STS such that the staff finds them acceptable.

The RAI items listed below are the Open Items identified in this section:

RAI-SRP-16-CTSB-135-1818/51	Open Item: OI-SRP-16-CTSB-135-1818/51
RAI-SRP-16-CTSB-135-1818/53	Open Item: OI-SRP-16-CTSB-135-1818/53

Conclusion

The applicant adhered to the ECCS information as provided in the Westinghouse STS, with some differences to reflect US-APWR unique design features. With respect to US-APWR unique design features, the GTS are sufficient to assure operation of these features within the bounds of the safety analyses. In addition, the US-APWR GTS, Section 3.5, and its Bases do not contain any “bracketed information” or “Reviewer’s Notes,” other than those associated with options to implement the newly proposed CRMP and SFCP as referenced in TS 5.5.18 and 5.5.19. Therefore, except for the two open items discussed above, the staff finds that Section 3.5 of the US-APWR GTS and Section B 3.5 of the US-APWR Bases are acceptable.

16.4.3.6 Containment Systems

Introduction

The US-APWR GTS and Bases, Section 3.6, Containment Systems, include requirements for the containment systems, which are designed to contain fission products that may exist in the containment atmosphere following accident conditions.

Evaluation

In general, Section 3.6 of the US-APWR GTS is modeled after Section 3.6 of the STS for Westinghouse plants, with differences to reflect US-APWR unique design features. These unique design features include (1) no use of safety-related equipment for post LOCA containment air cooling, containment air cleanup or containment combustible gas control, (2) no use of a containment spray additive system, and (3) no use of vacuum relief valves. The US-APWR GTS for the Containment Systems corresponds to the Westinghouse STS in the following manner:

STS	US-APWR TS	TITLE (*STS TITLE, if different)
3.6.1	3.6.1	Containment

3.6.2	3.6.2	Containment Air Locks
3.6.3	3.6.3	Containment Isolation Valves
3.6.4A	3.6.4	Containment Pressure
3.6.5A	3.6.5	Containment Air Temperature
3.6.6B*	3.6.6	Containment Spray System (*Containment Spray and Cooling Systems)
3.6.7*	None	(*Spray Additive System)
3.6.9*	None	(*Hydrogen Mixing System (HMS))
3.6.11*	None	(*Iodine Cleanup System (ICS))
3.6.12*	None	(*Vacuum Relief Valves)

Unlike typical PWR designs currently in operation in the U.S., the US-APWR design does not have a Containment Spray Additive System, a Containment HMS, a Containment ICS, or Containment Vacuum Relief Valves. As a result, the US-APWR GTS do not include any requirements comparable to the Westinghouse STS, Sections 3.6.7, 3.6.9, 3.6.11 and 3.6.12 for operations of these systems. In the APWR design, (1) the pH adjustment baskets in LCO 3.5.5 perform the function of maintaining the post accident pH level of water inventory inside the Containment, in place of the spray additive system in the Westinghouse PWR design, (2) the non safety-related combustible gas control system is designed for severe accident events, (3) the DBA analyses as described in APWR DCD Sections 6.5.3 and 15.6.5 do not credit removal of gaseous iodine by a safety-related filtration system similar to the one used in the Westinghouse PWR design, and (4) the containment external pressure analysis for an inadvertent spray actuation event as described in APWR DCD Section 6.2.1 does not credit operation of vacuum relief valves as those used in the Westinghouse PRW design. Therefore, the staff finds these omissions in the US-APWR GTS to be acceptable.

Although the GTS, Section 3.6, does model the STS in format and content, the staff noted differences that warranted technical justification and clarification beyond what was given in Section 3.6 of the GTS and its Bases. The following items are summaries of the key concerns raised during the staff's review of the US-APWR GTS, Section 3.6:

- The US-APWR GTS, Section 3.6.3, contains operability requirements for the containment isolation valves. The US-APWR GTS Section 3.6.3 requirements model similar requirements in the Westinghouse STS Section 3.6.3. During its review, however, the staff noted that all applicable requirements related to resilient seals used in the design of Containment Purge isolation valves were omitted in the US-APWR GTS. In RAI 16-60, the applicant was asked to justify these omissions. In its response letter dated February 4, 2009, MHI revised the US-APWR GTS to incorporate applicable portions of the Westinghouse STS to leave the possibility of using resilient seals in the US-APWR containment purge isolation valves. The staff finds this response acceptable, and confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI response; therefore, RAI 16-60 is considered resolved.

- The US-APWR GTS, Section 3.6.6, contains operability requirements for the Containment Spray system. The US-APWR GTS Section 3.6.6 requirements model similar requirements in the Westinghouse STS Section 3.6.6B. However, the US-APWR design does not have a safety grade Containment Cooling system comparable to that in the Westinghouse PWR design, which together with the Containment Spray system covers the total containment cooling loads during a DBA event. As a result, the staff determined that the completion times for

Condition A with one CS train inoperable (7 days) and Condition B with less than two CS trains operable (72 hours), did not appear to be adequate considering the lack of available redundant equipment. In RAI 16-64, the applicant was asked to provide justification for these completion times. In its response letter dated February 4, 2009, MHI proposed to (1) revise the CT for Action A1 to be 72 hours based on the single failure criterion not being met, (2) delete Condition B and its' associated actions using LCO 3.0.3 as the default action for unanalyzed plant configuration and (3) renumber, as necessary, the remaining Condition C. The staff finds this response acceptable since the revised GTS 3.6.6 and its associated Bases conform to the guidance provided in the STS and reflect the CS system design and operation as described in APWR DCD Section 6.2.2. The staff also confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI response; therefore, RAI 16-64 is considered resolved.

- In RAI 6.2.4-50, the applicant was asked to clarify a design feature of the low-volume containment purge valve which appears to be in conflict with requirements specified in SR 3.6.3.2. In its response letter dated June 16, 2009, MHI provided clarifying details including changes to DCD Table 9.4-1 and the GTS Bases B 3.6.3 to make this supporting information consistent with SR 3.6.3.2 requirements. The staff finds this response acceptable, and confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI response; therefore, RAI 6.2.4-50 is considered resolved

- In RAIs 16-59, 16-61, 16-63 and 16-65, the applicant was asked to correct editorial errors found in TS Section 3.6. In its response letter dated February 4, 2009, the applicant acknowledged the need to revise TS Section 3.6 to reflect these corrections. The staff has confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI responses; therefore, RAIs 16-59, 16-61, 16-63 and 16-65 are considered resolved.

The remaining portions of the US-APWR GTS, Section 3.6 are similar to the applicable STS such that the staff finds them acceptable.

Conclusion

The applicant adhered to the Containment Systems information as provided in the Westinghouse STS, with some differences to reflect US-APWR unique design features. With respect to US-APWR unique design features, the GTS are sufficient to assure operation of these features within the bounds of the safety analyses. In addition, the US-APWR GTS, Section 3.6, and its Bases do not contain any “bracketed information” or “Reviewer’s Notes,” other than those associated with options to implement the newly proposed CRMP and SFCP as referenced in TS 5.5.18 and 5.5.19. Therefore, the staff finds that Section 3.6 of the US-APWR GTS and Section B 3.6 of the US-APWR Bases are acceptable.

16.4.3.7 Plant Systems

Introduction

The US-APWR GTS and Bases, Section 3.7, Plant Systems, include the requirements for other plant systems and components on the secondary-side of the steam generators such as the main steam safety valves, the main steam isolation valves, the main feedwater valves, the main steam depressurization valves (MSDVs), the feedwater system, the component cooling water system, the essential service water system, etc., and requirements for controlling parameters in the secondary side fluid such as specific activity, or boron concentration and water level in the spent fuel storage pit.

Evaluation

In general, Section 3.7 of the US-APWR GTS is modeled after Section 3.7 of the STS for Westinghouse plants, with differences to reflect US-APWR unique design features. These unique design features include no use of safety-related equipment for post FHA fuel building air cleanup and no allowance for high-density storage of spent fuel assemblies in the storage spool. The US-APWR GTS for secondary-side plant systems correspond to the Westinghouse STS in the following manner:

STS	US-APWR GTS	TITLE (*STS TITLE, if different)
3.7.1	3.7.1	MSSVs
3.7.2	3.7.2	MSIVs
3.7.3*	3.7.3	Main Feedwater Isolation Valves (MFIVs), Main Feedwater Regulation Valves (MFRV), MFBRVs, and SGWFCV (*Main Feedwater Isolation Valves (MFIVs) and MFRVs and Associated Bypass Valves)
3.7.4*	3.7.4	Main Steam Depressurization Valves (MSDVs) (*Atmospheric Dump Valves (ADV))
3.7.5*	3.7.5	EFW System (*Auxiliary Feedwater System)
3.7.6*	3.7.6	EFW Pit (*Condensate Storage Tank)
3.7.7	3.7.7	CCW System
3.7.8*	3.7.8	ESWS(*Service Water System SWS))
3.7.9	3.7.9	Ultimate Heat Sink (UHS)
3.7.10*	3.7.10	MCRVS (*Control Room Emergency Filtration System (CREFS))
3.7.11*	3.7.10	MCRVS (*Control Room Emergency Air Temperature Control System (CREATCS))
3.7.12*	3.7.11	Annulus Emergency Exhaust System (*ECCS Pump Room Exhaust Air Cleanup System)
3.7.13*	None	N/A (*FBACS)
3.7.14*	3.7.11	Annulus Emergency Exhaust System (*Penetration Room Exhaust Air Cleanup System)
3.7.15*	3.7.12	Fuel Storage Pit Water Level (*Fuel Storage Pool Water Level)
3.7.16*	3.7.13	Fuel Storage Pit Boron Concentration (*Fuel Storage Pool Boron Concentration)
3.7.17*	None	N/A (*Spent Fuel Pool Storage)
3.7.18	3.7.14	Secondary Specific Activity

Unlike the typical Westinghouse PWR design currently in operation in the U.S., the US-APWR design does not have a FBACS. The FHA analyses, as described in US-APWR DCD Section 15.7.4 for a postulated accident in the spent fuel storage area, do not credit the removal of gaseous iodine by a safety-related filtration system similar to the one currently used in Westinghouse PWR plants in the U.S., for mitigation of dose consequences to the public. As a result, the US-APWR GTS does not contain operability requirements for this system as is provided in the Westinghouse STS 3.7.13. The staff determined this omission in the US-APWR GTS to be acceptable.

Although the GTS, Section 3.7, does model the STS in format and content, the staff noted differences that warranted technical justification and clarification beyond what was given in Section 3.7 of the GTS and its Bases. The following items are summaries of the key concerns raised during the staff's review of the US-APWR GTS, Section 3.7:

- US-APWR GTS 3.7.1 contains the operability requirements for the main steam safety valves (MSSVs). Section 3.7.1 of the US-APWR GTS models the MSSV operability requirements in the Westinghouse STS. As part of its review, the staff noted inconsistency between the US-APWR GTS and the referenced ASME Code, Section III, NC 7000, regarding the +/- 3 percent tolerance applied to the valve lift setpoint. In RAI 16-144, the applicant was asked to provide further clarification for this inconsistency. In its response letter dated February 20, 2009, MHI proposed to revise this tolerance to +/- 1 percent to be consistent with ASME Code, Section III, requirements. The staff finds this revision acceptable and confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI response; therefore, RAI 16-144 is considered resolved.

- US-APWR GTS, Section 3.7.4, contains the operability requirements for the MSDVs. Section 3.7.4 of the US-APWR GTS models the ADV operability requirements in the Westinghouse STS. As part of its review, the staff noted differences between the US-APWR GTS and the Westinghouse STS regarding a closed block valve in the flow path to the MSDV. In RAI 16-153, the applicant was asked to provide further clarification on this difference. In its response letter dated February 20, 2009, MHI proposed to add a discussion on a closed block valve, which states: "A closed block valve does not render it or its MSDV line inoperable if operator action time to open the block valve is supported in the accident analysis." This approach is acceptable to the staff since a review of DCD subsection 15.6.3 confirmed that the cited operator action was credited in a steam generator tube rupture event which is the limiting event for the MSDVs. The staff also confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI response; therefore, RAI 16-153 is considered resolved.

- In RAI 16-155, the applicant was asked to clarify the minimum EFWS Pit volume specified in SR 3.7.6.1 which was identical to the maximum usable volume described in DCD subsection 10.4.9. In its response letter dated February 20, 2009, MHI revised the applicable information in the DCD to clearly delineate the minimum volume taking into consideration allowances for instrumentation errors. This change is acceptable to the staff since it removes the ambiguity in the DCD which led to a misinterpretation of the specified value in the GTS. The staff confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI response; therefore, RAI 16-155 is considered resolved.

- US-APWR GTS, Section 3.7.9, contains bracketed information regarding TS requirements for the plant UHS which will be established by potential applicants for construction permits or COLs.

- US-APWR GTS, Section 3.7.10, contains operability requirements for the MCRVS. The applicant combined TS requirements from Westinghouse STS 3.7.10 and STS 3.7.11 into one requirement, TS 3.7.10, in the US-APWR GTS. The staff finds the combined US-APWR GTS 3.7.10 requirements acceptable since they are comparable in format and content to the applicable STS requirements and reflect the relevant US-APWR design and system information provided in the DCD Subsections 6.4 and 9.4.1. The applicant also adopted TSTF-448, Revision 3, which addresses safety issues identified in Generic Letter 2003-01 regarding Control Room habitability requirements. As part of its review, the staff noted that some TSTF model requirements are not fully incorporated into the US-APWR GTS. In RAI 16-145, the applicant was asked to provide further clarifications on these items. In its response letter dated February 20, 2009, the applicant proposed to revise TS 3.7.10 and the associated Bases to fully incorporate TSTF-448 model requirements set forth in TSTF-448, Revision 3. The staff finds this response acceptable and confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI response; therefore, RAI 16-145 is considered resolved.

- US-APWR GTS Section 3.7.10 and the associated Bases contain bracketed preliminary information regarding an assessment of a toxic gas release event to be addressed by potential applicants for construction permits or COLs.

- The US-APWR GTS, Section 3.7.11, contain operability requirements for the Annulus Emergency Exhaust System. The applicant combined model TS requirements from two Westinghouse specifications, STS 3.7.12 and STS 3.7.14, into one specification, TS 3.7.11, in the US-APWR GTS. The staff finds the combined US-APWR GTS 3.7.11 requirements acceptable since they are comparable in format and content to the applicable STS requirements and reflect relevant design and system information provided in DCD Subsection 9.4.5.

- US-APWR GTS, Section 3.7 does not include TS requirements equivalent to those provided in Westinghouse STS 3.7.17 for storage of spent fuel assemblies. In Technical Report MUAP-07039, "Justifications for Deviations Between NUREG-1431 Revision 3.1 and US-APWR Technical Specifications," the applicant states that the US-APWR design does not have a Region 2 location for high-density storage like the one existing in the Westinghouse design, and thus, no TS requirements are needed for control of storage in such a location. This justification is consistent with design information provided in DCD Section 9.1.1. Therefore, the staff determined this omission in the US-APWR GTS to be acceptable.

- In RAI 16-149, the applicant was asked to justify not providing applicable LCOs for safety-related ESF ventilation systems such as the Class 1E Electrical Room heating, ventilation, and air conditioning (HVAC) system or the emergency feedwater (EFW) Pump Area HVAC system. In its response letter dated

February 20, 2009, MHI stated:

> The definition of "OPERABLE – OPERABILITY" in Technical Specification reads, "A system, subsystem, train, component, or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified safety function(s) and when all necessary attendant instrumentation, controls, normal or emergency electrical power, cooling and seal water, lubrication, and other auxiliary equipment that are required for the system, subsystem, train, component, or device to perform its specified safety function(s) are also capable of performing their related support function(s)." The ESF AHUs are required to support primary systems that mitigate a design basis accident or transient. Thus, MHI considers that the LCO for these ESF AHUs are included in LCO for primary systems.

The staff finds the stated position acceptable since it is consistent with general guidance provided in the Westinghouse STS. Therefore, RAI 16-149 is considered resolved.

- In RAI 9.2.1-26, the applicant was asked to address an inconsistency between GTS 3.7.8 and relevant information provided in DCD sections 8.3.1 and 9.2.1 regarding heat loads from the GTG coolers. In its response letter dated June 16, 2009, MHI confirmed that information provided in DCD Sections 8.3.1 and 9.2.1 is correct, and proposed changes to correct errors made in TS 3.7.8 and its associated Bases. The staff finds this response acceptable, and confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI response. Therefore, the TS-related issue raised in RAI 9.2.1-26 is considered resolved.

- Also, in RAI 9.4.1-12, the applicant was asked to clarify testing requirements specified in SR 3.7.10.5 regarding verification of design cooling loads for any of the four redundant 50 percent MCRATCS trains. In its response letter dated November 20, 2009, the applicant provided the requested details including proposed changes to TS 3.7.10 and the associated Bases to reflect these new details. Verification that the stated changes are correctly incorporated in the US-APWR DCD is a confirmatory item (CI 9.4.1-12).

- In RAIs 16-141, 16-147, 16-150, 16-151, 16-154 and 16-157, the applicant was asked to correct editorial errors found in TS Section 3.7. In its response letter dated February 20, 2009, the applicant acknowledged the need to revise the TS Section 3.7 to reflect these corrections. The staff has confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI responses; therefore, RAIs 16-141, 16-147, 16-150, 16-151, 16-154 and 16-157 are considered resolved.

The remaining portions of the US-APWR GTS, Section 3.7 are similar to the applicable STS such that the staff finds them acceptable.

Conclusion

The applicant adhered to the Plant Systems information as provided in the Westinghouse STS, with differences to reflect US-APWR unique design features. With respect to US-APWR unique design features, the GTS are sufficient to assure operation of these features within the bounds of the safety analyses. The US-APWR GTS, Section 3.7, and its Bases do contain "bracketed information." The staff reviewed each piece of "bracketed information" to understand its intent and to determine whether each was site-specific and appropriately deferred to applicants for construction permits or COLs that reference the US-APWR GTS. The staff concluded that each such item was indeed plant- or site-specific. Therefore, the staff finds that Section 3.7 of the US-APWR GTS and Section B 3.7 of the US-APWR Bases are acceptable.

16.4.3.8 Electrical Power Systems

Introduction

The US-APWR GTS and Bases, Section 3.8, includes requirements for the Electrical Power Systems that provide redundant, diverse and dependable power sources for all plant operating conditions. In the event of a total loss of off-site power, on-site GTGs and batteries are provided to supply electrical power equipment necessary for the safe shutdown of the plant.

Evaluation

Although the US-APWR GTS, Section 3.8, does model the STS in format and content, the staff noted differences that warranted technical justification and clarification beyond what was given in Section 3.8 of the GTS and its Bases. The US-APWR GTS for electrical power systems correspond to the Westinghouse STS in the following manner:

STS	US-APWR GTS	TITLE (*STS TITLE, if different)
3.8.1	3.8.1	AC Sources – Operating
3.8.2	3.8.2	AC Sources – Shutdown
3.8.3	3.8.3	Class 1E GTG Fuel Oil, Lube Oil, and Starting Air (*DFO, LO, and Starting Air)
3.8.4	3.8.4	DC Sources – Operating
3.8.5	3.8.5	DC Sources – Shutdown
3.8.6	3.8.6	Battery Parameters
3.8.7	3.8.7	Inverters – Operating
3.8.8	3.8.8	Inverters – Shutdown
3.8.9	3.8.9	Distribution Systems – Operating
3.8.10	3.8.10	Distribution Systems – Shutdown

The following are summaries of key concerns raised during the staff's review of the US-APWR GTS, Section 3.8:

- In RAI-SRP-16-CTSB-134-1825, Question 16-23, the staff asked the applicant to provide justification for the minimum amount of fuel contained in the GTG day tank in SR 3.8.1.4 and the minimum run time. MHI responded that while the capacity of the GTG fuel oil storage tank should be consistent with the accident analysis and RG 1.137, the capacity of the day tank is not based on the US-APWR accident analyses, but is designed for full-load fuel consumption for 1 hour plus 10 percent, which is equivalent to 600 gallons, based on the provided GTG fuel demand of 542 gal/hr at full load. The staff finds the response acceptable since it meets the guidance of RG 1.137 for fuel consumption of the prime mover and is not credited in the accident analysis. Therefore RAI-SRP-16-CTSB-134-1825, Question 16-23, is closed.

- In RAI-SRP-16-CTSB-134-1825, Question 16-24, the staff asked the applicant to provide justification for the performance frequency of 24 months for the automatic and manual bus transfer surveillance test, SR 3.8.1.7, compared to the performance frequency of 18 months for the STS NUREG-1431 SR 3.8.1.8. In summary, the MHI response was that the increased surveillance interval would not significantly degrade reliability. The staff finds the response acceptable. The 24 month frequency of the surveillance is intended to be consistent with the expected fuel cycle lengths and is based on engineering judgment. The switching function of the circuit breakers will not be degraded within 24 months based on appropriate maintenance of the breaker, and therefore the frequency was concluded to be acceptable from a reliability standpoint. RAI-SRP-16-CTSB-134-1825, Question 16-24, is closed.

- In RAI-SRP-16-134-1825, Question 16-25, the staff asked the applicant to provide justification why a US-APWR Class 1E GTG maximum allowable startup time of 100 seconds is acceptable to support the assumptions made for the DBA analysis compared to the DG maximum allowable startup time of 10 seconds in the DG startup surveillance test requirements for the STS NUREG-1431 TS 3.8.1, LCO 3.8.1. The MHI response was that maximum allowable startup time of 100 seconds for a Class 1E GTG is considered in the accident analysis, as shown in Table 15.0-5 of DCD Chapter 15. The staff finds the response acceptable. RAI-SRP-16-134-1825, Question 16-25, is closed.

- In RAI-SRP-16-CTSB-134-1825, Question 16-26 (EEB RAI 16-2), the staff asked the applicant to provide justification why there is no required action equivalent to the STS NUREG-1431 LCO 3.8.1, Required Action A.2, for LCO 3.8.1 Condition A in the US-APWR GTS to provide assurance that an event with a coincident single failure will not result in a complete loss of redundant required safety functions associated with critical, two-train, safety loads.

  The applicant responded that the “condition that one required feature composed of four trains becomes inoperable during the existence of Condition A, furthermore if a single failure of one GTG is caused, features in redundant three trains would keep their one hundred and fifty percent capacity which satisfies the required function,” and therefore, the Required Action to declare a required feature inoperable was not necessary.

  STS LCO 3.8.1 Condition A requires a cross check among the redundant safety divisions to determine how many trains of a given system are unavailable. The applicant did not include this cross check; therefore the staff believes Required Action A.2 should be added. This is Open Item OI-SRP-16-CTSB-134-1825, Question 16-26 (EEB RAI 16-2).

- In RAI-SRP-16-CTSB-134-1825, Question 16-27, the staff asked the applicant to provide justification for the performance frequency of 24 months for the automatic and manual bus transfer surveillance test SR 3.8.1 and US-APWR Class 1E GTG refueling cycle surveillance tests SR 3.8.1.8 through SR 3.8.1.18. The industry operating experience with DGs may not directly translate over for GTGs. The applicant based the Class 1E GTG reliability performance and SR frequency on operating experience of non-nuclear GTGs, presented in Technical Report MUAP-07024. This is an open item, OI-16-CTSB-134-1825, Question 16-27, and the staff will make a determination on it in the context of the staff review of Technical Report MUAP-07024.

- In RAI-SRP-16-CTSB-134-1825, Question 16-28, the staff asked the applicant to provide further details in the Bases discussion for the US-APWR TS 3.8.1, Condition C, when the plant is operating in Mode 1, 2, 3, or 4 with neither of the two qualified offsite circuits available and Required Action C.1 is being implemented to restore one of the inoperable circuits. The applicant responded by adding a clarifying statement to the Bases. The Class 1E GTGs connect to Class 1E buses when all other ac power sources are unavailable, until one required offsite circuit is restored to operable status. Completion Time of subsequent conditions is limited by maximum completion time in accordance with administrative controls. The staff finds the MHI response acceptable and verified that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI response. RAI-SRP-16-CTSB-134-1825, Question 16-28, is closed.

- In RAI-SRP-16-CTSB-134-1825, Question 16-30, the staff asked the applicant to provide justification for the completion time of 2 hours in the US-APWR TS 3.8.1, LCO 3.8.1 Actions, Condition E when 3 required GTGs are inoperable. The applicant responded that the required safety function can be maintained with expected single failure, and that Condition E is equivalent to Condition E of the STS. The staff finds the MHI response acceptable. RAI-SRP-16-CTSB-134-1825, Question 16-30, is closed.

- In RAI-SRP-16-CTSB-134-1825, Question 16-31, the staff asked the applicant to provide clarification on whether the intent of TS 3.8.1, LCO 3.8.1, Item c, is to require operable automatic load sequencers for all four Class 1E ac power safety trains; since their function can also affect offsite circuits, or operable automatic load sequencers for only those Class 1E ac power safety trains that are backed up by operable Class 1E GTGs. In summary, the MHI response clarified that when an automatic load sequencer becomes inoperable, its corresponding Class 1E ac power system cannot perform the safety function for mitigation against operating contingencies, and therefore, is also considered inoperable. The staff finds the MHI response acceptable. RAI-SRP-16-134-1825, Question 16-31, is closed.

- In RAI-SRP-16-CTSB-134-1825, Question 16-32, the staff asked the applicant to provide clarification whether Condition F, under US-APWR TS 3.8.1, LCO 3.8.1 ACTIONS, is intended to include the Condition in which the plant is operating in MODE 1, 2, 3, or 4 with more than one automatic load sequencers inoperable. The staff determined that it was not clear why only one Condition with one completion time was used to address the automatic load sequencers. MHI responded that in TS 3.8.1 there is no Condition that addresses more than one automatic load sequencer being inoperable, and therefore when more than one is inoperable, the shutdown LCO 3.0.3 is entered. The staff finds the MHI response acceptable. RAI-SRP-16-134-1825, Question 16-32, is closed.

- In RAI-SRP-16-CTSB-134-1825, Question 16-34, the staff asked the applicant to provide justification for the difference in the minimum current limit (greater than or equal to 400 A) supplied by the battery charger at greater than or equal to the minimum established float voltage for at least 8 hours cited in US-APWR TS 3.8.4 surveillance test requirement SR 3.8.4.2, compared to the minimum current limit cited in STS NUREG-1431 TS 3.8.4 SR 3.8.4.2 (greater than or equal to 800 A). The applicant stated that the capacity of the battery charger is based on battery capacity and steady-state loads. The battery capacity and steady-state load is different from that of the STS. The Bases discussion is nearly identical to the STS, because the methodology is the same. The staff finds the MHI response acceptable. RAI-SRP-16-134-1825, Question 16-34, is closed.

- In RAI-SRP-16-CTSB-134-1825, Question 16-36, the staff asked the applicant to provide justification for not including a Condition under TS 3.8.4, LCO 3.8.4 ACTIONS, specifically addressing the case in which the plant is operating in Mode 1, 2, 3, or 4 when two or more required dc electrical power subsystems become inoperable. MHI responded that the condition of "three required dc electrical power subsystems inoperable" is similar to the condition of "two required dc electrical power subsystems inoperable" in STS NUREG-1431. Therefore, when a plant is in this condition, the plant shall enter LCO 3.0.3. The staff finds the MHI response acceptable. RAI-SRP-16-134-1825, Question 16-36, is closed.

- In RAI-SRP-16-CTSB-134-1825, Question 16-37, the staff asked the applicant to provide justification for the difference between the US-APWR TS Class 1E battery float current limit of 5A and its corresponding verification completion time of once per 24 hours and the STS NUREG-1431 float current limit of 2A and corresponding completion time of once per 12 hours. (Also affects sections 3.8.5 and 3.8.6). The applicant placed the float current values in brackets, which allows the COL applicant to determine the proper value. In terms of the 24 hour surveillance interval, MHI is required to return the surveillance interval back to 12 hours, in accordance with the Westinghouse STS. The staff finds MHI's response to the float current values acceptable. Revision 2 of the US-APWR DCD did not show the change from the 24 hour surveillance interval back to a 12 hour surveillance interval. Verification that the referenced change is correct and that all changes are properly incorporated into the US-APWR DCD is Confirmatory Item CI-SRP-16-CTSB-1825/37.

- In RAI-SRP-16-CTSB-134-1825, Question 16-44, the staff asked the applicant to provide justification for not including a Condition under TS 3.8.7, LCO 3.8.7 ACTIONS, specifically addressing the case in which the plant is operating in Mode 1, 2, 3, or 4 when two or more required inverters become inoperable. MHI responded that when the associated Action for two or more required inverters becoming inoperable is not provided, the plant shall enter shutdown LCO 3.0.3. The staff finds the response acceptable. RAI-SRP-16-134-1825, Question 16-44, is closed.

- In RAI No. 72-853, Question 16-8 (EEB), the staff asked the applicant to confirm that 0.9 is the design load power factor that the GTG will experience during accident loading.

  The applicant responded that the GTG load power factor does not exceed 0.9. In US-APWR DCD Chapter 8, Table 8.3.1.4, the average of load power factors during accident loading is approximately 0.85. Therefore, the applicant described the GTG load power factor as being ≤ 0.9 in DCD TS SR (SR) 3.8.1.9.

  Given that the accident loading is roughly 0.85 power factor, the staff recommends that 0.9 be used as an upper bound, but that a statement be added that the loading should be as close to 0.85 as is practical. This is Open Item OI-SRP-16.3.8-EEB-08.

The remaining portions of US-APWR GTS Section 3.8 and Bases are similar to the applicable STS such that the staff finds them acceptable.

The RAI items listed below are Open Items, as previously discussed:

RAI-SRP-16-CTSB-134-1825/26 (16-2)	Open Item: OI-SRP-16-CTSB-134-1825/26 (16-2)
RAI-SRP-16-CTSB-134-1825/27	Open Item: OI-SRP-16-CTSB-134-1825/27
RAI No 72-853 Question 16-8 (EEB)	Open Item: OI-SRP-16.3.8-EEB-08

Conclusion

The applicant adhered to the Electrical Power Systems information as provided in the Westinghouse STS, with differences to reflect US-APWR use of GTGs in lieu of DGs and other unique design features. With respect to US-APWR unique design features, the GTS are sufficient to assure operation of these features within the bounds of the safety analyses. The US-APWR GTS, Section 3.8, and its Bases contain "bracketed information," including "bracketed information" associated with options to implement the newly proposed CRMP and SFCP as referenced in TS 5.5.18 and 5.5.19. The staff reviewed each piece of "bracketed information" to understand its intent and to determine whether each was site-specific and appropriately deferred to applicants for construction permits or COLs that reference the US-APWR GTS. The staff concluded that each such item was indeed plant- or site-specific. Therefore, except for resolution of the outstanding open items, the staff finds that Section 3.8 of the US-APWR GTS and Section B 3.8 of the US-APWR Bases are acceptable.

16.4.3.9 Refueling Operations

Introduction

The US-APWR GTS and Bases, Section 3.9, include requirements for boron concentration, unborated water source, nuclear instrumentation, containment closure, RHR, and water inventory in the refueling pool during Mode 6.

Evaluation

In general, Section 3.9 of the US-APWR GTS is modeled after Section 3.9 of the STS for Westinghouse plants. The US-APWR GTS, Section 3.9, Refueling Operations, corresponds to the Westinghouse STS in the following manner:

STS	US-APWR GTS	TITLE (*STS TITLE, if different)
3.9.1	3.9.1	Boron Concentration
3.9.2	3.9.2	Unborated Water Source Isolation Valves
3.9.3	3.9.3	Nuclear Instrumentation
3.9.4	3.9.4	Containment Penetrations
3.9.5	3.9.5	RHR and Coolant Circulation - High Water Level
3.9.6	3.9.6	RHR and Coolant Circulation - Low Water Level
3.9.7	3.9.7	Refueling Cavity Water Level

Although the GTS, Section 3.9, does model the STS in format and content, the staff noted differences that warranted technical justification and clarification beyond what was given in Section 3.9 of the GTS and its Bases. The following items are summaries of the key concerns raised during the staff's review of the US-APWR GTS, Section 3.9:

- The US-APWR GTS, Subsection 3.9.4, LCO 3.9.4.a, contains a requirement for containment closure with the equipment hatches to be held in place with 4 bolts. The Westinghouse STS has identified this requirement as preliminary pending additional details regarding equipment hatch weight, bolting size, and bolt material. In RAI 16-15, the applicant was asked to provide additional details on the equipment hatch weight and bolting design. In its response letter dated January 29, 2009, the applicant stated:

  > "The weight of equipment hatch is planned as 900 kN or less. The diameter of bolts is planned as more than 1.4 inch. When the equipment hatch is held in place by four bolts, the shear stress for each bolt is less than 33,000 psi, which is enough smaller than one half of the minimum yield stress of bolt material 81,000 psi." [sic].

  The staff noted that the information provided above is still preliminary in nature, and suggested that the "4 bolts" requirement in LCO 3.9.4.a remain bracketed as shown in the Westinghouse STS. This is an open item (OI-SRP-16-CTSB-133-1827/15).

- In LCO 3.9.4.a, the applicant proposed a new option to allow an open equipment hatch that is capable of being closed when needed and a new SR 3.9.4.2 to be performed if the option is used. In RAI 16-20, the applicant was asked to provide a discussion in the US-APWR GTS Bases comparable to that provided in the AP1000 GTS regarding the steaming condition due to loss of RHR. In its response letter dated January 29, 2009, the applicant indicated that no further information would be provided in the Bases and stated:

  > "The requirement that equipment hatches are capable of being closed, which is different from the Technical Specifications of AP1000, is approved by NRC in Technical Specification Task Force TSTF-68-A, Revision 2."

  In a review of TSTF-68-A, Revision 2, the staff noted that the NRC's acceptance of TSTF-68-A, Revision 2, is applicable only to Containment Personnel Air Lock Doors, and not to Equipment Hatches. Therefore, the staff has determined that the above response is unacceptable. A discussion of the steaming condition should have been provided as originally requested. This is an open item (OI-SRP-16-CTSB-133-1827/20).

- In the US-APWR GTS Bases B 3.9.6, LCO section, the applicant did not include a discussion of two applicable Notes (Notes 1 and 2) which are used to allow special operating conditions for CS/RHR pumps. In RAI 16-19, the applicant was asked to provide additional information in the Bases. In its response letter dated January 29. 2009, the applicant acknowledged the need to revise the TS Bases to include a discussion of these two notes. The staff finds this response acceptable, and confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI response; therefore, RAI 16-19 is considered resolved.

- "Decay time" is the interval from when the reactor was last critical and when initial movement of an irradiated fuel assembly is acceptable. Decay time is a key assumption in dose consequence estimates of a design-basis FHA analysis, which satisfies 10 CFR 50.36(d)(2)(ii), Criterion 2, and is required to be included in an LCO in the US-APWR GTS, preferably in Section 3.9. RAI 16-18 requested justification for not providing an LCO for the decay time. MHI letter dated January 29, 2009, proposed a new LCO 3.9.8, requiring a 24 hour minimum decay time. The staff finds the proposed TS 3.9.8 and the associated TS Bases acceptable since they are in compliance with 10 CFR 50.36 requirements and reflect the FHA analysis provided in DCD Subsection 15.7.4. Further, the staff confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI response; therefore, RAI 16-18 is considered resolved.

- In addition, in RAIs 16-12, 16-13, 16-14, 16-16 and 16-17, the applicant was asked to correct editorial errors found in TS Section 3.9. In its response letter dated January 29, 2009, the applicant acknowledged the need to revise the TS Section 3.9 to reflect these corrections. The staff has confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI responses; therefore, RAIs 16-12, 16-13, 16-14, 16-16 and 16-17 are considered resolved.

The remaining portions of the US-APWR GTS, Section 3.9, are similar to the applicable STS such that the staff finds them acceptable.

The RAI items listed below are Open Items:

RAI-SRP-16-CTSB-133-1827/15	Open Item: OI-SRP-16-CTSB-133-1827/15
RAI-SRP-16-CTSB-133-1827/20	Open Item: OI-SRP-16-CTSB-133-1827/20

Conclusion

The applicant adhered to the Refueling Operations information as provided in the Westinghouse STS. In addition, the US-APWR GTS, Section 3.9, and its Bases do not contain "bracketed information" or "Reviewer's Notes" other than those associated with the option to implement the newly proposed CRMP and SFCP as referenced in TS 5.5.18 and 5.5.19. Therefore, except for the two open items discussed above, the staff finds that Section 3.9 of the US-APWR GTS and Section B 3.9 of the US-APWR Bases are acceptable.

16.4.4.0 Design Features

Introduction

The US-APWR GTS, Section 4.0, contains other design features not covered in the US-APWR GTS, Section 3-series. Section 4.0 of the US-APWR GTS contains such information as site location, site maps, and other information related to core design and fuel storage design.

Evaluation

- The US-APWR GTS, Section 4.1, contains bracketed information regarding site-specific information for the future plant location to be provided by potential applicants for construction permits or COLs.

- The US-APWR GTS, Section 4.3, contains bracketed information to be addressed by potential applicants for construction permits or COLs, regarding the boron concentration of 200 ppm, which is used in the spent fuel rack analysis in which the spent fuel pool is fully flooded with borated water. In RAI 16-135, the applicant was asked to provide the basis for this boron concentration value since a comparable requirement is not listed in the Westinghouse STS. In its response letter dated February 20, 2009, the applicant referenced MHI Technical Report MUAP-07032-P as providing the requested information. The applicant subsequently submitted Revision 1 of this technical report and again proposed changes to the affected Section 4.3.1. Therefore, RAI 16-135 will remain as an open item (OI-SRP-16-CTSB-161-1812/135) until the staff completes its review of MUAP-07032-P.

- In RAI 16-129, the applicant was asked to correct editorial errors found in TS Section 4.0. In its response letter dated February 20, 2009, the applicant acknowledged the need to revise TS Section 4.0 to reflect these corrections. The staff finds this response acceptable, and confirmed that Revision 2 of the US-APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI response; therefore, RAI 16-129 is considered resolved.

The remaining portions of the US-APWR GTS, Section 4.0, are similar to the applicable STS such that the staff finds them acceptable.

The RAI item listed below is an Open Item as discussed above:

RAI-SRP-16-CTSB-161-1812/135 Open Item: OI-SRP-16-CTSB-161-1812/135

Conclusion

The applicant adhered to the design features information as provided in the Westinghouse STS. In addition, the US-APWR GTS, Section 4.0 does contain “bracketed information.” The staff reviewed each piece of “bracketed information” and requested additional information to further understand its intent and to determine that each was site-specific and appropriately deferred to applicants for construction permits or COLs that reference the US-APWR GTS. The staff concluded that each such item was indeed plant- or site-specific. Therefore, except for the open item discussed above, the staff finds that Section 4.0 of the US-APWR GTS is acceptable.

16.4.5.0 Administrative Controls

Introduction

The US-APWR GTS, Section 5.0 includes provisions which address various administrative controls related to key plant personnel responsibilities, plant procedures, special programs and reports, etc., to ensure the plant is operated safely.

Evaluation

In general, the US-APWR GTS, Section 5.0, is modeled after Section 5.0 of the Westinghouse STS, with differences to reflect the applicant's newly proposed administrative controls for implementation of Risk-Informed Technical Specifications, Initiatives 4b and 5b, and the adoption of TSTF-448, "Control Room Habitability," Revision 3 and TSTF-511, "Eliminate Working Hour Restrictions from TS 5.2.2 to Support Compliance with 10 CFR Part 26," Revision 0.

- In US-APWR GTS 5.2.2, the applicant adopted TSTF-511, Revision 0, which requests the deletion of TS provisions on controls of overtime for selected plant personnel working on safety-related equipment since such provisions are covered in 10 CFR Part 26, "Fitness for Duty Programs." Because this subject to governed by the rule in Part 26, the staff finds this to be acceptable.

- In RAI 16-136, the applicant was asked to provide clarification on the listed face velocity of 2400 fps for the MCREFS in TS 5.5.11.c. In its response letter dated February 20, 2009, MHI corrected this value to 40 fps (2400 fpm) and proposed also to delete this information from the GTS. The staff reviewed the new information against guidance (in the form of Reviewer's Notes) provided in the Westinghouse STS which state "If the system has a face velocity greater than 110 percent of 0.203 m/s (40 ft/min), the face velocity should be specified." Based on this guidance, the staff determined that the proposed deletion is unacceptable. This is an open item (OI-SRP-16-CTSB-161-1812/136).

- In US-APWR GTS 5.5.18, the applicant proposed the CRMP as an option to be adopted by potential COL applicants. The applicant stated that implementation of the CRMP is in accordance with guidance provided in NEI 06-09, and is specified in selected TS throughout the US-APWR GTS. Also, in US-APWR GTS 5.5.19, the applicant proposed the SFCP as an option to be adopted by potential COL applicants. The applicant stated that implementation of the SFCP is in accordance with guidance provided in NEI 04-10, and is specified in selected TS throughout the US-APWR GTS. In RAIs 16-131, 16-132 and 16-133, the applicant was asked to clarify various program elements covered in NEI 04-10 and NEI 06-09. In its response letter dated February 20, 2009, MHI explained that these programs would conform to the NRC-approved guidance and adequately addressed the staff's concerns. Therefore, RAIs 16-131, 16-132 and 16-133 are considered resolved. However, the existing NRC guidance in RG 1.174, Revision 1, which is used in both NEI 06-09 and NEI 04-10, does not address risk-metrics for new reactors. The staff is currently considering a revision to RG 1.174 to incorporate new metrics for risk assessment of new reactor operations. In addition, GTS 5.5.18 paragraph b is not strictly in accordance with NEI 06-09 Revision 0, Section 2.3.1, paragraph 5. Either paragraph b needs to state, "The RICT shall be recalculated prior to exceeding the most limiting technical specification front-stop CT, but not later than 12 hours from the plant configuration change," or, since this is redundant to NEI 06-09 Revision 0, paragraph b can be deleted. In the GTS, the NEI guidance documents can be bracketed (i.e., [NEI 06-09 Revision 0] and [NEI 04-10 Revision 1]), thereby allowing the COL applicant to insert the appropriate revision number if new metrics are proposed. The COL applicant will not be able to adopt either GTS 5.5.18 or GTS 5.5.19 until issues are resolved relating to the referenced RG 1.174 in NEI 06-09 Revision 0 and NEI 04-10 Revision 1.

- In US-APWR GTS 5.5.20, the applicant adopted the program description text for the Control Room Habitability program as provided in the TSTF-448, Revision 3. The staff finds this to be acceptable.

- In RAIs 16-138, the applicant was asked to provide the missing details regarding exceptions to regulatory requirements in TS 5.5.16 for the Containment Leakage Rate Testing program. In its response letter dated February 20, 2009, MHI revised TS 5.5.16 to include a list of NRC approved exceptions. The staff finds this response acceptable and confirmed that Revision 2 of the US APWR DCD, dated October 27, 2009, contains the changes committed to in the RAI responses; therefore, RAIs 16-138 is considered resolved.

- In addition, in RAIs 16-130, 16-139 the applicant was asked to correct editorial errors found in TS Section 5.0. In its response letter dated February 20, 2009, the applicant acknowledged the need to revise TS Section 5.0 to reflect these corrections. Verification that these changes are correctly incorporated in the US-APWR DCD are confirmatory items (CI-SRP-16-CTSB-133-1827/130 and CI-SRP-16-CTSB-133-1827/139).

- Further, the US-APWR GTS, Section 5.0, contain bracketed information regarding various aspects of the administrative programs and reports as listed below, to be completed by the COL applicant:

  - TS Subsections 5.1, 5.2, and 5.3 on position titles and qualifications of plant staff.
  - TS 5.5.9 on tube repair options in the SG Program.
  - TS 5.5.18 on the newly proposed CRMP as an option to be adopted by a COL applicant.
  - TS 5.5.19 on the newly proposed SFCP as an option to be adopted by a COL applicant.
  - TS 5.5.20 on exceptions to guidance in RG 1.197, to be addressed by the COL applicant based on site-specific information.
  - TS 5.6.1 on the Annual Radiological Environmental Operating Report format.
  - TS 5.6.7 on reporting of repaired SG tubes.

The remaining portions of the US-APWR GTS, Section 5.0 are similar to the applicable STS such that the staff finds them acceptable.

Verification that the RAI changes listed below are correctly incorporated into the US-APWR DCD is necessary via the corresponding RAI Confirmatory Item identifier referenced below:

RAI-SRP-16-CTSB-161-1812/130 Confirmatory Item: CI-SRP-16-CTSB-133-1827/130
RAI-SRP-16-CTSB-161-1812/139 Confirmatory Item: CI-SRP-16-CTSB-133-1827/139

The RAI item listed below is an Open Item as discussed above:

RAI-SRP-16-CTSB-161-1812/136 Open Item: OI-SRP-16-CTSB-161-1812/136

Conclusion

The applicant adhered to the Administrative Programs consistent with the Westinghouse STS with some noted differences, as discussed above. In addition, the US-APWR GTS, Section 5.0, does contain "bracketed information" and "Reviewer's Notes." The staff reviewed each piece of "bracketed information" and "Reviewer's Notes" to determine whether it was site-specific and appropriately deferred to applicants for construction permits or COLs that reference the US-APWR GTS. The staff concluded that each such item was indeed plant- or site-specific. Therefore, except for the confirmatory items discussed above, and resolution of the outstanding open items, the staff finds that Section 5.0 of the US-APWR GTS is acceptable.

16.5 Combined License Information Items

Chapter 1 of the US-APWR DCD includes two tables of information concerning COL information items. These lists, Tables 1.8-1 and 1.8-2, discuss site-related equipment interfaces with the US-APWR certified design, and a compilation of COL applicant items for Chapters 1 through 19 of the US-APWR DCD, many of which are referenced in the above sections.

Throughout the US-APWR DCD, bracketed items and Reviewer's Notes are used to identify information or parameters that are plant specific or that are based on preliminary design information not yet finalized in the DCD. The US-APWR GTS and Bases currently include bracketed information, such as that relating to TS requirements for the plant UHS, site location, etc. In addition, the US-APWR GTS contain "bracketed information" associated with options to implement the newly proposed CRMP and SFCP. An applicant that references the US-APWR DC is required to replace the applicable bracketed information with plant-specific values.

16.6 Conclusions

In general, as discussed above, the staff determined that the US-APWR DCD, Chapter 16, "Technical Specifications," and Chapter 16B, "Bases," closely modeled the format and content described in RG 1.206, Revision 1, March 2007, and the applicant used the guidance provided in NUREG 0800, Revision 2, March 2007, to prepare the US-APWR GTS. In addition, for the reasons set forth above, the applicant did generally conform to the STS provided by NUREG-1431, "Standard Technical Specifications Westinghouse Plants," as MHI determined applicable to its US-APWR design. The applicant also omitted, changed some of the requirements in the Westinghouse STS, or developed new specifications, surveillances and Bases when they determined differences in design warranted such changes or additions.

The US-APWR DCD identified conditions that COL applicants must satisfy in order to complete particular PTS. For example, selection of instrumentation component setpoints is highly dependent on the operating characteristics of the equipment as procured. MHI will not be asked to submit the information that can only be obtained through plant-specific analyses. However, all DC-related information, including specific or bounding values, or methodologies for determining specific or bounding values, will be required prior to final approval of the PTS for a COL applicant.

In addition, supporting information provided in the Bases document was consistent with the applicable STS and, in general, was sufficient to permit understanding of the system designs and their relationship to the applicable safety evaluations. Such items as the reactor core, RCS, instrumentation and control systems, electrical systems, containment systems, other ESFs, auxiliary and emergency systems, power conversion systems, radioactive waste handling systems, and fuel handling systems were discussed insofar as they are pertinent.

For the reasons set forth above, and with the noted exceptions, the staff finds the US-APWR FSAR, Chapter 16, are acceptable and satisfy the requirements of 10 CFR 50.36, 10 CFR 50.36a, and 10 CFR 52.47(a)(11).